Obesity Algorithm®

2016-2017

Obesity Medicine Association

CLINICAL LEADERS IN OBESITY MEDICINE®

obesitymedicine.org

Disclaimer and Permissions

Disclaimer

The Obesity Algorithm® guidelines were originally presented by the Obesity Medicine Association (OMA) in 2013 and have since been updated yearly to include the latest treatments and trends in the field of obesity medicine. They were developed to assist health care professionals in the management and care for patients with overweight and obesity. The Obesity Algorithm is not intended to be a substitute for a medical professional's independent judgment and should not be considered medical advice. The content herein is based on medical literature and the clinical experiences of obesity medicine specialists. In areas regarding inconclusive or insufficient scientific evidence, the authors used their professional judgment.

The Obesity Algorithm is a working document that represents the state of obesity medicine at the time of publication. OMA encourages medical professionals to use this information in conjunction with, and not as a replacement for, their best clinical judgment. The presented recommendations may not be appropriate in all situations. Any decision by practitioners to apply these guidelines must be made in light of local resources and individual patient circumstances.

Permissions

The Obesity Medicine Association owns the copyright to the Obesity Algorithm but invites you to use the slide set. Access to the Obesity Algorithm content and/or permission for extensive quoting or reproducing excerpts and for the reproduction and use of copyrighted text, images, or entire slides will not be granted until the requestor has signed the copyright consent and permission agreement available at www.ObesityAlgorithm.org. OMA reserves the right to deny a request for permission to use the Obesity Algorithm.

Peer Review

Since its original release in 2013, the Obesity Algorithm has undergone peer review by medical professionals and providers, facilitated by:

- Public posting on the web with free access and free download
- Presentations and discussions at OMA meetings
- Presentations and discussions at other scientific sessions and conferences
- Citations in medical literature

Throughout the year, OMA receives comments based on widespread exposure amongst world-wide colleagues (e.g., scientific and clinical peers), as well as via online public access. OMA members are encouraged to provide feedback. This 2016-2017 version of the Obesity Algorithm incorporates worldwide input, as well as interim scientific and clinical trial data.

Obesity Medicine Association

Major Updates Included in the 2016-2017 Version

- General updates and text edits
- Obesity terminology and health care office environment
- Obesity genetic syndromes (complementary to the OMA Pediatric Obesity Algorithm)
- Obesity paradox
- Body composition assessment
- Energy expenditure assessment
- Diet patterns (“diets”)
- Gastrointestinal hormones
- Expanded section on FDA-approved bariatric procedures
- Macro and micronutrients in post-bariatric surgery patients
- Microbiome
- References

Obesity Medicine Association

Authors and Citation

Core Authors: Harold E. Bays, MD, FTOS, FACC, FACE, FNLA; Jennifer C. Seger, MD, FOMA; Craig Primack, MD, FACP, FAAP, FOMA; William McCarthy, MD, FOMA; Joshua Long, MD, FASMBS; Stacy L Schmidt PhD; Sunil Daniel, MD, FTOS; Julie Wendt, MD; Deborah B. Horn, DO, MPH, MFOMA; Eric C. Westman, MD, MHS, MFOMA

Contributing Authors: Nihar Shah MD, FACP, and Thomas Clark, MS, MD, FACS, FASMBS

Citation: Bays HE, Seger JC, Primack C, McCarthy W, Long J, Schmidt SL, Daniel S, Wendt J, Horn DB, Westman EC: Obesity Algorithm, presented by the Obesity Medicine Association. www.obesityalgorithm.org. 2016-2017. (Accessed = [INSERT DATE])

Purpose

To provide clinicians with an overview of principles important to the care of patients with increased and/or dysfunctional body fat, based upon scientific evidence, supported by medical literature, and derived from the clinical experiences of members of the Obesity Medicine Association.

Process

- The Obesity Algorithm was derived from input by volunteer OMA members consisting of:
  - Clinicians
  - Clinical trialists
  - Researchers
  - Academicians

- The Obesity Algorithm project has never received industry funding

- The authors have never received payment for their contributions

Obesity Medicine Association

Intent of Use

The Obesity Algorithm is intended to be a “living document” updated once a year (as needed). It is intended to be an educational tool used to translate the current medical science and the experiences of obesity specialists to better facilitate and improve the clinical care and management of patients with overweight and obesity.

This algorithm *is not* intended to be interpreted as “rules” and/or directives regarding the medical care of an individual patient.

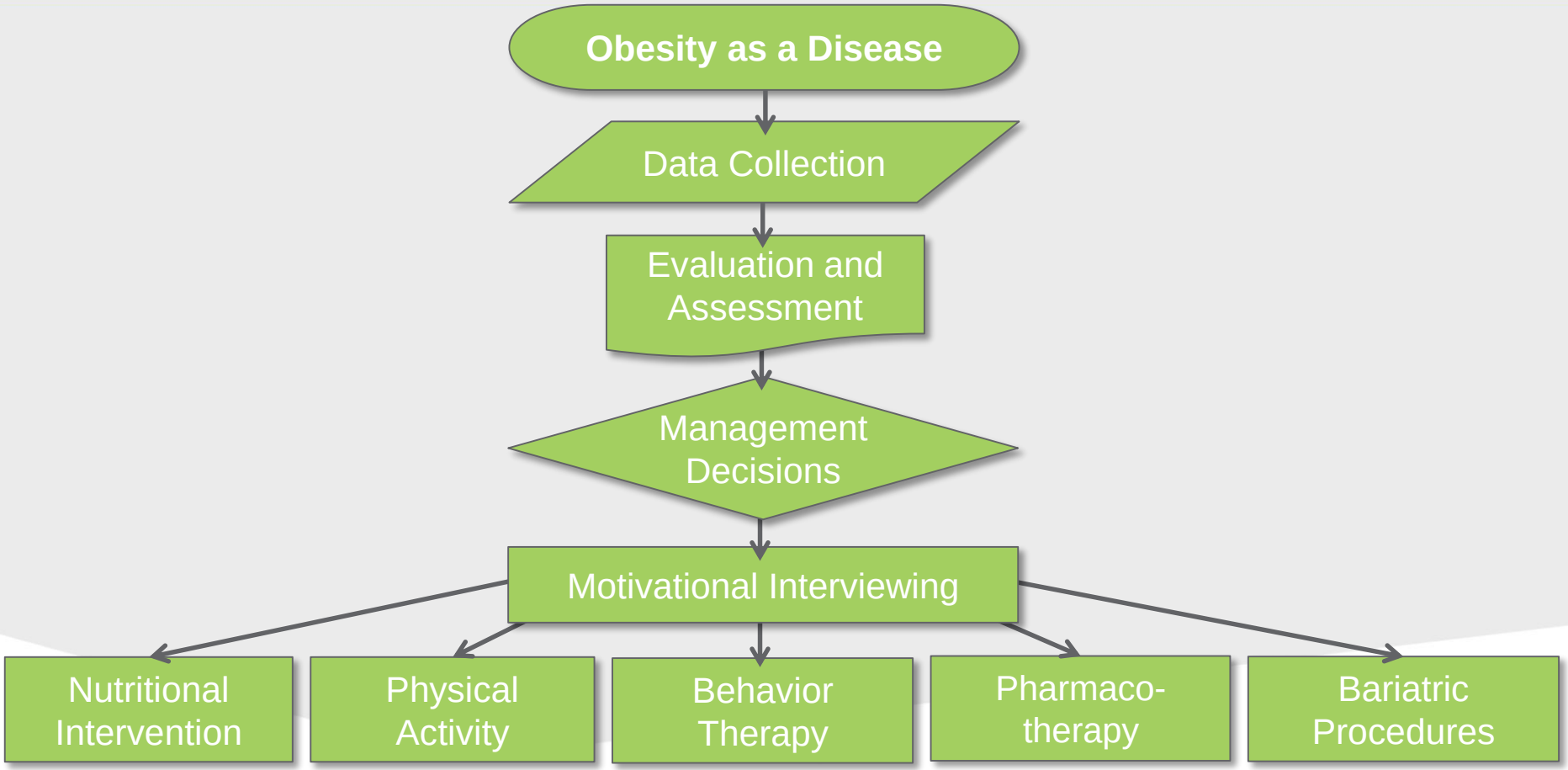
While the hope is many clinicians may find this algorithm helpful, the final decision regarding the optimal care of the patient with overweight and obesity is dependent upon the individual clinical presentation and the judgment of the clinician who is tasked with directing a treatment plan that is in the best interest of the patient.

The Obesity Algorithm is listed by the American Board of Obesity Medicine as a suggested resource and study-aid for the obesity medicine certification exam. (abom.org/exam-resources)

Table of Contents

Obesity Medicine Association

Obesity Algorithm



Reference/s: [1]

Obesity Defined as a Disease

The Obesity Medicine Association's 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."

Reference/s: [1]

Obesity Medicine Association

Obesity Is a Disease When…

- The patient has excessive body fat, as assessed by reliable measures
- Excessive body fat is caused by genetic or developmental errors, infections, hypothalamic injury, adverse reactions to medications, nutritional imbalance, and/or unfavorable environmental factors
- Multiple pathogenic adipocyte and/or adipose tissue endocrine and immune dysfunctions contribute to metabolic disease (adiposopathy or “sick fat” disease)
- Multiple pathogenic physical forces from excessive body fat cause stress damage to other body tissues (fat mass disease)

The adverse health consequences of increased body fat are not simply “co-morbidities” or “associated risk factors”

Reference/s: [1]

Obesity Medicine Association

Obesity Terminology

“People-first” language recognizes the potential hazards of referring to or labeling individuals by their disease. Thus, **“patient who is overweight or has obesity” or “patient with overweight or obesity”** are preferred over “obese patient.” This is similar to the standard with other diseases, such as diabetes mellitus, wherein “patient with diabetes” is preferred over “diabetic patient.”

Encouraged Terms

- Weight
- Unhealthy weight
- Overweight
- Body mass index
- Affected by obesity

Discouraged Terms

- Morbidly obese
- Obese
- Fat

Reference/s: [2,3]

Obesity Medicine Association

Obesity Health Care Office Environment

Clinicians and staff should be trained to avoid hurtful comments, jokes, or being otherwise disrespectful, as patients with obesity may be ashamed or embarrassed about their weight.

Positive Office Space

- Sturdy, armless chairs and high, firm sofas in waiting rooms
- Sturdy, wide exam tables that avoid or prevent tipping
- Sturdy stool or step with handles to help patients climb onto the exam table
- Tables/chairs/toilet seats should sustain higher body weights
- Extra-large patient gowns
- Split toilet seat; provide a specimen collector with a handle
- Reading materials in the waiting room that focus on healthy habits, rather than physical looks or being “thin”

Appropriate Medical Devices

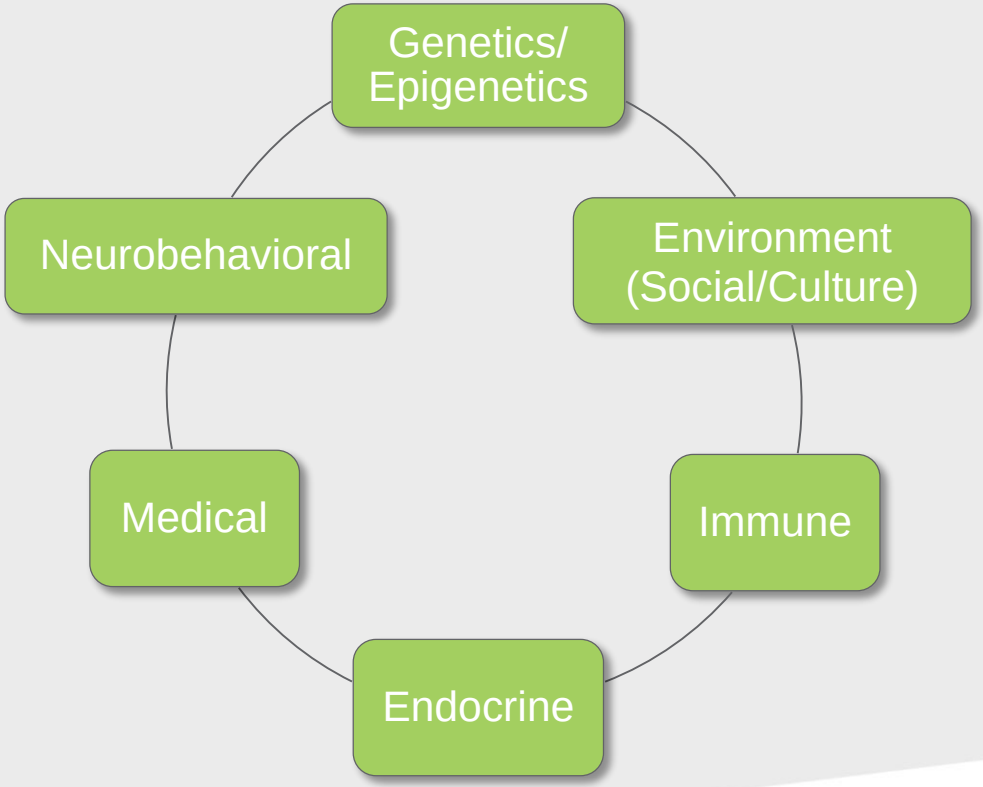
- Large adult blood pressure cuffs or thigh cuffs on patients with an upper-arm circumference greater than 34 cm
- Extra-long needles to draw blood
- Large vaginal specula
- Weight scales with the capacity to measure patients who weigh more than 400 pounds

Reference/s: [4,5]

Obesity Medicine Association

Obesity as a Multifactorial Disease

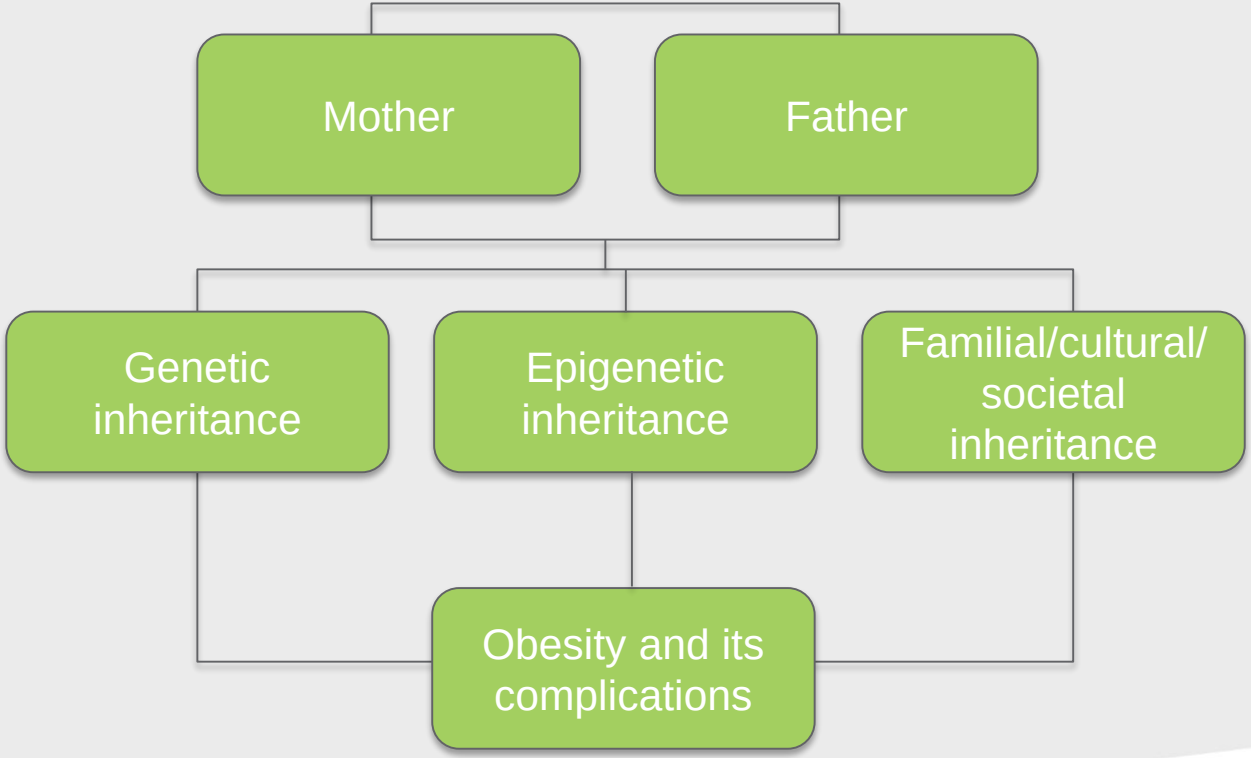
Obesity as a Multifactorial Disease



Reference/s: [1]

Obesity Medicine Association

Multifactorial Inheritance Factors Contributing to Obesity



Reference/s: [6]

Obesity Medicine Association

Genetics: Melanocortin 4 Receptor Deficiency

Clinical Presentation

- Obesity, especially in families
- Hyperphagia and obesity early in childhood
- Insulin resistance
- Increase in bone mineral density (“big boned”)
- Accelerated linear growth
- Reduced sympathetic nervous activity

Genetic Abnormality

- Autosomal dominant or recessive
- Most common known genetic defect predisposing to obesity
- Polymorphism of gene localized to chromosome 18q22

Reference/s: [6,7]

Obesity Medicine Association

Genetics: Prader–Willi Syndrome

Clinical Presentation

- Obesity, often hyperphagic
- Short stature
- Weak muscle tone
- Poor growth
- Small hands/feet
- Delayed development
- Underdeveloped genitals (often with infertility)
- Behavioral/emotional challenges
- Mild to moderate intellectual impairment
- Insatiable appetite
- Narrow forehead
- Almond-shaped eyes
- Triangular mouth
- Often with fair skin and light-colored hair

Genetic Abnormality

- Not inherited
- Most cases involve loss of function of a portion of chromosome 15
- Often reported as the most common human genetic "obesity syndrome"

Reference/s: [6,7]

Obesity Medicine Association

Genetics: Albright's Hereditary Osteodystrophy

Clinical Presentation

- Obesity
- Short stature
- Rounded face
- Skeletal defects: shortened fourth metacarpals and other bones of the hands and feet
- Dental hypoplasia
- Soft-tissue calcifications/ossifications
- Pseudohypoparathyroidism (hypocalcemia, hyperphosphatemia)

Genetic Abnormality

- Associated with molecular defect in the gene (GNAS1), which encodes for the alpha subunit of the stimulatory G protein

Reference/s: [6]

Obesity Medicine Association

Genetics: Bardet–Biedl Syndrome

Clinical Presentation

- Obesity
- Metabolic abnormalities (e.g., type 2 diabetes mellitus,
- high blood pressure, dyslipidemia)
- Blindness (retinal dystrophy and pigmentary retinopathy)
- Anosmia
- Hearing loss
- Dysmorphic extremities: polydactyly and short or fused fingers and toes
- Poor coordination
- Dental abnormalities
- Intellectual disability
- Behavioral/emotional challenges
- Hypogonadism (with infertility)
- Renal cystic disease; renal insufficiency, which may lead to end-stage renal disease

Genetic Abnormality

- Autosomal recessive
- Mutations of at least 16 genes (BBS genes) applicable to cilia involved in:
  - Cell movement
  - Chemical signaling
  - Sensory input (sight, hearing, and smell)

Reference/s: [6,7]

Obesity Medicine Association

Genetics: Cohen Syndrome

Clinical Presentation

- Obesity
- Developmental delay
- Intellectual disability
- Small head size
- Narrow hands and feet with slender fingers
- Weak muscle tone
- Retinal dystrophy
- Joint hypermobility
- Thick hair and eyebrows
- Thick eyelashes
- “Open mouth” expression with incisoral prominence
- Low white blood cell count
- Overly friendly behavior

Genetic Abnormality

- Typically auto recessive
- Mutation of the VPS13B gene (COH1 gene)

Reference/s: [6]

Obesity Medicine Association

Genetics: Borjeson-Forssman-Lehmann Syndrome

Clinical Presentation

- Mainly in males
- Intellectual disability
- Seizure disorders
- Large earlobes
- Shortened toes
- Small genitalia
- Gynecomastia

Genetic Abnormality

- X-linked disorder
- Mutation of the zinc finger gene PHF6 (located on the X chromosome)

Reference/s: [6]

Obesity Medicine Association

Genetics: Other Genetic Syndromes Associated with Obesity

- Leptin deficiency
- Leptin receptor deficiency
- Src homology 2 B adapter protein 1 (SH2B1) mutations
- Carboxypeptidase E mutations
- Prohormone convertase-1 deficiency
- Proopiomelanocortin deficiency
- Proprotein convertase subtilisin kexin 1/3 deficiency
- Brain derived neurotrophic factor (BDNF) deficiency
- TrkB deficiency
- Sim1 deficiency
- Maternal uniparental disomy of chromosome 14
- Trisomy 21 (Down's Syndrome)

- Fragile X syndrome
- Turner's syndrome
- Alstrom syndrome
- Carpenter syndrome
- Macrosomia, Obesity Macrocephaly Ocular abnormalities (MOMO) syndrome
- Rubinstein-Taybi syndrome
- Rapid-onset Obesity with Hypothalamic dysfunction
- Hypoventilation and Autonomic Dysregulation (ROHHAD syndrome)
- Deletions/mutations of various other gene loci 17 and polymorphisms of fat mass and obesity associated (FTO) gene located on chromosome 16.

Reference/s: [6]

Obesity Medicine Association

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

Reference/s: [6]

Obesity Medicine Association

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

Reference/s: [6,8,9]

Obesity Medicine Association

Overall Obesity Management Goals

Within Subsets of Patients with Overweight and/or Obesity

Deranged endocrine and immune responses

↓

Sick Fat Disease (SFD) (Adiposopathy)

Endocrine/metabolic:
- Elevated blood glucose
- Elevated blood pressure
- Dyslipidemia
- Other metabolic diseases

Abnormal and pathologic physical forces

↓

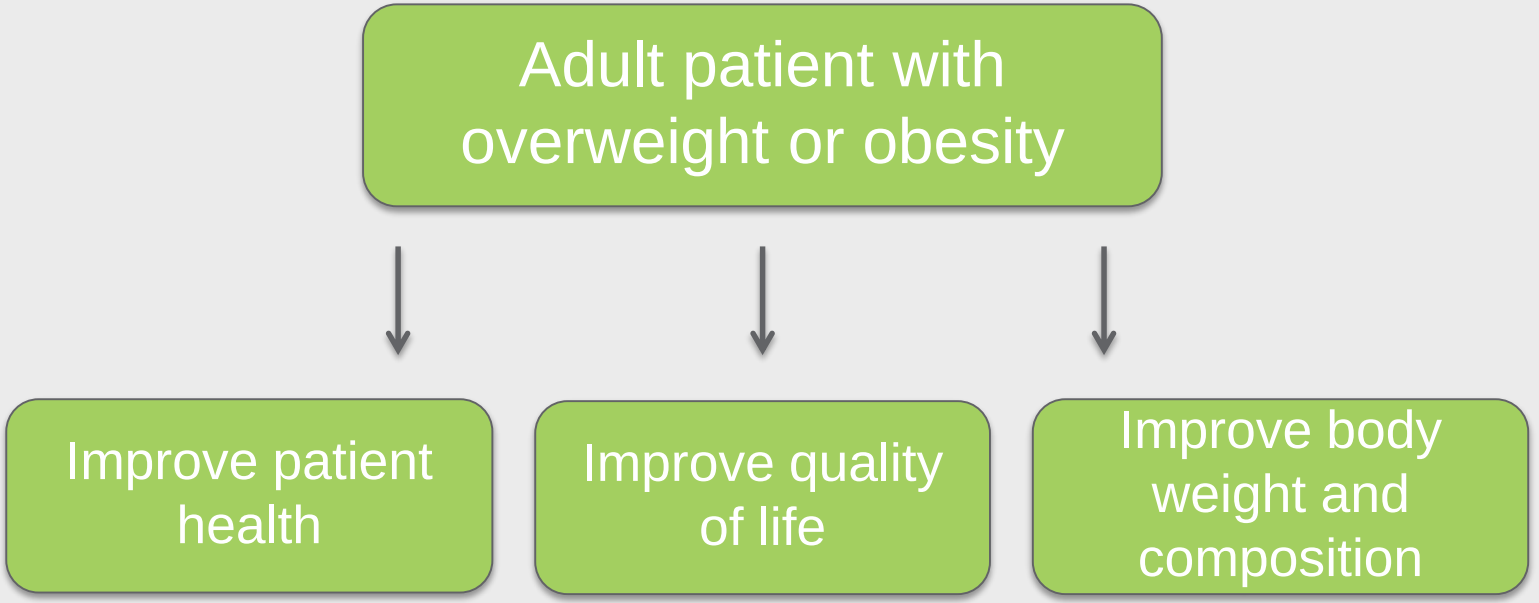
Fat Mass Disease (FMD)

Biomechanical/structural:
- Stress on weight-bearing joints
- Immobility
- Tissue compression (i.e., sleep apnea, gastrointestinal reflux, high blood pressure, etc.)
- Tissue friction (i.e., intertrigo, etc.)

Reference/s: [10,11,12]

Obesity Medicine Association

Overall Management Goals



Reference/s: [1]

Obesity Medicine Association

Obesity Classification

Body Mass Index: Increase Body Fat (Adiposity)

Body mass index (BMI) in kilograms per meters squared (kg/m^2)*

Normal Weight	Overweight	Class I Obesity	Class II Obesity	Class III Obesity
18.5-24.9	25.0-29.9	30.0-34.9	35.0-39.9	≥ 40

*Different BMI cut-off points may be more appropriate based upon gender, race, and ethnicity

Reference/s: [13-15]

Obesity Medicine Association

Percent Body Fat: American Council on Exercise Classification

American Council on Exercise Classification:
Percent body fat*

Essential Fat	Athletes	Fitness	Acceptable	Obesity
Women: 10-13% Men: 2-5%	Women: 14-20% Men: 6-13%	Women: 21-24% Men: 14-17%	Women: 25-31% Men: 18-24%	Women: ≥ 32% Men: ≥ 25%

*Based on “expert opinion;” cut-off points not scientifically validated

Reference/s: [16]

Obesity Medicine Association

Percent Body Fat: U.S. Army Regulations

U.S. Army regulations: Percent body fat (%BF)

Men %BF Calculator
(Age, height, & tape measure of neck and waist)

Maximum allowable %BF to join Army
- Age 17-20 24%
- Age 21-27 26%
- Age 28-39 28%
- Age 40+ 30%

Maximum allowable %BF after entry
- Age 17-20 20%
- Age 21-27 22%
- Age 28-39 24%
- Age 40+ 26%

Women %BF Calculator
(Age, height, & tape measure of neck, waist, and hip)

Maximum allowable %BF to join Army
- Age 17-20 30%
- Age 21-27 32%
- Age 28-39 34%
- Age 40+ 36%

Maximum allowable %BF after entry
- Age 17-20 30%
- Age 21-27 32%
- Age 28-39 34%
- Age 40+ 36%

Reference/s: [17-18]

Obesity Medicine Association

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)

Reference/s: [19-22]

Obesity Medicine Association

Obesity: Summary Diagnostic Metrics and Diagnostic Codes

Body Mass Index
≥ 30 kg/m²

Percent Body fat
Women: ≥ 32%
Men: ≥ 25%

Abdominal Obesity: Women
≥ 35 inches
≥ 88 centimeters

Abdominal Obesity: Men
≥ 40 inches
≥ 102 centimeters

Overweight and Obesity E66

- Code first obesity complicating pregnancy, childbirth and the puerperium, if applicable (O99.21-)
- Use additional code to identify body mass index (BMI), if known (Z68.-)

Excludes:
- adiposogenital dystrophy (E23.6)
- lipomatosis NOS (E88.2)
- lipomatosis dolorosa [Dercum] (E88.2)
- Prader-Willi syndrome (Q87.1)

E66.0 Obesity Due to Excess Calories

- E66.01 Morbid (severe) obesity due to excess calories
- E66.09 Other obesity due to excess calories
- E66.1 Drug-induced obesity
- E66.2 Morbid (severe) obesity with alveolar hypoventilation
- E66.3 Overweight
- E66.8 Other obesity
- E66.9 Obesity, unspecified

Reference/s: [23]

Obesity Medicine Association

Body Mass Index (BMI)

Advantages

- Increased BMI generally correlates with metabolic and fat mass diseases in population studies
- Commonly used
- Reasonably reproducible
- Low cost
- Adequate measure for epidemiological studies
- Adequate screening metric for most patients

Disadvantages

- May not correlate with metabolic and fat mass diseases in an individual patient
- Does not account for muscle mass
- May over-diagnose obesity in muscular individuals, under-diagnose patients with sarcopenia
- BMI cut-off points do not distinguish between men and women, nor ethnic and racial considerations
- Should be used as part of the clinical evaluation, and not the sole measure of obesity for all patients

Reference/s: [13-15]

Obesity Medicine Association

Percent Body Fat

Advantages

- More specific assessment of body fat
- May be a reasonable longitudinal measure, especially in patients who may not be losing weight, but engaged in resistance exercise training, and thus may be losing body fat, and increasing muscle

Disadvantages

- Some measurement techniques are not always accurate, nor easily reproducible (i.e., single site skinfold calipers)
- Electronic body fat measurements may be expensive, and as with calipers, the accuracy and reproducibility is dependent upon the equipment and software, as well as the expertise of the technician
- Cut-off points not validated to correlate to metabolic disease

Reference/s: [16,24]

Obesity Medicine Association

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

Reference/s: [20-22]

Obesity Medicine Association

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/m^2
- %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]

Obesity Medicine Association

Fat Mass Disease:

Abnormal and Pathologic Physical Forces

Obesity Medicine Association

CLINICAL LEADERS IN OBESITY MEDICINE®

obesitymedicine.org

Clinical Manifestations: Fat Mass Disease

Cardiovascular

- Congestive heart failure and cor pulmonale
- Varicose veins
- Thromboembolic events (i.e., pulmonary embolus, stroke)
- Hypertension (i.e., compression of kidney)

Pulmonary

- Dyspnea
- Obstructive sleep apnea
- Hypoventilation/Pickwickian syndrome
- Asthma

Neurologic

- Intracranial hypertension (pseudotumor cerebri) due to increased intra-abdominal pressure and sleep apnea, with impaired central venous return.
- Stroke (see “cardiovascular”)
- Nerve entrapment (i.e., meralgia paresthetica, carpal tunnel syndrome)

Reference/s: [25-27]

Obesity Medicine Association

Clinical Manifestations: Fat Mass Disease

Musculoskeletal

- Immobility
- Osteoarthritis (e.g. knees, hips)
- Low back pain
- Myalgias
- Altered center of gravity
- Impaired balance

Gastrointestinal

- Gastroesophageal reflux
- Hernias

Integument

- Striae distensae (skin stretch marks)
- Stasis pigmentation
- Venous stasis ulcers
- Cellulitis
- Skin tags
- Intertrigo (i.e. bacterial, fungal skin fold infections)
- Carbuncles

Reference/s: [25-27]

Obesity Medicine Association

Clinical Manifestations: Fat Mass Disease

Psycho-Social

- Depression
- Hopelessness
- Low self-esteem
- Body-image dissatisfaction
- Diminished sex drive
- Impaired intimacy and sexual relationships
- Decreased work productivity
- Increased work absenteeism

Biases

- Society
- Family
- Workplace
- Harassment
- Bullying

Negative Self or External Perceptions

- “Unmotivated”
- “Weak-willed”
- “Less intelligent”
- “Less attractive”
- “Unsuccessful”
- “Overindulgent”
- “Lazy”

Reference/s: [25-27]

Obesity Medicine Association

Sleep Disorders and Obesity: Obstructive Sleep Apnea*

History

- Snoring (usually loudly)
- Insomnia
- Restless sleep
- Sudden wakening with choking or gasping
- Headaches
- Daytime sleepiness
- Fatigue
- Increased risk of motor vehicle accidents
- Forgetfulness
- Mood changes
- Lack of interest in sexual behavior
- Gastroesophageal reflux

*Other sleep disorders associated with obesity include insomnia and restless leg syndrome.

Reference/s: [28-29]

Obesity Medicine Association

Sleep Disorders and Obesity: Obstructive Sleep Apnea

Physical Findings

- Increased neck circumference
  - Men > 17 inches
  - Women > 16 inches
- Head abnormalities
  - Modified Mallampati score of 3 or 4
  - Retrognathia
  - Lateral peritonsillar narrowing
  - Macroglossia
  - Tonsillar hypertrophy
  - Enlarged uvula
  - High arched/narrow palate
  - Nasal abnormalities
  - Overbite
- Cardiopulmonary abnormalities
  - Peripheral edema
  - Cardiac dysrhythmia
  - High blood pressure

Reference/s: [28-29]

Obesity Medicine Association

Sleep Disorders and Obesity: Obstructive Sleep Apnea

Diagnosis

- Questionnaires:
  - Berlin Sleep Questionnaire
  - Epworth Sleepiness Scale
  - STOP-Bang Questionnaire
    - **STOP = S**noring, **T**iredness, **O**bserved apnea and
    - high blood **P**ressure)
    - **Bang**: **B**MI, **a**ge, **n**eck circumference, **g**ender
- Testing
  - In-lab overnight sleep studies
    - Apnea hypopnea index (AHI)
      - 5-15/hour = mild sleep apnea
      - 15-30/hour = moderate sleep apnea
      - > 30/hour = severe sleep apnea
  - Home sleep test
  - Multiple sleep latency test

Adverse Consequences of Untreated Obstructive Sleep Apnea

- Worsening obesity
- Congestive heart failure
- Atrial fibrillation
- Nocturnal dysrhythmias
- Stroke
- High blood pressure
- Type 2 diabetes mellitus
- Pulmonary hypertension

Reference/s: [28-30]

Obesity Medicine Association

Sleep Disorders and Obesity: Obstructive Sleep Apnea

Treatment

- Reduction of fat mass
- Behavior therapy to improve sleep patterns
- Oral appliances
  - Mandibular reposition devices
  - Tongue retaining devices
- Nasal expiratory positive airway
- Continuous positive airway pressure
- Adaptive servo-ventilation
- Surgery
  - Laser-assisted uvulopalatoplasty
  - Radiofrequency ablation
  - Palatal implants
  - Electrical stimulation of upper airway muscles

Reference/s: [31]

Obesity Medicine Association

Adiposopathy (Sick Fat Disease):
Abnormal Endocrine and Immune Responses

Obesity Medicine Association
CLINICAL LEADERS IN OBESITY MEDICINE®

Anatomic Changes

- Positive caloric balance may lead to adipocyte hypertrophy with variable increases in adipocyte number, as regulated by intracellular:
  - Sterol regulatory element binding protein-1 (SREBP1),
  - Peroxisome proliferator-activated receptor (PPAR) gamma
  - CCAAT-enhancer binding proteins (C/EBPs)

Reference/s: [32-33]

Obesity Medicine Association

Anatomic Changes

- When adipogenesis (proliferation and differentiation) is impaired in peripheral subcutaneous adipose tissue (SAT), then inadequate storage of excess energy in SAT may result in energy overflow and increased circulating free fatty acids
  - Worsening adipocyte hypertrophy and adipocyte dysfunction
  - Increasing (“ectopic”) fat deposition in other depots
    - Visceral fat
    - Subcutaneous SAT
    - Pericardiac fat
    - Perivascular fat
  - Increasing (“ectopic”) fat deposition in other body organs
    - Liver
    - Muscle
    - Pancreas
    - Heart
    - Kidney

Reference/s: [32-33]

Obesity Medicine Association

Functional Changes

- Increased adipocyte hypertrophy and adipose tissue accumulation may contribute to:
  - Adipocyte and adipose tissue hypoxia
  - Increased adipose tissue immune cell infiltration
  - Increased adipocyte apoptosis
  - Increased reactive oxygen species and oxidative stress
  - Extracellular matrix abnormalities
  - Intraorganelle dysfunction (e.g., mitochondrial and endoplasmic reticulum stress)
  - Changes in adipose tissue neural network and innervations

Reference/s: [32-33]

Obesity Medicine Association

Adiposopathic Endocrinopathies

- Angiogenesis
- Adipogenesis
- Extracellular matrix dissolution and reformation
- Lipogenesis
- Growth factor production
- Glucose metabolism
- Production of factors associated with the renin-angiotensin system
- Lipid metabolism
- Enzyme production
- Hormone production
- Steroid metabolism
- Immune response
- Hemostasis
- Element binding (e.g., sterol regulatory element-binding proteins, and calcium)
- Multiple receptors:
  - Traditional peptides and glycoprotein hormones
  - Nuclear hormones
  - Cytokines or adipokines with cytokine-like activity
  - Growth factors
  - Catecholamine receptors

Reference/s: [33-37]

Obesity Medicine Association

Adiposopathic Immunopathies

- Proinflammatory adipose tissue factors
  - Factors with cytokine activity (e.g., leptin)
  - Acute-phase response proteins (e.g., C-reactive protein)
  - Proteins of the alternative complement system
  - Chemotactic or chemo-attractants for immune cells
  - Eicosanoids and prostaglandins (e.g., PGE2)

- Anti-inflammatory adipose tissue factors (e.g., adiponectin)

Reference/s: [33-35,37]

Obesity, Health, and Harmony of Function of Body Organs

Adiposopathy most often results in metabolic disease when accompanied by:

- Dysfunction other body organs
- Limitations of the metabolic “flexibility” of other body organs to mitigate the pathogenic metabolic, endocrine, and immune responses promoted by obesity

Metabolic health is dependent upon the interactions or crosstalk with adipose tissue and other body organs:

- Liver
- Muscle
- Pancreas
- Immune system
- Heart and vasculature
- Brain
- Endocrine glands
- Intestine
- Other body organs

Reference/s: [33]

Obesity Medicine Association

Metabolic Manifestations of Adiposopathy

- High blood glucose (prediabetes mellitus, type 2 diabetes mellitus)
- High blood pressure
- Metabolic syndrome
- Adiposopathic dyslipidemia
  - Increased triglyceride levels
  - Decreased high-density lipoprotein cholesterol levels
  - Increased atherogenic particle number (increased apolipoprotein B)
  - Increased proportion of small, dense, low-density lipoprotein particles
  - Increased triglyceride-rich lipoproteins
  - Increased lipoprotein-remnants
- Insulin resistance
- Hepatosteatosis (fatty liver)
- Hyperuricemia and gout
- Cholelithiasis
- Acanthosis Nigricans
- Nephrolithiasis
- Glomerulopathy
- Pro-thrombotic predisposition
- Neuropsychiatric diseases (such as worsening depression due to adiposopathic immune and endocrine responses)
- Asthma (due to adiposopathic immune and endocrine responses)
- Worsening of other inflammatory diseases (osteoarthritis, atherosclerosis, etc.)

Reference/s: [33-35,37]

Obesity Medicine Association

Gender-specific Manifestations of Adiposopathy

Women

- Hyperandrogenemia
- Hirsutism
- Acne
- Polycystic ovarian syndrome
- Menstrual disorders
- Infertility
- Gestational diabetes mellitus
- Preeclampsia
- Thrombosis

Men

- Hypoandrogenemia
- Hyperestrogenemia
- Erectile dysfunction
- Low sperm count
- Infertility

Reference/s: [38-40]

Obesity and Adiposopathy Increases the Risk of Cancers

- Bladder cancer
- Brain cancer
- Breast cancer (postmenopausal)
- Cervical cancer
- Colon cancer
- Endometrial/uterine cancer
- Esophageal cancer
- Gallbladder cancer
- Head and neck cancer
- Kidney/renal cancer
- Leukemia
- Liver cancer
- Multiple myeloma
- Non-Hodgkin lymphoma
- Ovarian cancer
- Pancreatic cancer
- Prostate cancer (prognosis is worse, not necessarily increased risk)
- Stomach cancer
- Thyroid cancer

Reference/s: [41-45]

Obesity Medicine Association

Adiposopathic and/or Fat Mass Pathologies:
Genitourinary and Reproductive Manifestations

Genitourinary

- Urinary stress incontinence
- Pelvic prolapse (e.g. cystocele, rectocele, uterine prolapse, vault prolapse)

Reproductive Pre-pregnancy

- Men
  - Buried or hidden penis
  - Erectile dysfunction
  - Psychological barriers to sexual behavior
  - Infertility
- Women
  - Psychological barriers to sexual behavior
  - Infertility, anovulation, polycystic ovary syndrome

Reproductive Pregnancy

- Gestational diabetes mellitus
- Preeclampsia
- Increased risk of miscarriage and stillbirth
- Overdue pregnancy
  - Increased need for induction
  - Increased need and complications of cesarean section in women (delayed healing and wound infection)
- Large for gestational age offspring
- Thrombosis
- Obstructive sleep apnea

Reference/s: [46-48]

Obesity Medicine Association

Obesity Paradox

Obesity Paradox

ANATOMIC OBESITY PARADOX

- Are some fat depots protective while others are “paradoxically” pathogenic?

PHYSIOLOGIC OBESITY PARADOX

- Are some individuals who are overweight or with obesity “paradoxically” healthy?
- Do some individuals who are normal weight, or only mildly overweight, “paradoxically” have metabolic disease?

DEMOGRAPHIC (GENDER AND RACE) PARADOX

- Are women at a “paradoxically” lower age-adjusted cardiovascular disease risk than men?
- Are some races “paradoxically” at increased risk for metabolic diseases for the same amount of body weight?

THERAPEUTIC OBESITY PARADOX

- Can adding body fat “paradoxically” treat metabolic diseases typically associated with too much body fat?
- Does an increase in fat mass always predispose to metabolic disease?
- Does a decrease in fat mass always improve metabolic disease?

CARDIOVASCULAR OUTCOMES OBESITY PARADOX

- Why are individuals who are modestly overweight often report to have a better prognosis after cardiovascular disease (CVD) events and cardiovascular procedures?

ATHEROSCLEROSIS “OUTSIDE-TO-IN” OBESITY PARADOX

- What is the role of pericardial and perivascular adipose tissue in promoting atherosclerosis?

THERAPEUTIC APPROACH OBESITY PARADOX

- How do clinicians best navigate the apparent paradox of “blame” versus “accountability” in obesity management?

Reference/s: [11,33,51]

Obesity Medicine Association

Obesity Paradox: General Concepts

- Obesity increases mortality
- Obesity increases morbidity
- More than one “obesity paradox” exists
- Obesity paradoxes are less paradoxical when viewed from the perspective of both fat mass ***and*** fat function

Reference/s: [52,53]

Obesity Medicine Association

Anatomic Obesity Paradox

Are some fat depots protective while others are "paradoxically" pathogenic?

Peripheral Subcutaneous Adipose Tissue (SAT) Can Be Protective

- Provides storage of energy
- Physical padding
- Thermal insulation
- During positive caloric balance, if adipocyte proliferation and differentiation are sufficient to mitigate adiposopathic adipocyte hypertrophy, endocrinopathies, inflammation, and lipotoxic energy overflow to other fat depots and other body organs, then an increase in body fat may not be as pathogenic in promoting metabolic disease

Reference/s: [11,33,51]

Obesity Medicine Association

Anatomic Obesity Paradox

Are some fat depots protective while others are "paradoxically" pathogenic?

Peripheral Subcutaneous Adipose Tissue (SAT) Can Be Pathogenic

- Fat mass diseases
- During positive caloric balance, if adipocyte proliferation and differentiation are ***not*** sufficient to mitigate adiposopathic adipocyte hypertrophy, endocrinopathies, inflammation, and lipotoxic energy overflow to other fat depots and other body organs, then this may increase the risk of metabolic diseases such as diabetes mellitus, high blood pressure, and dyslipidemia.
- SAT is ~80% of total fat mass
  - Majority of adipose tissue-derived systemic free fatty acids originate from SAT, with extrahepatic lipotoxicity potentially contributing to insulin resistance in muscle
  - Majority of adipose tissue-derived free fatty acids in the portal system originate in SAT (not VAT), with lipotoxicity potentially contributing to insulin resistance in the liver
- An increase in abdominal SAT is associated with adiposopathic predisposition to metabolic disease, not unlike VAT

Reference/s: [11,33,51]

Obesity Medicine Association

Anatomic Obesity Paradox

Are some fat depots protective while others are “paradoxically” pathogenic?

Visceral Adipose Tissue (VAT) Can Be Protective

- Provides storage of energy
- Physical padding to protect against mechanical damage to abdominal organs
- May protect against peritoneal catastrophes (perforated visceral organs)
- Thermal insulation

Reference/s: [11,33,51]

Obesity Medicine Association

Anatomic Obesity Paradox

Are some fat depots protective while others are "paradoxically" pathogenic?

Visceral Adipose Tissue (VAT) Can Be Pathogenic

- VAT adipocytes have higher basal lipolysis than SAT adipocytes
  - Increased sensitivity to catecholamines
  - Decreased sensitivity to insulin
  - Direct portal access to the liver
- More active expression of adiposopathic endocrinopathies than SAT
- More active expression of adiposopathic immunopathies than SAT
- More associated with increased risk of metabolic disease, possibly because increased visceral adiposity reflects dysfunctions of all fat depots

Reference/s: [11,33,51]

Obesity Medicine Association

Anatomic Obesity Paradox

Are some fat depots protective while others are "paradoxically" pathogenic?

- Both subcutaneous adipose tissue (SAT) and visceral adipose tissue (VAT) are potentially protective and pathogenic
- SAT and VAT mass and function are interdependent
- Both SAT and VAT express adiposopathic endocrinopathies and immunopathies when promoting metabolic diseases
- An increase in visceral adiposity is a surrogate marker for the dysfunction of SAT and other fat depots
- An increase in visceral adiposity is a surrogate marker for global fat dysfunction, helping to account for its association with metabolic diseases
- Central obesity is a clinical measure that reflects both an increase in visceral fat and an increase in subcutaneous abdominal fat

Reference/s: [11,33,51]

Obesity Medicine Association

Anatomic Obesity Paradox

Are some fat depots protective while others are "paradoxically" pathogenic?

Benign Multiple Symmetrical Lipomatosis

- Increased fat accumulation in the subcutaneous adipose tissue regions of the arms, legs, shoulders, and neck.
- Increased proliferation of small adipocytes in subcutaneous adipose tissue
- Increased secretion of anti-inflammatory adipokines (e.g. adiponectin)
- Typically, glucose or lipid disorders do not develop

Inherited Lipodystrophy

- Variable lack of body fat and impaired adipose tissue function (e.g., low adiponectin levels and inability to adequately store fat)
- High circulating free fatty acids (lipotoxicity)
- Hyperglycemia and dyslipidemia

Reference/s: [11,33,51]

Obesity Medicine Association

Physiologic Obesity Paradox

Are some individuals who are overweight or with obesity "paradoxically" healthy? Do some individuals who are normal weight, or only mildly overweight "paradoxically" have metabolic disease?

"Metabolically Healthy But Obese" Phenotype

- Defined as individuals who respond to positive caloric balance without pathogenic adipose tissue dysfunction sufficient to result in metabolic disease
- The prevalence of MHO is decreased with greater intensity of metabolic assessment
- MHO may still experience fat mass disease, sleep apnea, and increased risk of cancers
- With aging, MHO are at greater risk of future development of metabolic disease

"Metabolically Obese Normal Weight" Phenotype

- Defined as normal-weight individuals who express metabolic diseases typically associated with an increased in body fat
- Some individuals may express adiposopathy with increased body fat not outside the upper range of normal
- Some individuals may have dysfunction of other body organs that are disharmonious in their physiologic interactions with adipose tissue ("metabolic inflexibility")

Reference/s: [11,33,51]

Obesity Medicine Association

Demographic (Gender and Race) Obesity Paradox

Are women at a "paradoxically" lower age-adjusted cardiovascular disease risk than men?
Are some races "paradoxically" at increased risk for metabolic diseases for the same amount of body weight?

For the Same Age and Weight, Men Have a Higher Rate of CVD Compared to Women

- Cardiovascular disease (CVD) is the most common cause of death in women and men
- During positive caloric balance:
  - Men often expand fat deposition via the more pathogenic adipocyte hypertrophy and android or "apple" fat distribution.
  - Women often expand fat deposition via the less pathogenic adipocyte proliferation and gynoid or "pear" fat distribution

Reference/s: [11,33,51]

Obesity Medicine Association

Demographic (Gender and Race) Obesity Paradox

Are women at a "paradoxically" lower age-adjusted cardiovascular disease risk than men?
Are some races "paradoxically" at increased risk for metabolic diseases for the same amount of body weight?

For the Same Increase in Body Fat, Individuals of Asian Descent Have an Increased Risk for Type 2 Diabetes Mellitus, Metabolic Syndrome, and Cardiovascular Disease Compared to Other Races

- Greater adipocyte size; reduced number of adipocytes
- Increased visceral adiposity
- Increased free fatty acid and leptin levels
- Increased pro-inflammatory factors (e.g., C-reactive protein), and decreased anti-inflammatory factors (e.g., adiponectin)
- Increased insulin resistance
- Asians require a lower cut-off point for the clinical determination of overweight and obesity

Reference/s: [11,33,51]

Obesity Medicine Association

Therapeutic Obesity Paradox

Can adding body fat "paradoxically" treat metabolic diseases typically associated with too much body fat?
Does an increase in fat mass always predispose to metabolic disease?
Does a decrease in fat mass always improve metabolic disease?

- **Peroxisome proliferator-activated receptor agonists (thiazolidinediones)** increase the proliferation and differentiation of adipocytes, increasing fat mass, providing increased adipocyte functionality, and are approved as glucose-lowering agents

- **Weight loss with human immune virus antiretroviral (HIV) therapy** may result in HIV lipodystrophy, with impairment in adipocyte differentiation, reduction in mean fat cell size, possible decrease in adipocyte proliferation, decrease in subcutaneous adipose tissue accumulation, relative increase in visceral adipose tissue accumulation, and increased risk of hyperglycemia and dyslipidemia.

Reference/s: [11,33,51]

Obesity Medicine Association

Therapeutic Obesity Paradox

Can adding body fat "paradoxically" treat metabolic diseases typically associated with too much body fat?
Does an increase in fat mass always predispose to metabolic disease?
Does a decrease in fat mass always improve metabolic disease?

Transplantation of Fat in Lipoatrophic Mice

- Lipoatrophic mice have virtually no white adipose tissue
- Severe hyperglycemia.
- Fat transplant improves hyperglycemia, hyperinsulinemia, and muscle insulin sensitivity

Liposuction of Subcutaneous Adipose Tissue (SAT)

- Removal of SAT does not improve hyperglycemia, high blood pressure, and dyslipidemia

Reference/s: [11,33,51]

Obesity Medicine Association

Cardiovascular Disease Outcomes Obesity Paradox

Why are individuals who are modestly overweight often reported to have a better prognosis after cardiovascular disease (CVD) events and cardiovascular procedures?

The Obesity CVD Paradox May Be Risk-factor Dependent

- Individuals who are modestly overweight may have improved CVD prognosis only if they are physically fit
- Cigarette smoking decreases body weight (especially with chronic lung disease), but increases CVD risk

Reference/s: [11,33,51]

Obesity Medicine Association

Cardiovascular Disease Outcomes Obesity Paradox

Why are individuals who are modestly overweight often reported to have a better prognosis after cardiovascular disease (CVD) events and cardiovascular procedures?

The Obesity CVD Paradox May Reflect Different Cardiovascular Pathologies

- The pathophysiology applicable to obesity and adiposopathy may differ from other pathophysiologies leading to CVD events; the prognosis may differ as well
- Inherent vasculopathies predisposing to CVD events may be independent of body weight, be of greater severity, and have poorer outcomes compared with CVD events that occur due to obesity
- Familial hypercholesterolemia (FH) is an inherited disorder that is independent of body weight, results in severe elevations in cholesterol, and which has a disproportionally high rate of (premature) CVD morbidity and mortality
- A patient with FH who is a heavy smoker and not overweight may be at greater risk for an ST segment elevated myocardial infarction (STEMI) than a nonsmoker without FH who is overweight or with obesity

Reference/s: [11, 33, 51, 54, 55]

Obesity Medicine Association

Cardiovascular Disease Outcomes Obesity Paradox

Why are individuals who are modestly overweight often reported to have a better prognosis after cardiovascular disease (CVD) events and cardiovascular procedures?

The Obesity CVD Paradox Might Be Partially Explained by Enhanced Cardiovascular Autorepair Potential

- Adipocytes, blood vessels, and cardiomyocytes share a similar lineage of mesenchymal stem cells
- Individuals who are overweight often have a greater reservoir of adipose tissue mesenchymal cells
- After an acute CVD event, increased circulating reparative mesenchymal cells might conceivably migrate to the injured myocardial site, and assist with cardiovascular tissue repair

Reference/s: [11,33,51]

Obesity Medicine Association

Cardiovascular Disease Outcomes Obesity Paradox

Why are individuals who are modestly overweight often reported to have a better prognosis after cardiovascular disease (CVD) events and cardiovascular procedures?

The Obesity CVD Paradox Might Be Partially Explained by a Disproportional Attention Directed towards CVD Prevention among Patients with Obesity

- Patients with obesity often have medical conditions that prompt earlier access and more frequent access to medical care
- In the global management of patients with obesity, preventative interventions may be disproportionately implemented, perhaps involving earlier and more frequent CVD diagnostic procedures, and initiation of therapeutic agents proven to reduce CVD
- Obesity increases the risk of type 2 diabetes mellitus (T2DM); while it remains unclear the degree by which glucose-lowering reduces CVD risk, patients with T2DM are often treated with antihypertensive, lipid-altering, and perhaps antithrombotic agents that reduce CVD morbidity and mortality

Reference/s: [11,33,51]

Obesity Medicine Association

Atherosclerosis “Outside-to-In” Obesity Paradox

What is the role of pericardiac and perivascular adipose tissue in promoting atherosclerosis?

Atherosclerosis is most often described as an ***“inside-to-in”*** pathogenic process wherein atherogenic apoB containing lipoproteins enter the subendothelia, become oxidized, and then help promote inflammation, plaque formation, and ultimately, plaque rupture leading to CVD events

Reference/s: [11,33,51]

Obesity Medicine Association

Atherosclerosis “Outside-to-In” Obesity Paradox

What is the role of pericardiac and perivascular adipose tissue in promoting atherosclerosis?

An “Outside-to-in” Atherogenic Model Suggests That Adiposopathic Adipose Tissue Surrounding the Heart and Arteries Also Contributes to Atherosclerosis

- Coronary calcium correlates to epicardial fat
- Coronary calcium scoring is used to assess atherosclerosis
- Adipose tissue surrounding the heart and arteries may serve as a local supplier of toxic, free fatty acids to the myocardium, and thus contribute to “fatty heart”
- Pericoronary adipose tissue may serve as a supply site for oxidized low density lipoproteins in coronary plaques, possibly via transport through the interstitial space

Reference/s: [11,33,51]

Obesity Medicine Association

Atherosclerosis “Outside-to-In” Obesity Paradox

What is the role of pericardiac and perivascular adipose tissue in promoting atherosclerosis?

An “Outside-to-in” Atherogenic Model Suggests That Adiposopathic Adipose Tissue Surrounding the Heart And Arteries Also Contributes to Atherosclerosis

- Adipose tissue surrounding the heart and arteries may secrete factors that alter endothelial cells and function
- “Sick” epicardial adipose tissue may have reduced anti-inflammatory secretions (e.g., reduced adiponectin) and increased pro-inflammatory adipokine secretion that can be transported into vessel walls via transcellular passing or diffusion (vasocrine regulation)
- Adipose tissue surrounding the heart and arteries may help supply macrophages to an expanded adventitial vas vasorum, resulting in even greater pro-atherogenic inflammatory signaling

Reference/s: [11,33,51]

Obesity Medicine Association

Therapeutic Approach Obesity Paradox

How do clinicians best navigate the apparent paradox of "blame" versus "accountability" in obesity management?

- Individual responsibility can encompass both "blame" and "accountability"
- "Blame" often goes beyond assigning responsibility and often leads to condemnation and accusations, with the intent to elicit guilt
  - Promoting guilt is often counterproductive in changing behavior
- "Accountability" most often refers to record keeping and shared decision-making
  - Promoting accountability is a critical component towards modifying behavior
  - A lack of acknowledging individual responsibility may invite counterarguments and reduce feelings of empathy by others
  - A reluctance to recommend accountability via record keeping and shared decision-making may deprive the patient of an important behavior modification technique

Reference/s: [2, 56]

Obesity Medicine Association

Stress and Obesity:
Cause and Effect

Obesity Medicine Association
CLINICAL LEADERS IN OBESITY MEDICINE®

obesitymedicine.org

Psychological or Medical Stress

Stress Responses

- Cognitive changes
  - Increased (e.g., some cases of emergent stress)
  - Decreased (e.g., some cases prolonged stress)
- Physiological changes
- Behavioral changes
- Pain
  - Potential analgesia with emergent stress
  - Potential worsening of pain with chronic stress

Reference/s: [57-60]

Obesity Medicine Association

Psychological or Medical Stress: Endocrine Response

Emergent "Fight or Flight" Response

(Increased Sympathomimetic Activity)

- Increase in short-term sympathetic nervous system activation
- Increased catecholamines (e.g., norepinephrine and epinephrine)
- Cardiovasculopulmonary responses
  - Increased blood pressure
  - Vasoconstriction
  - Increased heart rate and contractility
  - Impaired blood flow to kidney
  - Bronchial dilation
- Metabolic responses
  - Potential increase in glucose levels (increased insulin resistance, increased hepatic glycogenolysis, and increased hepatic gluconeogenesis)
  - Increased adipose tissue lipolysis

Reference/s: [57-60]

Obesity Medicine Association

Psychological or Medical Stress: Endocrine Response

Submit and Stay Response

(Increased hypothalamic pituitary axis activity)

Increased Longer-term Stress Hormone Release

- Increased corticotropin-releasing hormone
- Increased adrenocorticotropin
- Increased arginine, vasopressin, and oxytocin
- Increased blood cortisol

Metabolic Responses to Increased Cortisol

- Potential increase in glucose levels (increased insulin resistance and increased hepatic gluconeogenesis)
- Increased blood pressure
- Increased adipose tissue lipolysis (cortisol is a catabolic hormone)

Reference/s: [57-60]

Obesity Medicine Association

Medical or Psychological Stress: Immune Response

Acute Response (Catecholamine-mediated)

- Immune effects can be mixed, but in general, may enhance immune response:
  - Demargination of leukocytes from vascular endothelia increases leukocyte blood concentration
  - Increased:
    - Innate immune response
    - Adaptive immune response
    - T-lymphocyte cytokine response

Prolonged Response (Glucocorticoid-mediated)

- Immune effects can be mixed, but in general, may dysregulate immune response:
  - Decreased leukocyte mobilization with decrease in leukocyte blood concentration
  - Decreased:
    - Innate immune response
    - Adaptive immune response
    - T-lymphocyte cytokine response

Reference/s: [57-61]

Obesity Medicine Association

Chronic Psychological Stress and Eating Behavior

Limbic System

(Thalamus, hypothalamus, amygdala, hippocampus)

- Chronic stress-induced endocrinopathies and immunopathies may adversely affect the limbic system
- Hypothalamic dysfunction (such as with trauma) is an important cause of obesity

Cerebrum

(Frontal, parietal, occipital, and temporal lobes)

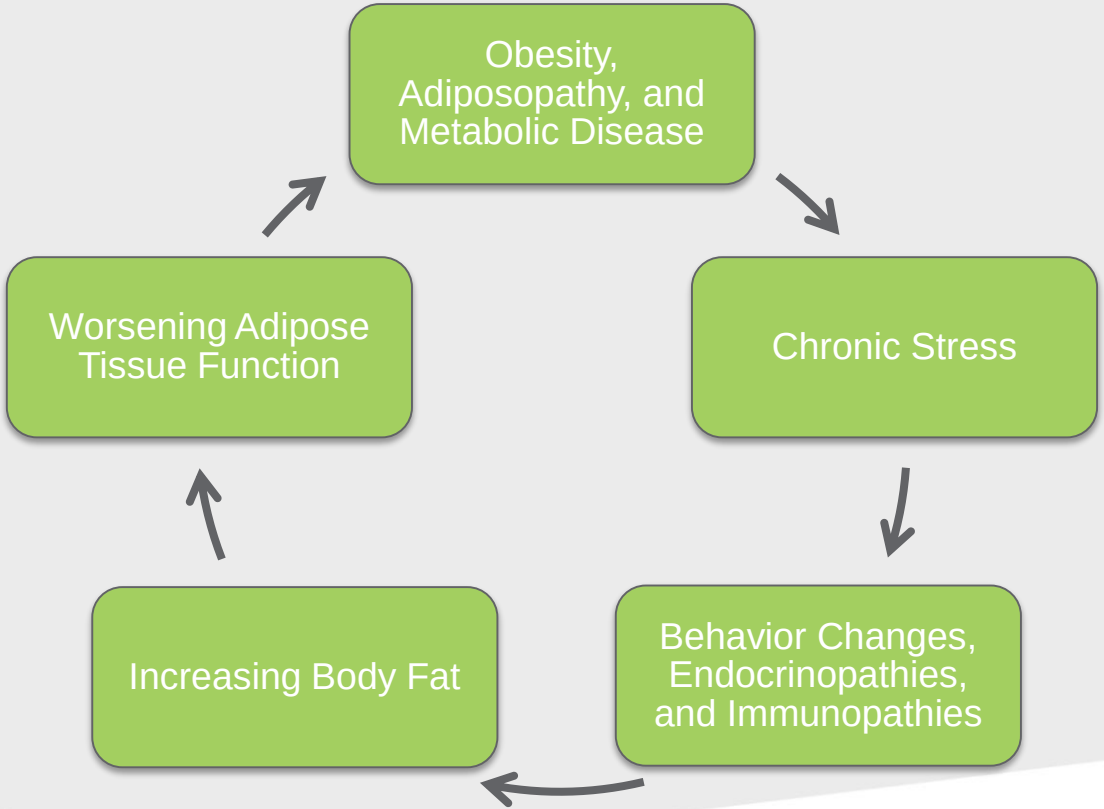
- Priority replacement: personal, work, or emotional priorities may overtake priorities relative to nutrition, physical activity, and/or health
- Chronic stress-induced endocrinopathies and immunopathies may adversely affect the cerebrum
- Gourmand Syndrome
  - While not necessarily a stress disorder, Gourmand Syndrome is illustrative of how cerebral disorders may affect eating behaviors
  - Occurs with damage to right frontal lobe (trauma/stroke)
  - Post-injury passion for gourmet foods

Enhanced desire for hyperpalatable foods

Reference/s: [57-60]

Obesity Medicine Association

Adiposopathy Stress Cycle



Reference/s: [1]

Obesity Medicine Association

Patient Evaluation:

History

History

Medical History and Review of Systems

- Age, gender, race, ethnicity
- Fat mass disease (i.e., osteoarthritis, sleep apnea)
- Adiposopathy (i.e., type 2 diabetes mellitus, high blood pressure)
- Eating disorders
- Mental stress
- Sleep pattern
- Other medical and surgical conditions
- Medication and food allergies
- Medications that may affect body weight
- Cigarette smoking
- Alcohol intake
- Recreational drug use (e.g., marijuana, cocaine)

Family History

- Family members affected by obesity
- Applicable familial medical diseases

Support Systems

- Person who selects and purchases food
- Availability and involvement of family and friends
- Educational access to healthy nutrition and physical activity (e.g., current knowledgebase, availability of Internet, knowledge centers, etc.)

Socioeconomic and Cultural History

- Economic status
- Social status
- Cultural background
- Occupation
- Family structure
- Parenting behavior
- Marital status
- Living situation
- Abuse (physical, mental, sexual)
- Geographic location (e.g., urban food desert)

Reference/s: [62]

Obesity Medicine Association

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 un-sustained, 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: [63-65]

Obesity Medicine Association

Physical Activity History

- Success and/or failure of previous physical activity/exercise efforts
- If no longer engaged in a routine physical activity/exercise regimen:
  - When? (Date of change)
  - What? (Cause of change)
  - Why? (Identify barriers to re-engagement)
- Current physical activity (FITTE)
  - Frequency
  - Intensity
  - Time or Duration
  - Type
  - Enjoyment (physical activity/exercise preferences)
- Current fitness level, endurance capacity, mobility, and equipment needs
- Access to locations amenable to increased physical activity/exercise (e.g., gym, workplace, exercise facilities, bicycle paths and walk ways, urban or rural home setting)
- Perceived barriers to increased physical activity

Reference/s: [66-68]

Obesity Medicine Association

Physical Activity History

Examples of common medical conditions that should be evaluated before prescribing an exercise program:

- Diseases of the heart, lung, musculoskeletal, and other body systems
- Metabolic diseases having potential risks with increased physical activity:
  - Atherosclerotic coronary heart disease (worsening ischemia)
  - Diabetes mellitus (hypoglycemia)
  - High blood pressure (increase blood pressure with resistance training)

Reference/s: [66-68]

Obesity Medicine Association

Routine Preventive Medical Care

Ensure individual with overweight or obesity receives standard preventive medical care, which, depending upon gender and age, may include:

- Breast exam (and mammogram as applicable)
- Pelvic exam
- Pap smear
- Testicular exam
- Rectal exam and stool for occult blood (sigmoidoscopy or colonoscopy as applicable)
- Immunizations

Reference/s: [4]

Obesity Medicine Association

Patient Evaluation:

Physical Exam

Obesity Medicine Association

CLINICAL LEADERS IN OBESITY MEDICINE®

obesitymedicine.org

Physical Exam

Vital Signs

- Height with bare or stocking feet measured with a stadiometer
- Weight using calibrated scale and method consistent from visit to visit (i.e., light indoor clothing or gown)
- Body mass index
- Waist circumference
  - Standing using superior iliac crest
  - May not provide additional diagnostic information among patients with BMI > 35 kg/m^2
- Blood pressure using appropriately sized cuff
- Pulse
- Neck circumference

General Physical Exam

- Comprehensive physical exam
- Special emphasis on physical exam of the nose, throat, neck, lung, heart, abdomen, musculoskeletal system, and integument

Reference/s: [69]

Obesity Medicine Association

Patient Evaluation:

Laboratory and Diagnostic Testing

Obesity Medicine Association

CLINICAL LEADERS IN OBESITY MEDICINE®

obesitymedicine.org

Laboratory: Routine

Adiposity-relevant Blood Testing

- Fasting blood glucose
- Hemoglobin A1c
- Fasting lipid levels
  - Triglycerides
  - Low-density lipoprotein (LDL) cholesterol
  - High-density lipoprotein (HDL) cholesterol
  - Non-HDL cholesterol
- Liver enzymes and other liver blood tests
  - Aspartate aminotransferase (AST)
  - Alanine aminotransferase (ALT)
  - Alkaline phosphatase
  - Total bilirubin
- Electrolytes (i.e., potassium, sodium, calcium, phosphorous, etc.)
- Renal blood testing (i.e., creatinine, blood urea nitrogen, etc.)
- Uric acid
- Thyroid stimulating hormone (TSH)
- Vitamin D levels

General Laboratory Testing

- Complete blood count
- Urinalysis
- Urine for microalbumin

Reference/s: [69,70]

Obesity Medicine Association

Laboratory: Individualized Blood Testing

- Glucose tolerance testing
- Fasting insulin testing
- Fasting proinsulin, C-peptide, and insulin if hyperinsulinemia is suspected as a secondary cause of obesity (e.g. insulinoma, nesidioblastosis, etc.)
- One milligram (mg) overnight dexamethasone cortisol suppression test, 24-hour urine collection for (free) cortisol, or repeated measures salivary cortisol collection at 11:00 PM if endogenous hypercortisolism is suspected as a secondary cause of obesity
- Prolactin, estradiol, follicle-stimulating hormone, luteinizing hormone, and pregnancy test in women with unexplained oligomenorrhea or amenorrhea
- Testosterone and other androgen levels (i.e., dehydroepiandrosterone sulfate/DHEAS) for women with hirsutism or polycystic ovarian syndrome
- Testosterone (and if low to a clinically significant degree: possibly prolactin, follicle-stimulating hormone, and luteinizing hormone) for men with impotence or physical findings of hypogonadism
- Apolipoprotein B and/or lipoprotein particle number, especially if triglyceride levels are elevated
- Iron studies (iron, total iron building capacity, ferritin)
- High-sensitive C-reactive protein (hs-CRP)

Reference/s: [71,72]

Obesity Medicine Association

Diagnostic Testing: Individualized

- Magnetic-resonance imaging or computed tomography of the brain if a structural lesion of the pituitary/hypothalamus is suspected (i.e., craniopharyngioma, pituitary tumor)
- Resting electrocardiogram
- Cardiac stress testing
- Echocardiogram
- Coronary calcium scores
- Cardiac positron emission tomography imaging (computed tomography)
- Ankle-brachial index
- Sleep studies
- Imaging studies of the liver (i.e., ultrasound)
- Anaerobic threshold/VO_2 testing
- Resting metabolic rate (RMR)

Reference/s: [73-75]

Obesity Medicine Association

Diagnostic Testing: Individualized

Body Composition

- Dual-energy X-ray absorptiometry (DEXA), ideally with visceral fat assessment
- Bioelectric impedance
- Near-infrared interactance
- Whole-body air displacement plethysmography (BOD POD)
- Myotape measurements (to assess muscle mass as well as wrist and neck size for use in percent body fat equations)
- Caliper percent body fat measurements (e.g., three-site skinfold calculations)
- Underwater weighing
- Quantitative magnetic resonance (QMR)
- Computerized tomography (single slice or volume method)
- Deuterium dilution

Emerging Science Testing

- Leptin
- Adiponectin
- Leptin-to-adiponectin ratio
- Free fatty acids
- Immune markers
  - Tumor necrosis factor
  - Interleukin 1 and 6
- Infectious testing
  - Gut microbiota
  - Adenovirus assays
  - Evaluation for other microbes

Reference/s: [76-80]

Obesity Medicine Association

Body Composition

Body Compartments: Fat-free Mass versus Lean Body Mass

Fat free mass* is total body mass less any body fat. It includes:

- Water
- Mineral
- Protein and glycogen

*Usually what is directly measured by two compartment techniques, such as DEXA

Lean body mass* is total body mass less adipose tissue. It includes:

- Water
- Mineral
- Protein and glycogen
- Essential fat in organs, central nervous system, and bone marrow

*Usually differs from fat-free mass by only ~5%, slightly less in men, slightly more in women)

Reference/s: [78,81-83]

Obesity Medicine Association

Body Compartments

Two Compartment:

- Fat mass
- Fat-free mass
- Can be assessed by:
  - Dual-energy x-ray absorptiometry (DEXA)
  - Underwater, or hydrostatic weighing
  - Air displacement plethysmography (BOD POD)
  - Bioelectrical impedance (BIA)
  - Skin fold thickness-derived calculations
  - Deuterium dilution

Three Compartment:

- Fat mass
- Total body water
- Fat-free dry mass (bone and protein)

(Although DEXA measures two compartments at a time, it can assess the "three compartments" of fat mass, lean soft tissue mass, and bone mineral mass. Similarly, assuming total body water is a constant proportion of fat free mass may allow BIA to estimate more compartments (e.g., fat free mass, fat mass, and total body water)

Four Compartment:

- Fat mass
- Total body water
- Bone mineral
- Protein
- Can be assessed by combination of two compartment assessments, such as hydrostatic weighing, plus dual-energy x-ray absorptiometry (DEXA), plus deuterium dilution or hydrostatic weighing, plus DEXA, plus bioimpedance spectroscopy

Six Compartment:

- Fat mass
- Total body water
- Bone mineral
- Non-Bone mineral
- Protein
- Glycogen

- **Fat mass** = stored and essential lipids
- **Water** = usually largest single component of body mass
  - ~55% intracellular
  - ~45% extracellular
- **Minerals** = calcium, phosphorous, magnesium, etc.
- **Protein & glycogen** = "residual"

Reference/s: [84-85]

Obesity Medicine Association

Body Compartments: Measurement Summary

Method	Accuracy*	Expense	Limitations
Calipers	User dependent	Inexpensive	Not optimal measuring technique for patients with very high body mass index
Dual-energy X-ray absorptiometry (DEXA)	Accurate	Relatively expensive	Not all DEXA (1) distinguish visceral versus subcutaneous fat, or (2) accommodate patients with very high body mass index
Air displacement (BOD POD)	Accurate with some potential variability	Inexpensive	Clothing and hydration dependent
Bioelectrical impedance	Accurate with some potential variability	Inexpensive	Hydration dependent
Under water weighing densitometry	Accurate	Relatively inexpensive	Time consuming, requires water submersion, and depends upon adequate lung exhalation
Computerized Tomography / Magnetic Resonance Imaging	Accurate	Expensive	Not all CT & MRI can accommodate individuals with very high body mass index
Deuterium dilution hydrometry	Accurate	Relatively inexpensive	Not readily available for commercial use

*The accuracy of all methods depends on the degree of training, and quality of equipment.

Reference/s: [86]

Obesity Medicine Association

Body Compartments: Measurements

- **Cadaver analysis** is the only true “gold standard” for body composition assessment
- **Body weight or body mass index** are not direct measures of body composition
- **Skinfold calipers** can be used to estimate proportion of body fat
- **Hydrodensitometry (underwater weighing)** estimates proportion of body fat based upon the Archimedes principle that the buoyant force of a body immersed in fluid is equal to the weight of the displaced fluid.
  - Lean tissues (bone and muscle) are more dense than water, and a person with more muscle will weigh more underwater
  - Fat is less dense than water, and a person with more body fat will weigh less underwater
  - Two-compartment model

Reference/s: [87,88]

Obesity Medicine Association

Body Compartments: Dual Energy X-Ray Absorptiometry (DEXA)

- Depending on software, DEXA can measure both body fat and bone-mineral density
- Low risk of radiation exposure, ~5% of standard chest X-ray
- Results may vary from machine to machine, and technician to technician
- Greatest accuracy achieved with appropriate user training, standard operating procedures, and routine calibration
- Greatest utility may be for serial measurements on the same machine by same technician
- DEXA can measure abdominal visceral fat

Reference/s: [81,89]

Obesity Medicine Association

Body Compartments: Dual Energy X-Ray Absorptiometry (DEXA)

- Monoenergetic X-Ray measures an homogenous absorber component
- Dual-energy X-Ray quantitates densities of two absorber components
- In body areas with no bone, DEXA can measure the “two compartments” of fat mass and lean soft tissue mass
- In body areas with bone, DEXA can measure the “two compartments” of soft tissue mass and bone mineral mass
- By combining these two analyses, DEXA can provide data regarding three compartments (fat, lean tissue, and bone)

Reference/s: [81,89]

Obesity Medicine Association

Body Compartments: Whole Body Plethysmography (BOD POD)

- Plethusmos = Greek for enlargement
- Measures body volume by air displacement
- Displacement principles similar to water displacement by hydrodensitometry weighing
- No strenuous exercise two hours before procedure
- No eating or drinking one hour before procedure
- Light clothing (tight swimsuit is preferred)
- Two-compartment model

Reference/s: [76, 90, 91]

Obesity Medicine Association

Body Compartments: Bioelectrical Impedance Analysis (BIA)

- BIA measures impedance by body tissues to flow of electrical current (electrical resistance = impedance)
- Electrical current passes more easily through water and muscle and less easily through fat
- Many BIA analyses assume fat-free mass has a constant proportion of water (~70%)
- Preparation: remove all metal, eliminate body waste prior to procedure, and avoid exercise causing sweat eight hours before, avoid large amounts of caffeine or alcohol 12 hours before
- While often considered a two-compartment model (fat versus fat-free mass), the assumption that total body water is a constant proportion of fat-free mass may allow estimation of more compartments (e.g., fat-free mass, fat mass, and total body water)

Reference/s: [92,93]

Obesity Medicine Association

Body Compartments: Deuterium Dilution

- In adults, intra and extracellular water constitutes ~70% of Fat Free Mass (FFM)
- With an estimate of total body water (TBW), the amount of Fat Mass can, in turn, be estimated via Body Mass minus FFM
- Deuterium is a stable (non-radioactive) isotope of hydrogen (^2H), administered as deuterium oxide ($^2H^2O$)
- After mixing with body water, deuterium is eliminated from the body in urine, saliva, sweat and human milk
- One technique is to collect post-dose saliva samples 3 and 4 hours after the deuterium oxide is administered
- While correction is required for some deuterium that distributes to non aqueous tissues, TBW (kg) can be calculated by the dose of $^2H^2O$ (mg) / ^2H in saliva (mg/kg) less baseline (pre-dose) ^2H
- Two-compartment model

Reference/s: [94]

Obesity Medicine Association

Body Compartments: CT and MRI

- Both computerized tomography (CT) and magnetic resonance imaging (MRI) accurately measure adipose tissue and skeletal muscle
- CT increases exposure to ionizing radiation, a potential clinical concern with repeat CT testing
- MRI = No radiation exposure
- Both CT and MRI accurately assess visceral and hepatic fat

Reference/s: [95-97]

Obesity Medicine Association

Energy Expenditure

Energy Expenditure: Components Overall

In moderately sedentary individuals, components of total energy expenditure:

- 70% resting metabolic rate
- 20% physical activity
- 10% dietary thermogenesis

Reference/s: [98]

Energy Expenditure: Component Variability

With the exception of individuals engaged in physical exercise outside typical study populations, the coefficient of variation in humans regarding energy expenditure:

- Resting metabolic rate = 5 – 10%
- Physical exercise = 1 – 2%
- Diet-induced thermogenesis = 20%

Reference/s: [99]

Obesity Medicine Association

Energy Expenditure: Component of NEAT

Often the widest variance in energy expenditure among individuals is non-exercise activity thermogenesis (NEAT)

- Working, fidgeting, and other activities of daily living, not including physical exercise
- Can range between 150-500 kcal/day, which is often greater than bouts of physical exercise
- NEAT can help explain perception that some individuals:
  - Are “naturally skinny”
  - Can maintain body weight compared to others, even with the same caloric intake and same exercise activity

Reference/s: [100,101]

Obesity Medicine Association

Energy Expenditure: Metabolic Rate

Basal Metabolic Rate

- Energy expended while fasting, rested, and supine in a thermoneutral environment
- Increased with increased body weight

Resting Metabolic Rate

- Energy expended at rest, does not require overnight supine measurement
- Increased with increased body weight

Reference/s: [102,103]

Obesity Medicine Association

Energy Expenditure: Measurement via Direct and Indirect Calorimetry

Direct Calorimetry

- Measures heat generated by an organism
- Measures differences in temperature of water entering and leaving the chamber via a heat exchanger
- Value of generated heat can estimate total energy expenditure
- Enclosed chamber/calorimeter

Indirect Calorimetry

- Estimates basal energy expenditure and resting energy expenditure via measuring oxygen consumption and carbon dioxide production
- A metabolic cart is an electronic device, typically on a mobile push “cart, ”that measures O_2 consumption (VO_2) and CO_2 production (VCO_2)
  - Computer system
  - Monitor
  - Breathing tubes

Reference/s: [93]

Obesity Medicine Association

Energy Expenditure: Direct Calorimetry Formula

Total energy expenditure = ~60% from heat + ~40% from ATP production

- Utilized by direct calorimetry
- Requires knowledge of generated heat, such as through the differences in water temperature entering and leaving a chamber

Reference/s: [104]

Obesity Medicine Association

Energy Expenditure: Indirect Calorimetry Formulas

Abbreviated Weir equation: Energy expenditure = VO_2 + VCO_2
[Weir equation: Energy expenditure = VO_2 + VCO_2 - Nitrogen (urine)]

- Utilized by indirect calorimetry
- Requires knowledge of:
  - Oxygen consumption (VO_2 in - VO_2 out)
  - CO_2 production (expired CO_2)
  - (Nitrogen level for full Weir equation)
- Assumes FIO_2 + FIN_2 = 1
- Inhaled ambient air = 21% O_2 + 79% N_2 + less than 1% CO_2

Reference/s: [105,106]

Obesity Medicine Association

Energy Expenditure: Indirect Calorimetry Formulas

Respiratory quotient (RQ) = CO_2 production / O_2 consumption

- Utilized by indirect calorimetry to assess proportion of metabolized fuels
- RQ for carbohydrates = 1.0
- RQ for fats = 0.7
- RQ for proteins = variable
- Overfeeding = increase in RQ to as high as 1.3 due to lipogenesis
- Underfeeding and ketosis = decrease in RQ due to lipolysis
- In treating severe chronic obstructive lung disease, increasing the proportion of dietary fats (relative to carbohydrates) decreases CO_2 production and decreases amount of energy spent on respirations
- Higher RQ may be predictive of future increase in fat mass

Reference/s: [105-107]

Obesity Medicine Association

Energy Expenditure: Measurement by Doubly Labeled Water

Background

- Estimates carbon dioxide production, which is reflective of energy expenditure via tissue respiration (carbon dioxide from body cells is exchanged for oxygen in blood)
- Oxygen component will decay quicker because oxygen is lost as both CO_2 (in expired air) + H_2O (urine and sweat)
- Hydrogen component will decay slower because hydrogen is lost only as H_2O

Measurements

- Doubly labeled water is administered orally using traceable hydrogen isotope (deuterium or ^{2}H) and oxygen isotope (^{18}O)
- The difference found in body fluids (sampling urine, saliva, or blood) is used to calculate the body's production of CO_2 over time

Reference/s: [108]

Obesity Medicine Association

Energy Expenditure: Measurement by Non-calorimetric Methods

- **Resting metabolic rate energy expenditure** can be estimated by calculations
  - Age
  - Gender
  - Weight
  - Height
  - Harris-Benedict and Mifflin St. Jeor Equation = age, gender, weight, height
  - Maintenance of Hemodialysis Energy (MHDE) Equation for dialysis patients
- **Physical activity energy expenditure** can be estimated by:
  - Physical activity records as input data to validated energy-expenditure tables
  - Calculations based on heart rate
  - Motion sensors (e.g., pedometers)
  - Accelerometers (uniaxial, bi-axial, tri-axial)
    - Wearable technologies such as watches or attachment to belt around waist or ankle

Reference/s: [105,109,110]

Obesity Medicine Association

Treatment

Treatment of Adult Patients with Overweight or Obesity

Medical Management and Coordination

- Nutrition
- Physical Activity
- Behavior Therapy
- Pharmacotherapy
- Bariatric Surgery

Reference/s: [1]

Obesity Medicine Association

Treatment of Adult Patients with Overweight or Obesity

- Treat adipocyte and adipose tissue dysfunction, which treats sick fat disease (SFD or adiposopathy)
- Treat excessive body fat, which treats fat mass disease (FMD)
- Treating diseases due to increased body fat and its adverse metabolic and biomechanical consequences may improve patient health, quality of life, body weight, and body composition

Reference/s: [1]

Obesity Medicine Association

Identify and Manage Secondary/Contributing Causes of SFD and FMD

Conditions that may promote fat mass gain:

Genetic Syndromes

- Isolated (i.e., Prader Willi)
- Familial (melanocortin 4 receptor deficiency)

Medical Conditions

- Hypothalamic damage
- Immobility
- Insulinoma
- Some cases of untreated hypothyroidism
- Hypercortisolism (Cushing's disease)
- Sleep disorders

Psychological and Behavioral Conditions

- Mental stress
- Depression
- Anxiety
- Post-traumatic stress syndrome
- Binge-eating disorder
- Night-eating syndrome
- Eating disorders not otherwise specified

Reference/s: [73, 111, 112]

Obesity Medicine Association

Concomitant Medications

Identify and Manage Concomitant Pharmacotherapy That Might Alter Body Weight

Cardiovascular Medications

May increase body weight:

- Some beta-blockers
  - Propranolol
  - Atenolol
  - Metoprolol
- Older and/or less lipophilic dihydropyridine (“dipine”) calcium channel blockers may increase body weight gain due to edema, compared to non-dihydropyridines and lipophilic dihydropyridines, and the increased edema may exacerbate obesity-related edema (and sleep apnea related peripheral edema), and also confound body weight as a measure of body fat
  - Nifedipine
  - Amlodipine
  - Felodipine

Diabetes Mellitus Medications

May increase body weight:

- Most insulins
- Sulfonylureas
- Thiazolidinediones
- Meglitinides

May decrease body weight:

- Metformin
- Glucagon-like peptide-1 agonists
- Sodium glucose co-transporter 2 inhibitors
- Alpha glucosidase inhibitors

 Reference/s: [12, 27, 113, 114, 310]

Metformin

May help improve adiposopathic disorders:

- Insulin resistance
- Polycystic ovarian syndrome
- Fatty liver
- Cardiovascular disease (especially when compared to sulfonylurea)

May help treat complications of other concurrent drug treatments:

- Antipsychotic-related weight gain
- Human immunodeficiency virus (HIV) protease inhibitor-associated abnormalities (i.e., HIV lipodystrophy)

May help reduce the overall cancer rate and help improve the treatment of multiple cancers:

- Colon
- Ovary
- Lung
- Breast
- Prostate

May enhance effects of gastrointestinal hormones applicable to weight loss (e.g., glucagon-like peptide-1, Peptide YY)

Reference/s: [115-118]

Obesity Medicine Association

Identify and Manage Concomitant Pharmacotherapy That Might Alter Body Weight

Hormones

May increase body weight:
- Glucocorticoids
- Estrogens

Variable effects on body weight:
- Progestins
  - Injectable or implantable progestins may have greatest risk for weight gain
  - May be dependent upon the individual
- Testosterone
  - May reduce percent body fat and increase lean body mass, especially if used to replace testosterone deficiency in men

Anti-seizure Medications

May increase body weight:
- Carbamazepine
- Gabapentin
- Valproate

May decrease body weight:
- Lamotrigine
- Topiramate
- Zonisamide

Reference/s: [113,119]

Obesity Medicine Association

Identify and Manage Concomitant Pharmacotherapy That Might Alter Body Weight

May increase body weight:

- Some tricyclic antidepressants (tertiary amines)
  - Amitriptyline
  - Doxepin
  - Imipramine
- Some selective serotonin reuptake inhibitors (e.g. paroxetine)
- Some irreversible monoamine oxidase inhibitors
  - Isocarboxazid
  - Phenelzine
- Mirtazapine

May decrease body weight:

- Bupropion

Variable effects on body weight:

- Some tricyclic antidepressants (secondary amines)
  - Desipramine
  - Nortriptyline
  - Protriptyline
- Some selective serotonin reuptake inhibitors
  - Citalopram
  - Escitalopram
  - Fluoxetine
  - Sertraline
- Some serotonin and norepinephrine re-uptake inhibitors
  - Desvenlafaxine
  - Duloxetine
  - Venlafaxine
- Some irreversible monoamine oxidase inhibitors (i.e., tranylcypromine)

Reference/s: [113,120-122]

Obesity Medicine Association

Identify and Manage Concomitant Pharmacotherapy That Might Alter Body Weight

Mood Stabilizers

May increase body weight:

- Gabapentin
- Lithium
- Valproate
- Vigabatrin

Variable/neutral effects on body weight:

- Carbamazepine (sometimes reported to increase body weight)
- Lamotrigine (sometimes reported to decrease body weight)
- Oxcarbazepine

Migraine Medications

May increase body weight:

- Amitriptyline
- Gabapentin
- Paroxetine
- Valproic acid
- Some beta-blockers

May decrease body weight:

- Topiramate

Reference/s: [113, 120-122]

Obesity Medicine Association

Identify and Manage Concomitant Pharmacotherapy That Might Alter Body Weight

Antipsychotics

May substantially increase body weight:

- Clozapine
- Olanzapine
- Zotepine

May somewhat increase body weight:

- Asenapine
- Chlorpromazine
- Iloperidone
- Paliperidone
- Quetiapine
- Risperidone
- Sertindole
- Lithium

Variable/neutral effects on body weight:

- Amisulpride
- Aripiprazole
- Haloperidol
- Lurasidone
- Ziprasidone

Hypnotics

May increase body weight:

- Diphenhydramine

May have limited effects on body weight:

- Benzodiazepines
- Melatonergic hypnotics
- Trazodone

 Reference/s: [113, 120-122]

Obesity Medicine Association

Identify and Manage Concomitant Pharmacotherapy That Might Alter Body Weight

Human Immunodeficiency Virus (HIV) Medications

May increase body weight:

- Some highly active antiretroviral therapies (HAART) protease inhibitors without HIV lipodystrophy

May decrease body weight:

- Some highly active antiretroviral therapies (HAART) protease inhibitors with HIV lipodystrophy

Chemotherapies

May increase body weight:

- Tamoxifen
- Cyclophosphamide
- Methotrexate
- 5-fluorouracil
- Aromatase inhibitors
- Corticosteroids

Reference/s: [113, 123,124]

Obesity Medicine Association

General Nutrition

General Nutrition

The principles outlined here pertain to general nutrition and may not apply to the individual patient.

Obesity Medicine Association

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

Reference/s: [125]

Obesity Medicine Association

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

Reference/s: [125]

Obesity Medicine Association

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

Reference/s: [125]

Obesity Medicine Association

Insulin Controls Fat Metabolism

- Insulin promotes fatty acid and triglyceride synthesis (lipogenesis) and storage, and it inhibits fat breakdown (lipolysis)
- Foods that cause a rise in blood glucose, such as sugars, starches, or amino acids will stimulate the secretion of insulin from the pancreas
- A diet that lowers the amount of insulin secreted is beneficial for weight loss

Reference/s: [70]

Obesity Medicine Association

Nutritional Therapy for Obesity

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.

Reference/s: [1]

Obesity Medicine Association

Nutritional Therapy for Obesity

Factors related to improved outcomes:

- Evidence-based
- Quantitative
- Patient adherence
- Patient preference
- Qualitative

Reference/s: [1]

Obesity Medicine Association

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

Reference/s: [1]

Obesity Medicine Association

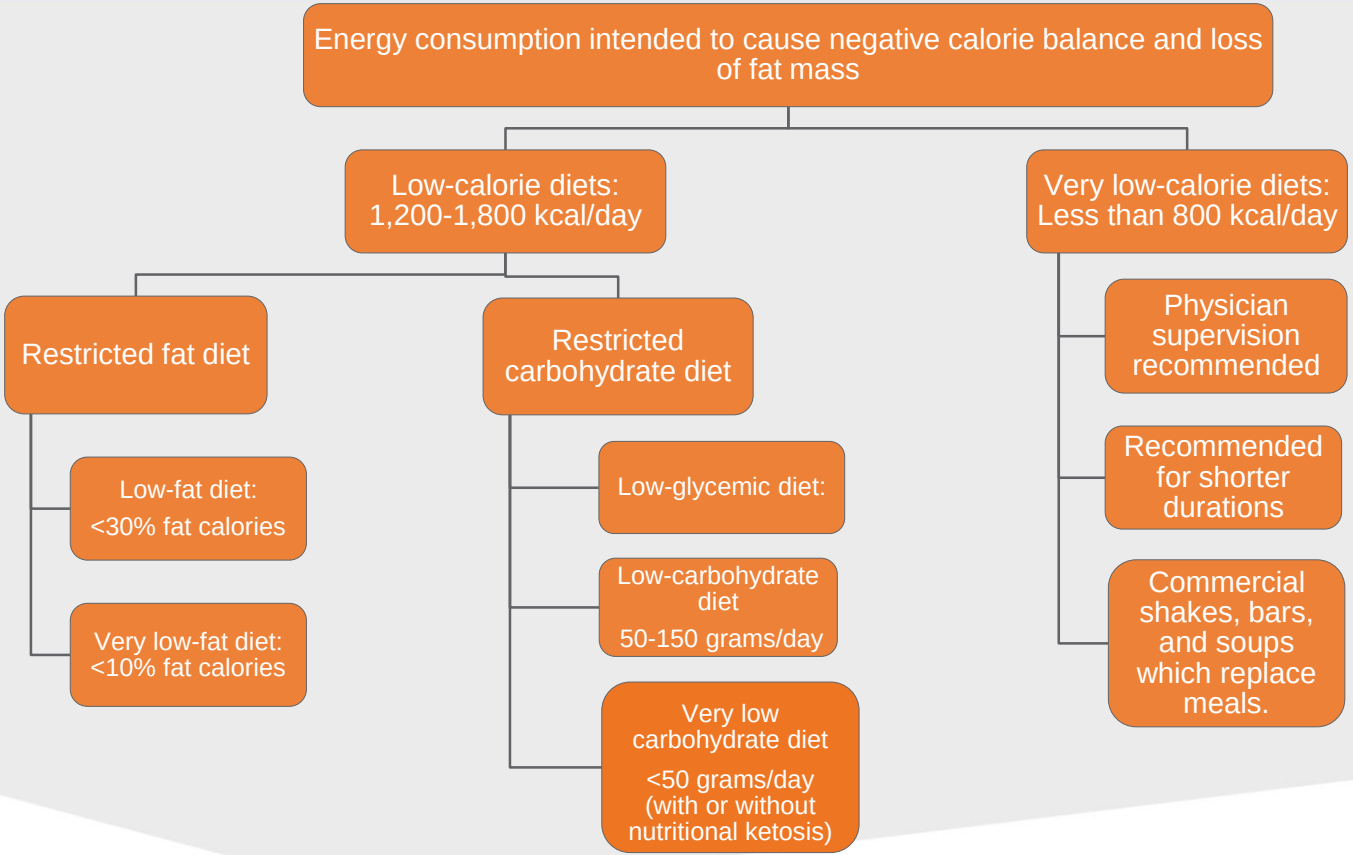
Choosing Nutritional Therapy for Obesity

- 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

Reference/s: [1]

Obesity Medicine Association

Nutritional Therapy for Obesity



Reference/s: [126-129]

Obesity Medicine Association

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 artificial sweeteners or adding low-glycemic-index foods
- May induce gout flare if history of gout
- May present challenges in patients undergoing dietary protein restriction (severe kidney disease)

Reference/s: [130-135]

Obesity Medicine Association

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: [136-137]

Obesity Medicine Association

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

Reference/s: [138-139]

Obesity Medicine Association

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 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

Reference/s: [140,141]

Obesity Medicine Association

Mediterranean Diet

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: [142-145]

Obesity Medicine Association

Therapeutic Lifestyle Change Diet (TLC)

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: [146-148]

Obesity Medicine Association

Atkins Diet

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.
- All phases encourage a balance of saturated, monounsaturated, and polyunsaturated fatty acids.

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

Reference/s: [149-151]

Obesity Medicine Association

Ornish Diet

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: [152-154]

Obesity Medicine Association

DASH Diet

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

Reference/s: [155,156]

Obesity Medicine Association

Paleolithic Diet

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: [157-159]

Obesity Medicine Association

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: [160-161]

Obesity Medicine Association

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: [160-161]

Obesity Medicine Association

Physical Activity

Physical Activity to Improve Health

Adiposopathy (Sick Fat Disease)

- Assist with weight maintenance
- Assist with weight loss
- Improve body composition
- Improve adiposopathic psychological disturbances
- Possibly improve adipocyte function (“train” fat cells)
  - Improve insulin sensitivity
  - Increase mitochondrial biogenesis
  - Increase browning (“beiging”) of fat cells

Non-adipose Parameters

- Improve metabolic health
- Improve musculoskeletal health
- Improve cardiovascular health
- Improve pulmonary health
- Improve mental health (e.g., mood, happiness, sense of well-being)
- Improve sexual health

Reference/s: [162-165]

Obesity Medicine Association

Medical Evaluation to Ensure Safety before Beginning New Exercise Program

- Assess current physical activity level
- Assess readiness
- Agree upon patient expectations and goals with written “contract”
- Assess potential need for medical testing/evaluation (i.e., cardiac stress testing, pulmonary function tests, musculoskeletal assessment, etc.)
- Assess mobility, fitness, and potential equipment needs or modifications
- Potential adjustment of medications
  - Before start of physical activity plan
  - During implementation of physical activity plan
- Optimal default
  - Back-up plan

Reference/s: [166]

Obesity Medicine Association

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

Reference/s: [167-168]

Obesity Medicine Association

Priority: Increase Energy Expenditure

Dynamic (Aerobic) Training

- Some physical activity is better than none
- 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
- > 300 minutes (5 hours) per week of moderate physical activity or 150 minutes (2.5 hours) per week of vigorous intensity aerobic exercise = promote more robust weight loss and prevent weight regain after weight loss

Resistive (Anaerobic) Strength Training

- Percent body fat better assessment of body composition than BMI
- Utilize appropriate weight-lifting technique
- Emphasize “core” muscle exercises
- Using a variety of free weights, machines, and resistance bands may elicit less boredom and provide greater flexibility regarding scheduling and location
- Short-term sore muscles may be expected
- Sore joints suggests poor technique, with possible need for medical evaluation and physical activity modification
- Prioritize muscle mass metrics (e.g., myotape measurements) versus amount of weight lifted

Reference/s: [169-170]

Obesity Medicine Association

Priority: Increase Energy Expenditure and Decrease Sedentary Time

Leisure Time Physical Activity

- Engage in competitive sport activities involving substantial physical activity, best if on a routine basis
- Engage in non-competitive sports such as running, hiking, cycling, cross-fit training, etc.
- Outdoor warm-weather physical activity in sunlight may facilitate negative caloric balance and have other health benefits, but need to avoid excessive sun exposure
- Engage in physical activity sport-alternatives, such as dancing

Transportational/Occupational Non-exercise Activity Thermogenesis (NEAT)

- Walk short distances instead of automated transportation
- Take stairs instead of elevator
- Carry overnight travel bags instead of using rollers
- Active work environment (i.e., standing desks, walking desks)
- Avoid prolonged inactivity
  - Take breaks from inactivity
  - Walk, stand, incidental movements

Reference/s: [171-172]

Obesity Medicine Association

Exercise Prescription

- Exercise prescription (FITT-VP)
  - ***F***requency
  - ***I***ntensity
  - ***T***ime or duration
  - ***T***ype or mode
  - ***V***olume or total energy expenditure of the exercise
  - ***P***rogression of the exercise

- Exercise prescription (FITTE)
  - ***F***requency
  - ***I***ntensity
  - ***T***ime spent
  - ***T***ype
  - ***E***njoyment level

Reference/s: [166,173]

Obesity Medicine Association

Metabolic Equivalent Tasks (METS)

- METS are used to assess the intensity of physical exercise: Kcal = METS x weight x time
- Equal to the amount of energy expended during one minute while lying down at rest
- Equal to ~3.5 milliliters of oxygen consumption per kilogram of bodyweight per minute (3.5 ml/kg/min)
- Oxygen consumption may be decreased with increased age
- Standing = 2 METS
- Walking 4 miles per hour = 4 METS
- Running 10 miles per hour = 16 METS

Reference/s: [174,175]

Obesity Medicine Association

Tracking Progress

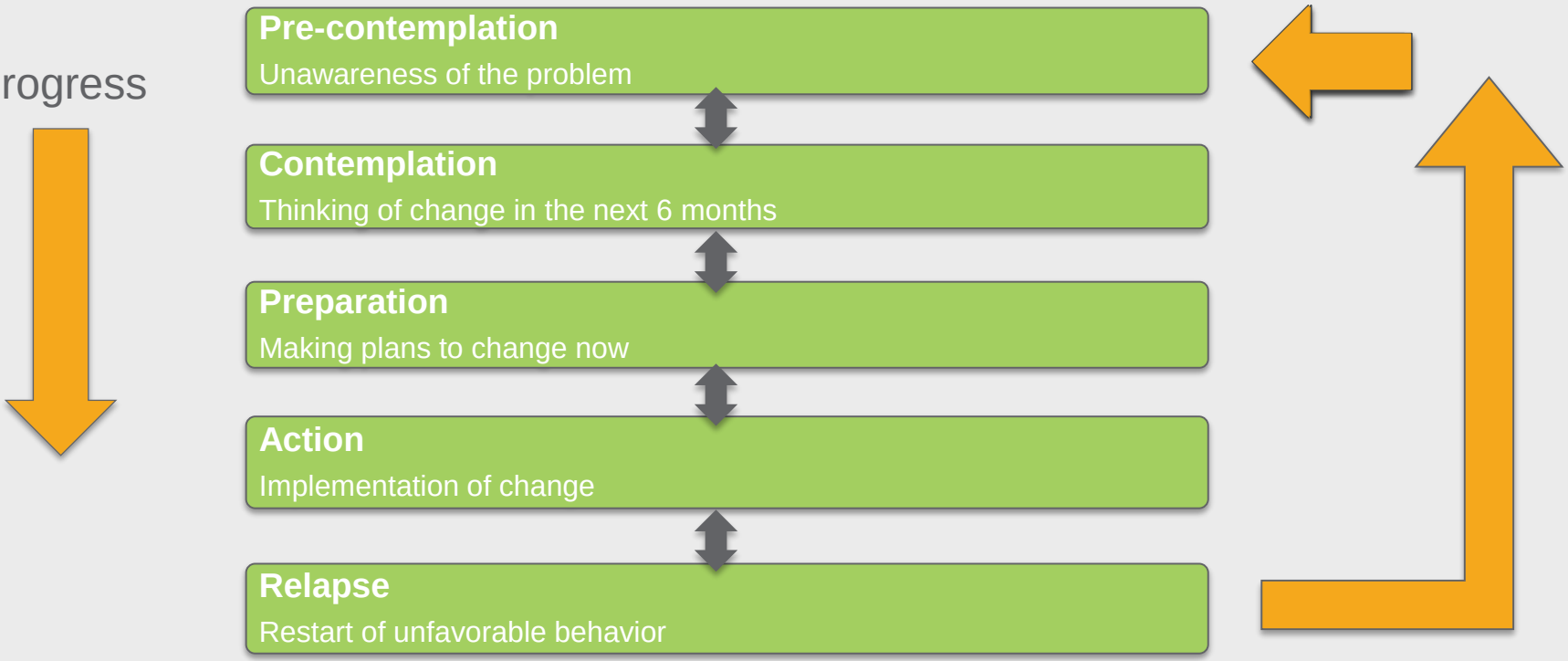
- Daily activity logs (written or electronic)
- Pedometer/accelerometer logs
- Dynamic training metrics (i.e., miles run, laps swam, etc.)
- Resistance training metrics (i.e., muscle-circumference measurements, reps, sets, etc.)
- Percent body fat measurements

Reference/s: [110, 176-179]

Obesity Medicine Association

Motivational Interviewing

Motivational Interviewing: Stages of Change



Reference/s: [180,181]

Obesity Medicine Association

Motivational Interviewing: Focus

Collaboration

- Working together to find and implement pragmatic solutions
- Not focusing on who is right and who is wrong

Evocation

- Drawing out the patient's thoughts and ideas regarding solutions
- Not telling the patient what to do

Autonomy

- Empowering the patient to own the solution
- Not the authoritarian power of the clinician

Reference/s: [182-184]

Obesity Medicine Association

Motivational Interviewing: Principles

- Express empathy
- Avoid argumentation
- Develop discrepancy
- Resolve ambivalence
- Support self-efficacy

Reference/s: [185-187]

Obesity Medicine Association

Express Empathy

- Communicate
- Understand
- Collaborate
- Support
- Encourage
- Listen

Reference/s: [185,188]

Obesity Medicine Association

Avoid Arguments: Resistance

Types of Resistance

- Resistance in changing behavior may arise when the patient:
  - Views the problem or solution differently than the clinician
  - Feels the clinician is being too judgmental and/or authoritative
- Types of resistance
  - Arguing
  - Denying
  - Ignoring
  - Interrupting

Roll with Resistance

- Rolling with resistance avoids arguments and confrontations by choosing not to challenge patient actions and statements that suggest resistance to change
- May be especially useful during initial interactions with the patient

Therapeutic Paradox

- Therapeutic paradox is analogous to "reverse psychology," wherein the clinician makes a statement seemingly in support of no change in hopes the patient will make an argument for change
  - *"It sounds like now is not the best time for you to make changes."*
  - *"You seem to be saying you have a lot going on right now that keeps you from making changes, so what do you think is the best way for us to move forward at this time?"*

Reference/s: [187,189]

Obesity Medicine Association

Avoid Arguments: Roll with Resistance Examples

Reflection

- Simple reflection: *"You don't think you can lose weight right now."*
- Amplified reflection: *"People worry too much about your weight; your current body weight is not really a problem."*
- Double-sided reflection: *"You had previously suggested you were committed to weight loss, but now you no longer feel commitment is necessary."*

Shifting Focus

- *"Your conflict with your contractor is obviously stressful to you, but you are a bit ahead of me; I would like for us to go back and talk about what led to your entries in your diet diary."*

Reframing

- *"I get the sense that when your family expresses concern about your body weight, they do so in a way that makes you angry. Maybe their intent is not to frustrate you but rather meant to reflect how much they care for you."*

Siding with the Negative

- *"You previously gave us permission to discuss your body weight. But now you seem resistant to talk about it, much less talk about change. At this point, I am not sure you would be able to change even if you wanted to change."*

Reference/s: [187,190-192]

Obesity Medicine Association

Discrepancy and Ambivalence

Identify Discrepancy

- Discrepancy explores the mismatch between where patients are today and where they want to be in the future
- Contrasts current behavior and life goals
- Can involve acknowledging positive and negative aspects of current behavior
- Can promote motivation for change

Amplify Discrepancy

- Amplifying discrepancy can help resolve ambivalence
- May facilitate thoughts of change

Resolve Ambivalence (defined as uncertainty in the desire for change)

- Resolution of ambivalence helps facilitate change
- Can involve discussing:
  - Benefits for change
  - Risks of change
  - Benefits and risk of no change

Reference/s: [187,193,194]

Obesity Medicine Association

Motivational Questioning: Evoking Change-talk Examples

Elicit Talk of Change

- *"Why do you want to change?"*
- *"How important is it that you change?"*
- *"What values are most important to you?"*
- *"How do your actions fit your values?"*
- *"How do you plan to change?"*
- *"How confident are you that you can change?"*

Exploring Past and Future

- *"How were things better in the past?"*
- *"What may happen if things stay the same?"*
- *"How would you like for things to change within the next year?"*
- *"What are the best ways for you to change in the next year?"*

Query Extremes

- *"How accurate is this statement: 'Some might think your current actions are so important to you that you won't give them up, no matter what the cost'?"*
- *"What is the worst case scenario if you do not change?"*
- *"What is the best case scenario if you do change?"*

 Reference/s: [187, 192, 195]

Obesity Medicine Association

Change Metric Examples

Importance of Change

- *"On a scale of 1-10, where one is not important and 10 is most important, how important is it for you to change?"*
- *"Why are you not at a lower/higher number?"*

Readiness to Change

- *"On a scale of 1-10, where one is not ready to change and 10 is absolutely ready to change, how ready are you to change?"*
- *"Why are you not at a lower/higher number?"*

Confidence in Ability to Change

- *"On a scale of 1-10, where one is not at all confident and 10 is absolutely confident, how confident are you in your ability to change?"*
- *"Why are you not at a lower/higher number?"*

Reference/s: [187, 192]

Obesity Medicine Association

Decision-balancing Examples

- *"Write down some of the good things and bad things about your current eating and physical activity levels."*

- *"It sounds like you enjoy many aspects about what has led to your current body weight, but now you have reasons why this needs to change."*

Reference/s: [187, 192]

Obesity Medicine Association

Self-efficacy: Affirmation

Supporting Self-efficacy

- Motivational interviewing assumes the patient is capable of making change
- Change is promoted by focusing on past patient successes and highlighting existing patient skills and strengths
  - *"You have lost weight. What do you think were the main things you did to achieve this?"*
  - *"How do you feel about your success?"*

Affirmation

- *"Your weight loss shows a real commitment toward improving your health."*
- *"It is clear you have made some real changes."*
- *"It seems that despite a lot of things happening, you have managed to stay on course, and that is really impressive."*
- *"Although you have not lost weight, the fact you have returned reflects how serious you are about losing weight."*

 Reference/s: [187, 196, 197]

Obesity Medicine Association

Self Efficacy: Advice/Feedback and Summary Examples

Advice/Feedback

- *"What do you know about how body fat can affect your…?"*
  - *Blood sugar/pressure/cholesterol*
  - *Heart*
  - *Breathing*
  - *Bones and joints*
  - *Possible pregnancy*
  - *Quality of life*
  - *[Other clinical consequences experienced by the patient]*

Summary

- *"From what you've said, you want to lose weight mainly because you are concerned about your health and because your family is concerned."*
- *"It seems that with your commitment to the weight-management plan, and with support from your family, most everyone agrees that overall you are making great progress."*
- *"Although you had made progress in the past, your weight went up a bit this time. But it is good you did not get so discouraged as to cancel your appointment."*

Reference/s: [197,198]

Obesity Medicine Association

Motivational Interviewing Techniques: Micro-Counseling (OARS)

Open-ended Questions

- Avoids binary answers such as “yes” or “no”
- Invites expression of elaborative thoughts
- May help patient explore reasons for and possibility of change

Affirmation

- An expressed recognition of the patient’s strengths and how these strengths can be applied to implement favorable change
- Affirmations to the patient by the clinician should be:
  - Relevant
  - Genuine

Reflections

- Careful listening can often be the most effective form of empathy
- After careful listening, the clinician is better able to:
  - Facilitate evocation
  - Develop discrepancy
  - Amplify and resolve ambivalence
  - Offer collaboration
  - Support self-efficacy

Summaries

- Each counseling session should conclude with a summary of:
  - What was discussed
  - Shift attention from negative past failures and toward positive but realistic future goals
  - Establish metrics to measure success of future goals
  - Outline follow-up plans

Reference/s: [199]

Obesity Medicine Association

Motivational Questioning: General Approach Examples

Open-ended Questions

- *"If you don't mind, can you tell me why are you here today?"* (Incorporates permission.)
- *"What do you hope we can accomplish today?"*
- *"What do you realistically think we can accomplish today?"*

Reflective Listening

- *"From what you are telling me, it sounds like you (or your family/friends) want you to lose weight, but you…"*
  - *" . . . have concerns."*
  - *" . . . are unsure how."*
  - *" . . . are unsure if you need to."*
  - *" . . . are unsure if you want to."*
  - *" . . . are unsure if you can."*
  - *" . . . are unsure if you are committed to change."*

Normalizing

- *"While no situation is the same, in general, many people often have problems losing weight."*
- *"Many people feel like you: they want to lose weight but find it difficult."*
- *"Many people have repeatedly tried to lose weight in the past before they were finally successful."*

Reference/s: [200,201]

Obesity Medicine Association

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: [202,203]

Obesity Medicine Association

Motivational Interviewing Techniques: FRAMES

- Feedback about Personal Risk
- Responsibility of Patient
- Advice to Change
- Menu of Strategies
- Empathetic Style
- Self-efficacy

Reference/s: [204,205]

Obesity Medicine Association

Behavior Therapy

Why Do People Eat Like They Do?

Physiologic

- Strong biologic forces that resist weight loss
- Weak biologic forces that resist weight gain
- Hypothalamic dysfunction
  - Trauma
  - Inflammation
- Hunger before meals
- Lack of satiety after meals
- Eating to facilitate sleep

- Five senses central nervous system signaling:
  - Sight of food
  - Smell of food
  - Hear talk of food, sounds of food (cooking, wrapper opening)
  - Taste of food
  - Feel of lack of food (i.e., vibration of “empty stomach,” borborygmi, texture, size)

Reference/s: [206-212]

Obesity Medicine Association

Why Do People Eat Like They Do?

Mental Stress

- Chronic stress-induced limbic (e.g., hypothalamic) endocrinopathies and immunopathies
- Chronic stress-induced cerebral endocrinopathies and immunopathies
- Chronic stress-induced priority replacement of personal, work, or emotional priorities that overtake nutritional and physical activity priorities

Timing and Emotions

- Timing
  - It's mealtime
  - Special occasions
  - Holidays
- Emotions
  - Surrogate for love and/or affection
    - For self
    - For others (children and friends)
  - Celebrate happiness
  - Soothe sadness
  - Avoidance: Cooking or eating can be a successful accomplishment, preferable to more challenging activities or situations
  - Treat:
    - Boredom
    - Fatigue
    - Stress

Reference/s: [206-212]

Obesity Medicine Association

Why Do People Eat Like They Do?

Environment

- Others are eating
- Food is available
- Offers of free food
- Highly researched and effective advertisements for energy dense foods
- Perceived obligations
  - Family gatherings
  - Business meetings
  - Clean-plate syndrome

Information Gap

- Lack of education about proper nutrition
- Challenges regarding access to nutritional information, especially when eating out
- Caloric content
- Nutritional content
- Marketing messages
  - “low fat”
  - “whole grain”
  - “no added sugar”
  - “natural sugar”
  - “cholesterol free”

Reference/s: [206-212]

Obesity Medicine Association

Why Do People Eat Like They Do?

Reward

- Eating as a remuneration for an accomplishment or “good day”
- Eating as compensation for a “bad day”
- Eating for pleasure, not because of hunger
- Over-consumption of palatable food may affect the brain’s reward system
  - Stimulates opioid release
  - Decreases biologic stress response
  - May ultimately simulate addiction-like reward deficits, which promotes compulsive eating

Reference/s: [206-212]

Obesity Medicine Association

Why Do People Eat Like They Do?

Eating Disorders

- Binge-eating disorder
- Bulimia nervosa
- Night-eating syndrome

Reference/s: [206-212]

Obesity Medicine Association

Eating Disorders and Obesity: Binge-eating Disorder

Diagnosis:

- Frequent episodes of consuming large amounts of food more than once per week for at least three months
  - No self-induced vomiting (purging)
  - No extra exercising
  - Feelings of lack of self control, shame, and guilt
- Occurs in 2-3 percent of U.S. adults
- Often considered the most common eating disorder
- May occur in up to 50 percent of patients with severe obesity
- Eating Attitudes Test may assist with diagnosis

Treatment:

- Often requires treatment by a qualified clinician
- Cognitive behavior therapy
- Lisdexamfetamine dimesylate is the only pharmacotherapy with an FDA indication to treat binge-eating disorder
- Although not FDA indicated for this use, clinical trials suggest other pharmacotherapies may be efficacious
  - Some selective serotonin reuptake inhibitors
  - Topiramate

Reference/s: [213-218]

Obesity Medicine Association

Lisdexamfetamine Dimesylate: Indications and Use

- Lisdexamfetamine dimesylate is a central nervous system stimulant indicated for the treatment of:
  - Moderate to severe binge-eating disorder (BED)
  - Attention Deficit Hyperactivity Disorder (ADHD)
- Limitations:
  - Not indicated for weight loss; safety and effectiveness for the treatment of obesity have not been established
- Drug Enforcement Agency Schedule II drug
- Dosing for BED: Once in the morning with or without food. Avoid afternoon doses. Capsule may be opened and mixed with yogurt, water, or orange juice (see drug interactions).
  - Starting dose = 30 mg every morning for one week
  - Titration dose = 50 mg every morning for one week
  - Top dose = 70 mg every morning
  - Recommended dose = 50-70 mg every morning
  - Severe renal impairment: Maximum dose is 50 mg per day
  - End-stage renal disease: Maximum dose is 30 mg per day

Reference/s: [219]

Obesity Medicine Association

Lisdexamfetamine Dimesylate

Potential Drug Interactions

- Agents that alter urinary pH can alter blood levels of amphetamine
  - Acidifying agents decrease amphetamine blood levels (e.g., ascorbic acid)
  - Alkalinizing agents increase amphetamine blood levels (e.g., sodium bicarbonate)
- Concurrent administration with monoamine oxidase (MAO) inhibition may contribute to hypertensive crisis

Pharmacokinetics

- Lisdexamfetamine is rapidly absorbed from the gastrointestinal tract, converted to dextroamphetamine and l-lysine primarily in the blood due to the hydrolytic activity of red blood cells
- Lisdexamfetamine is not metabolized by cytochrome P450 enzymes
- Approximately 96 percent of oral dose radioactivity is recovered in the urine (42 percent related to amphetamine, 25 percent to hippuric acid, and 2 percent to intact lisdexamfetamine)
- Plasma elimination half-life is less than one hour

Reference/s: [219]

Lisdexamfetamine Dimesylate: Potential Adverse Experiences

Most Common Adverse Reactions:

- Anorexia
- Anxiety
- Decreased appetite
- Decreased weight
- Diarrhea
- Dizziness
- Dry mouth
- Irritability
- Insomnia
- Nausea
- Upper abdominal pain
- Vomiting
- Increased heart rate
- Constipation
- Feeling jittery

Reference/s: [219]

Obesity Medicine Association

Lisdexamfetamine Dimesylate: Contra-indications

- Central nervous system stimulants (amphetamines and methylphenidate-containing products), including lisdexamfetamine dimesylate, have high potential for abuse and dependence
- Risk of abuse should be assessed prior to prescribing
- Patients should be monitored for signs of abuse and dependence while on therapy
- Known hypersensitivity (e.g., anaphylactic reactions, Stevens-Johnson Syndrome, angioedema, and urticarial) to amphetamine products or other ingredients in lisdexamfetamine dimesylate
- Use with monoamine oxidase (MAO) inhibitor or within 14 days of the last MAO inhibitor dose

Reference/s: [219]

Lisdexamfetamine Dimesylate: Warnings

- Serious cardiovascular reactions
  - Due to reports of sudden death in children and adolescents with serious heart problems, as well as sudden death, stroke, and myocardial infarction in adults, avoid use in patients with known structural cardiac abnormalities, cardiomyopathy, serious health arrhythmia, or coronary artery disease.
- Blood pressure or heart rate increases
  - Blood pressure and pulse should be monitored. Benefits and risks should be considered before use in patients for whom blood pressure increases may be problematic.
- Psychiatric adverse reactions
  - May cause psychotic or manic symptoms in patients with no prior history or exacerbation of symptoms in patients with pre-existing psychosis. Evaluate for bipolar disorder prior to stimulant use.
- Suppression of growth
  - Height and weight should be monitored in pediatric patients during treatment.
- Peripheral vasculopathy, including Raynaud's phenomenon
  - Stimulants are associated with peripheral vasculopathy, including Raynaud's phenomenon. Careful observations for digital changes is necessary during treatment with stimulants.

Reference/s: [219]

Obesity Medicine Association

Eating Disorders and Obesity: Bulimia Nervosa

Diagnosis:

- Cycle of recurrent binge eating and compensatory purging, laxative abuse, diuretic abuse, extra exercising, fasting, or strict dieting
- Occurs in approximately 1% of adults (mostly women)
- Russell sign: Calluses and abrasions on dorsum of the hands caused by repeated contact with the teeth during self-induced vomiting
- Laboratory: Hypokalemia due to hypomagnesemia

Treatment:

- Often requires treatment by a qualified clinician
- Fluoxetine is an FDA-approved pharmacotherapy for bulimia nervosa
- Although not FDA-indicated for this use, topiramate and naltrexone may be efficacious

Reference/s: [214-218]

Obesity Medicine Association

Eating Disorders and Obesity: Night-eating Syndrome

Diagnosis:

- At least 25% of daily food consumption (often greater than 50%) consumed after evening meal
- Recurrent awakenings from sleep that require eating to go back to sleep, often involving carbohydrate-rich snacks
- Little interest in breakfast (morning anorexia)
- Night-eating syndrome may occur in as much as 5% of the U.S. population

Treatment:

- Behavioral therapy regarding nutritional timing and content

Reference/s: [220-223]

Obesity Medicine Association

Why Don’t People Engage in Routine Physical Activity?

Physiologic

- Musculoskeletal, neurologic, pulmonary, cardiac, and other health disorders
- Pain or soreness
- Fatigue
- Conveniences which limit the physiologic need for physical activity
  - Automated transportation (i.e., cars, buses, etc.)
  - Elevators and escalators
  - Online shopping
  - Automated equipment that lessens manual labor

Lack of Time

- Work commitments
- Family responsibilities
- Time preferentially allotted for other entertainments with minimal energy expenditure
  - Television
  - Movies
  - Video games
  - Internet
  - Watching sports

Reference/s: [224,225]

Obesity Medicine Association

Why Don’t People Engage in Routine Physical Activity?

Disinterest

- “Exercise is boring”
- Past failures to achieve exercise goals
- Past failures in observing body changes
- Concerns of being seen:
  - In workout clothes
  - In gyms surrounded by others more fit
- Desire to avoid perspiration
  - General appearance
  - Hair
  - Odor

Environment

- Lack of:
  - Others (family, friends, etc.) engaged in physical activity
  - Safe environment
  - Parks or other areas for leisure activity
  - Accessible gym
  - Workplace exercise equipment
- Inadequate maintenance of increased physical activity, once started
- Insufficient education on physical activity
  - Benefits
  - Risks
  - Techniques
  - Recommendations

Reference/s: [224,225]

Obesity Medicine Association

Why Do People Regain Body Weight?

Physiologic Priority Imbalance

- Neuro-biologic processes strongly resist starvation
- Neuro-biologic processes weakly resist over-nutrition
- Analogous example:
  - Hypoglycemia can be profoundly symptomatic and may promote physiologic and behavioral priority for immediate caloric intake
  - Hyperglycemia is often asymptomatic and rarely promotes physiologic and behavioral priority for immediate reduced caloric intake

Neurobiology

- Weight loss may decrease neuroendocrine factors, which in turn may increase appetite
  - Leptin
  - Insulin
  - Cholecystokinin
  - Peptide YY
- Weight loss may increase ghrelin, which in turn may increase appetite
- Poor restorative sleep

Reference/s: [226-229]

Obesity Medicine Association

Why Do People Regain Body Weight?

Energy Expenditure

- Decrease in resting energy expenditure with weight loss
- Greater muscle efficiency with weight loss, resulting in less energy expenditure with physical activity

Behavior

- Lack of maintaining accountability logs
- Intervening stress
- Changing life circumstances
- Changing health status
- Resorting to previous nutritional and/or physical activity habits after achieving initial weight-loss success

Reference/s: [226-229]

Obesity Medicine Association

Behavior Therapy Techniques: Elements for Optimal Success

Doable

- Practical
- Accessible
  - Frequency
  - Consistency

Efficacious

- Evidence-based

Measurable

- Feedback
- Trackable
- Verifiable

Self-ownership

- Autonomous stakeholder
- Personal stakeholder
  - Positive reinforcement
  - Negative reinforcement

Reference/s: [1]

Obesity Medicine Association

Behavior Therapy: Encounters and Education

Frequent Encounters with Medical Professional or Other Resources Free from Provider Bias

- Physician
- Dietitian
- Nurse educator
- Advanced practitioners
- Physical activity professional trainer (i.e., trainer, physiologist, etc.)
- Mental-health professional
- Certified health coach
- Web-based programs
- Mobile access (i.e., text messages, applications, etc.)
- Multidisciplinary approach
  - Clinicians with professional expertise
  - Patient with self expertise

Education

- Medical health
- Mental health
- Nutrition
- Physical activity
- Establish healthy sleep habits
- Establish healthy eating habits (i.e., reduce speed of eating, drink water between meals, choose and have available healthy snacks, etc.)
- Recognize and anticipate inevitable weight-loss plateaus

Reference/s: [230-232]

Obesity Medicine Association

Behavior Therapy: Stimulus Control and Cognitive Restructuring

Stimulus Control

- Avoid eating for reasons other than hunger
- Avoid frequent snacking
- Avoid binge eating
- Utilize portion control
- Environmental removal of foods identified as especially tempting for the individual patient
- Being habitually mindful of eating stimuli may allow best chance for stimulus control

Cognitive Restructuring

- Address matters of body image
- Identify and establish a plan to counteract unhelpful or dysfunctional thinking leading to unhealthy behaviors and actions
- Emphasize rationale of aggressive yet realistic weight-loss expectations through an emphasis on weight loss as a matter of medical and mental health
- Encourage patient to:
  - Acknowledge he/she is capable of positive thoughts and behaviors
  - Replace unhelpful thoughts and behaviors with more productive ones
  - Practice behavior therapy skills between clinician encounters

Reference/s: [231,233]

Obesity Medicine Association

Behavior Therapy: Goal Setting and Self-Monitoring

Goal Setting

- Patients are given step-by-step instructions to accomplish goals (i.e., nutrition and physical activity prescriptions)
- SMART
  - **S**pecific
  - **M**easurable
  - **A**ssignable
  - **R**ealistic
  - **T**ime-related
- Goals beyond body weight alone may include overall improvement in physical and mental health

Self Monitoring

- Daily or weekly body weights
- Other routine self-anthropometric measurements (i.e., calipers for percent body fat, tape measure for waist circumference, myotape for muscle mass, etc.)
- Food diaries (including online services or mobile applications)
- Physical activity logs
- Pedometer/accelerometer measures
- Changes in clothing size
- Photo journaling

Reference/s: [231,234]

Obesity Medicine Association

Behavior Therapy: Behavioral Contracting and Problem Solving

Behavioral Contracting

- Tokens of reward
- Financial incentives

Problem Solving, Social Support, and Other Reinforcement Contingencies

- Stress management
- Establish alternative back-up procedures to engage during times that challenge adherence to agreed upon plans (e.g., stressful periods, life changes, etc.)
- Health care team support
- Mental-health professional
- Other group or social support
- Commercial weight loss/maintenance programs
- Encourage interactions with others that may provide positive recognitions for successes

Reference/s: [231,235,236]

Obesity Medicine Association

Technologies for Weight Management

Technologies and Social Media

Applications

- Record and assess nutritional and physical activity metrics
- May be assessed and reviewed by clinicians between face-to-face evaluations

Interactive Technology

- Body-weight scales that provide interactive feedback via email or text messaging
- Wearable technologies
  - Tracks active minutes, steps, floors climbed, distance, and caloric consumption
  - Monitors heart rate and sleep patterns
  - Provides daily exercise statistics
  - Wirelessly syncs with smartphones and computers, providing interactive information to user

Websites

- Websites can provide educational information regarding:
  - Nutrition
  - Caloric content of foods
  - Physical activity
  - Expected energy expenditure with certain physical activities
  - Meal plans
  - Recipes

Social Media

- Post daily meals and snacks to followers to enhance accountability (Twitter, Facebook, etc.)
- Obtain nutritional and physical activity advice from others (Twitter, Facebook, blogs, forums, etc.)

Reference/s: [110,178,179,237,238]

Obesity Medicine Association

Anti-obesity Medications

obesitymedicine.org

Obesity Medicine Association

CLINICAL LEADERS IN OBESITY MEDICINE®

Anti-obesity Medications

Adjunct to nutritional, physical activity, and behavioral therapies.

Objectives:

- Treat disease
  - Adiposopathy or sick fat disease (SFD)
  - Fat mass disease (FMD)
- Facilitate management of eating behavior
- Slow progression of weight gain/regain
- Improve the health, quality of life, and body weight of the patient with overweight or obesity

5-10 percent weight loss may improve both metabolic and fat mass disease.

Reference/s: [239]

Obesity Medicine Association

Food and Drug Administration (FDA) Principles

FDA-approved Anti-obesity Medication Indications:

- Patients with obesity (e.g., BMI $\geq$ 30kg/m^2)*
- Patients who are overweight (e.g., BMI $\geq$ 27kg/m^2) with presence of increased adiposity complications (e.g., type 2 diabetes mellitus, hypertension, dyslipidemia)*

If no clinical improvement after 12-16 weeks with one anti-obesity medication, consider alternative anti-obesity medication or increasing anti-obesity medication dose (if applicable).

*While body mass index (BMI) is the only measure listed in the prescribing information for anti-obesity medications, BMI has limitations. Especially in muscular individuals or those with sarcopenia, overweight and obesity are more accurately assessed by other measures.

Reference/s: [240]

Pregnancy and Lactation Categorization

Update to FDA Pregnancy and Lactation Labeling

- In December 2014, the FDA issued its “Pregnancy and Lactation Labeling Final Rule” (PLLR), which went into effect on June 30, 2015.
- The PLLR removed letter pregnancy categories - A, B, C, D, and X.
- Due to the fact that the prescribing information materials for most anti-obesity medications have yet to be updated to reflect the new rules, the Obesity Algorithm continues to include pregnancy and lactation categories.
- In general, anti-obesity drugs should not be administered to, nor taken by women who are pregnant or trying to become pregnant.

Reference/s: [48, 241,242]

Obesity Medicine Association

Pharmacotherapy

Examples of Anti-obesity Medications Approved in 1999 or Before

- Phentermine
- Diethylpropion
- Phendimetrazine
- Benzphetamine
- Orlistat

Examples of Anti-obesity Medications Approved in 2012 and Beyond

- Lorcaserin
- Phentermine HCL/topiramate extended release
- Naltrexone HCL/bupropion HCL extended release
- Liraglutide

Reference/s: [243]

Obesity Medicine Association

Sympathomimetic Amines

- Examples: Phentermine, diethylpropion, phendimetrazine, benzphetamine
- Increases satiety
- Drug Enforcement Agency (DEA) Schedule weight-management agents
  - DEA IV for phentermine and diethylpropion
  - DEA III for phendimetrazine and benzphetamine
- Potential adverse experiences include:
  - Palpitation
  - Tachycardia
  - Increased blood pressure
  - Overstimulation
  - Tremor
  - Dizziness
  - Insomnia
  - Dysphoria
  - Headache
  - Dryness of mouth
  - Dysgeusia
  - Diarrhea
  - Constipation
  - Pregnancy category X

Reference/s: [27, 244-247]

Obesity Medicine Association

Gastrointestinal Lipase Inhibitors

- Example: Orlistat
- Impairs gastrointestinal energy absorption
- Potential adverse experiences include:
  - Oily discharge from the rectum
  - Flatus with discharge
  - Increased defecation
  - Fecal incontinence
  - May increase risk of cholelithiasis
  - May increase risk of urinary oxalate
  - Rare post-marketing reports of severe liver injury
  - May decrease fast-soluble vitamin absorption (e.g., vitamins A, D, E, K, and beta carotene)
  - Pregnancy category X

 Reference/s: [244, 248, 249]

Obesity Medicine Association

Lorcaserin

Indications and Use

- Serotonin (5-hydroxytryptamine) 2c receptor agonist anti-obesity medication
- Drug Enforcement Agency Schedule IV drug
- Dose = 10 milligrams (mg) twice per day for immediate release formulation;
  20 mg once per day for extended release formulation

Potential Drug Interactions

- The safety of lorcaserin co-administration with other serotonergic or anti-dopaminergic agents is not yet established, which includes selective serotonin reuptake inhibitors, serotonin-norepinephrine reuptake inhibitors, monoamine oxidase inhibitors, triptans, bupropion, dextromethorphan, St. John's Wort: use with extreme caution due to the risk of serotonin syndrome or neuroleptic malignant syndrome. Similarly, other listed potential drug interaction include tricyclic antidepressants, lithium, tramadol, and dopamine antagonists.

Pharmacokinetics

- Lorcaserin is metabolized in the liver with metabolites excreted in the urine

Reference/s: [240,243,248-251]

Obesity Medicine Association

Lorcaserin

Most Common Adverse Reactions*

- Headache
- Dizziness
- Fatigue
- Nausea
- Constipation
- Cough
- Dry Mouth

*May increase prolactin levels

Contra-indications

- Pregnancy (Category X)

Warnings and Precautions

- The safety of coadministration with other serotonergic or antidopaminergic agents has not been established. If Serotonin Syndrome or Neuroleptic Malignant Syndrome (NMS) – like Reactions occur, lorcacerin should be immediately discontinued and the patient provided supportive treatment.
- If signs or symptoms of valvular heart disease develop, then consider lorcaserin discontinuation and evaluate the patient for possible valvulopathy.
- May cause disturbances in attention or memory; use with caution in patients working with hazardous machinery when starting lorcaserin treatment
- Due to potential euphoria and dissociation, do not exceed recommended dose of lorcaserin 10 mg twice daily, or 20 mg extended-release formulation once a day.
- Discontinue lorcaserin if depression or suicidal thoughts develop.
- Among patients treated with diabetes mellitus medications, weight loss may cause hypoglycemia.
- Patients experiencing priapism should seek emergency treatment if an erection lasts >4 hours, and lorcaserin should be used with caution in patients predisposed to priapism.

Reference/s: [240,243,248-251]

Obesity Medicine Association

Phentermine HCL/Topiramate Extended Release

Completion of Risk Evaluation and Mitigation Strategy (REMS) program to inform prescribers and female patients about the increased risk of congenital malformations (especially orofacial clefts) in infants exposed to phentermine HCL/topiramate extended release during the first trimester of pregnancy*

Indications and Use

- Drug Enforcement Agency Schedule IV drug
- Phentermine is a shorter-acting sympathomimetic amine approved as monotherapy as a weight-management drug
- Topiramate is a longer-acting neurostabilizer approved as monotherapy for seizure disorders and migraine headache prevention
- Doses = Once daily in the morning with or without food
    - Starting dose = 3.75 mg/23 mg (phentermine/topiramate extended release)
    - After 14-day intervals, and as clinically indicated, escalate doses to:
        - Recommended dose = 7.5 mg/46 mg
        - Titration dose = 11.25 mg/69 mg
        - Top dose = 15 mg/92 mg

*Completion of the FDA-mandated REMS program is optional and not required prior to prescribing phentermine HCL/topiramate extended release. Implementation of a REMS program by clinicians and pharmacies is intended to provide appropriate safety information to females of reproductive potential.

Reference/s: [243, 248, 249, 252-254]

Phentermine HCL/Topiramate Extended Release

Potential Drug Interactions

- May alter the exposure to oral contraceptives, causing irregular menstrual bleeding but not an increased risk of pregnancy
  - Oral contraceptives should not be discontinued if spotting occurs
- May potentiate central nervous system depressants such as alcohol
  - Patients should avoid concomitant alcohol
- May potentiate hypokalemia of non-potassium-sparing diuretics

Pharmacokinetics

- Phentermine is metabolized by the liver, with most excreted by the kidney
- Topiramate is excreted mainly by the kidney

Reference/s: [243,248,249,252-254]

Obesity Medicine Association

Phentermine HCL/Topiramate Extended Release

Most Common Adverse Reactions

- In clinical trials, adverse reactions occurring more than or equal to 5 percent of the time include:
  - Paresthesia
  - Dizziness
  - Dysgeusia (taste distortion/perversion)
  - Insomnia
  - Constipation
  - Dry mouth

Laboratory Abnormalities May Include

- Metabolic acidosis
- Elevated creatinine
- Lowering of glucose levels

Reference/s: [243,248,249,252-254]

Obesity Medicine Association

Phentermine HCL/Topiramate Extended Release

Contra-indications

- Contra-indicated:
  - Glaucoma
  - Hyperthyroidism
  - During or within 14 days of taking monoamine oxidase inhibitors
  - Women of reproductive potential should have a negative pregnancy test before treatment and monthly thereafter and should use effective contraception while on phentermine HCL/topiramate extended release
  - Pregnancy or nursing (Pregnancy category X)
- Should be discontinued in patients with:
  - Unacceptable increases in adrenergic responses, such as increase in heart rate, especially in those with cardiac and/or cerebrovascular disease
  - Suicidal behavior and ideation
  - Acute myopia and secondary angle-closure glaucoma
  - Unacceptable mood and sleep disorders
  - Cognitive impairment
  - Pregnancy or nursing

Reference/s: [243,248,249,252-254]

Obesity Medicine Association

Naltrexone HCL/Bupropion HCL Extended Release

Indications and Use

- Naltrexone is an opioid antagonist
- Bupropion is an aminoketone antidepressant with relatively weak inhibition of neuronal reuptake of norepinephrine and dopamine
- Drug Enforcement Agency Schedule: Not a scheduled drug
- Tablets = 8 mg/90 mg (naltrexone HCL/bupropion HCL extended release)
- Dosing:
  - Week 1 = 1 tablet in AM, no tablets in PM
  - Week 2 = 1 tablet in AM, 1 tablet in PM
  - Week 3 = 2 tablets in AM, 1 tablet in PM
  - Week 4 and beyond = 2 tablets in AM, 2 tablets in PM

Reference/s: [243,248,249,255]

Obesity Medicine Association

Naltrexone HCL/Bupropion HCL Extended Release

Potential Drug Interactions

- Monoamine oxidase inhibitors: Increased risk of hypertensive reactions
- Drugs Metabolized by CYP2D6: Bupropion inhibits CYP2D6 and can increase concentrations of:
  - Antidepressants (e.g., selective serotonin reuptake inhibitors and many tricyclics)
  - Antipsychotics (e.g., haloperidol, risperidone, and thioridazine)
  - Beta-blockers (e.g., metoprolol)
  - Type 1C antiarrhythmics (e.g., propafenone and flecainide)
- CYP2B6 inhibitors (e.g., ticlopidine or clopidogrel) can increase bupropion exposure. Do not exceed one tablet twice daily when taken with CYP2B6 inhibitors.
- CYP2B6 inducers (e.g., ritonavir, lopinavir, efavirenz, carbamazepine, phenobarbital, and phenytoin) may reduce efficacy by reducing bupropion exposure. Avoid concomitant use.
- Should be dosed with caution with drugs that lower seizure threshold
- CNS toxicity can occur when used concomitantly with dopaminergic drugs (e.g., levodopa and amantadine)
- Drug laboratory test interactions:
  - Can cause false positive urine test results for amphetamines

Reference/s: [243,248,249,255]

Obesity Medicine Association

Naltrexone HCL/Bupropion HCL Extended Release

Pharmacokinetics

- Both parent and the 6-beta-naltrexol metabolite are active
- Naltrexone and 6-beta-naltrexol are not metabolized by cytochrome P450 enzymes
- Naltrexone and its metabolites are excreted primarily by the kidney
- Bupropion is extensively metabolized
- CYP2B6 is the principal isozyme involved in the formation of hydroxybupropion, whereas cytochrome P450 isozymes are not involved in the formation of the other active metabolites
- Bupropion and its metabolites inhibit CYP2D6
- Following oral administration of 200 mg of 14C-bupropion in humans, 87 percent and 10 percent of the radioactive dose were recovered in the urine and feces, respectively

Reference/s: [243,248,249,255]

Obesity Medicine Association

Naltrexone HCL/Bupropion HCL Extended Release

Most common adverse reactions

- Nausea
- Constipation
- Headache
- Vomiting
- Dizziness
- Insomnia
- Dry mouth
- Diarrhea

Contra-indications

- Uncontrolled hypertension
- Seizure disorders, anorexia nervosa or bulimia, or undergoing abrupt discontinuation of alcohol, benzodiazepines, barbiturates, and antiepileptic drugs
- Use of other products containing bupropion
- Chronic opioid use
- During or within 14 days of taking monoamine oxidase inhibitors
- Known allergy to any of its ingredients
- Contra-indicated during pregnancy or nursing mothers (pregnancy category X)

Reference/s: [243,248,249,255]

Obesity Medicine Association

Naltrexone HCL/Bupropion HCL Extended Release

Warnings

- Monitor for depression or suicidal thoughts and discontinue if these symptoms develop
- Risk of seizure may be minimized by adhering to the recommended dosing schedule and avoiding co-administration with high-fat meals
- Monitor blood pressure and heart rate in all patients, especially those with cardiac or cerebrovascular disease
- Hepatotoxicity: Cases of hepatitis and clinically significant liver dysfunction observed with naltrexone exposure
- Angle-closure glaucoma has occurred in patients with untreated anatomically narrow angles treated with antidepressants
- Weight loss may cause hypoglycemia in patients treated with anti-diabetes mellitus medications. Glucose levels should be monitored.

Reference/s: [243,248,249,255]

Obesity Medicine Association

Liraglutide*

Indications and Use

- Liraglutide is a glucagon-like peptide-1 (GLP-1) receptor agonist
- Drug Enforcement Agency Schedule: Not a scheduled drug
- Solution for subcutaneous injection, pre-filled, multi-dose pen that delivers doses of 0.6 mg, 1.2 mg, 1.8 mg, 2.4 mg, or 3 mg
- Inject subcutaneously in the abdomen, thigh, or upper arm; the injection site and timing can be changed without dose adjustment
- Recommended dose of liraglutide for treatment of obesity is 3 mg daily, any time of day, without regard to the timing of meals
- Dosing:
  - Week 1 = 0.6 mg per day
  - Week 2 = 1.2 mg per day
  - Week 3 = 1.8 mg per day
  - Week 4 = 2.4 mg per day
  - Week 5 and onward = 3.0 mg per day

*Liraglutide for obesity was approved by the Food and Drug Administration (FDA) with a Risk Evaluation and Mitigation Strategy (REMS) program. While optional and not required prior to prescribing Liraglutide for obesity, the manufacturer provides a communication plan, implemented towards healthcare providers likely to prescribe Liraglutide for obesity. The goal is to inform healthcare providers about the potential risk of medullary thyroid carcinoma and the risk of acute pancreatitis (including necrotizing pancreatitis) associated with Liraglutide for obesity.

*Evaluate the change in body weight after 16 weeks and discontinue Liraglutide for obesity if the patient has not lost at least 4% of baseline body weight since it is unlikely that the patient will achieve and sustain clinically meaningful weight loss with continued treatment.

Reference/s: [243,248,249,256]

Obesity Medicine Association

Liraglutide

Potential Drug Interactions

- Liraglutide delays gastric emptying. This may impact absorption of concomitantly administered oral medications.
- Liraglutide has low potential for pharmacokinetic drug-to-drug interactions related to cytochrome P450 and plasma-protein binding

Pharmacokinetics

- Unlike native GLP-1, liraglutide is stable against metabolic degradation by both peptidases and has a plasma half-life of 13 hours after subcutaneous administration
- Liraglutide exposures are similar among three subcutaneous injection sites (upper arm, abdomen, and thigh); absolute bioavailability of liraglutide following subcutaneous administration is approximately 55 percent
- Liraglutide is endogenously metabolized similar to large proteins without a specific organ as a major route of elimination
- Following a [3H]-liraglutide dose, intact liraglutide is not detected in urine or feces, with only a minor part excreted as liraglutide-related metabolites in urine or feces (6 percent and 5 percent, respectively)

Reference/s: [243,248,249,256]

Obesity Medicine Association

Liraglutide

Most common adverse reactions

- Nausea
- Hypoglycemia
- Diarrhea
- Constipation
- Vomiting
- Headache
- Decreased appetite
- Dyspepsia
- Fatigue
- Dizziness
- Abdominal pain
- Increased lipase

Contra-indications

- Personal or family history of medullary thyroid carcinoma or Multiple Endocrine Neoplasia syndrome type 2
- Hypersensitivity to liraglutide or any product components
- Pregnancy

Reference/s: [243,248,249,256]

Obesity Medicine Association

Liraglutide

Warnings

- Counsel patients regarding the risk of medullary thyroid carcinoma (thyroid C-cell tumors) and the symptoms of thyroid tumors
- Discontinue promptly if pancreatitis is suspected; do not restart if pancreatitis is confirmed
- If cholelithiasis or cholecystitis are suspected, gallbladder studies are indicated
- Serious hypoglycemia can occur when liraglutide is used with an insulin secretagogue (i.e., a sulfonylurea)
  - Consider lowering the dose of anti-diabetes drugs to reduce the risk of hypoglycemia
- Monitor heart rate at regular intervals to evaluate for possible heart rate increase
- Renal impairment has been reported post-marketing, usually in association with nausea, vomiting, diarrhea, or dehydration, which may sometimes require hemodialysis
  - Use caution when initiating or escalating doses of liraglutide in patients with renal impairment
- Post-marketing reports exist regarding serious hypersensitivity reactions (e.g., anaphylactic reactions and angioedema)
  - If these occur, then liraglutide and other suspect medications should be discontinued, and the patient instructed to promptly seek medical advice
- Monitor for depression or suicidal thoughts and discontinue liraglutide if symptoms develop

Reference/s: [243,248,249,256]

Obesity Medicine Association

Early versus Late Weight-Management Intervention: Illustrative Consequences

Early Treatment/Prevention

44-year-old woman with overweight/obesity

- Pre-diabetes mellitus
- Pre-hypertension
- Mild dyslipidemia
- Discomfort to weight-bearing joints
- Mild snoring
- Low self-esteem due to increased body weight

Optimal Treatment Strategy

Decide to engage in early, proactive interventions intended to *prevent* onset of adverse health consequences from sick fat disease (diabetes mellitus, dyslipidemia, and hypertension) and fat mass disease (osteoarthritis):

- Optimize nutritional therapy and physical activity
- Initiate behavioral therapy
- Consider anti-obesity medications
- Consider bariatric surgery

Prevent onset of metabolic disease:

- Diabetes mellitus
- Dyslipidemia
- Hypertension

Prevent fat mass diseases:

- Osteoarthritis
- Sleep apnea
- Depression

Reference/s: [33,257]

Obesity Medicine Association

Delayed Treatment

44-year-old woman with overweight/obesity

- Pre-diabetes mellitus
- Pre-hypertension
- Mild dyslipidemia
- Discomfort to weight-bearing joints
- Mild snoring
- Low self-esteem due to increased body weight

Sub-optimal Treatment Strategy

Simply tell the patient to diet and exercise and otherwise wait for the onset of diabetes mellitus, dyslipidemia, hypertension, osteoarthritis, sleep apnea, and depression. Once adverse health consequences are blatantly apparent:

- Optimize nutritional therapy and physical activity
- Initiate behavioral therapy
- Consider anti-obesity medications
- Consider bariatric surgery

Continued…

Reference/s: [19,70,243,258-262]

Obesity Medicine Association

Delayed Treatment

If optimal intervention for obesity treatment and prevention is delayed, and the patient develops adverse consequences:

- Follow diabetes mellitus evaluation and treatment guidelines
  - American Diabetes Association Clinical Practice Recommendations
  - American Association of Clinical Endocrinology Comprehensive Diabetes Management Algorithm
- Follow lipid evaluation and treatment recommendations and guidelines
  - National Lipid Association Dyslipidemia Summary and Recommendations
  - American College of Cardiology/American Heart Association Cholesterol Guidelines
- Follow blood pressure guidelines
  - Report of the Joint National Committee for Management of High Blood Pressure in Adults
- Follow other disease-specific guidelines
- Utilize diabetes mellitus therapies most likely to improve adipose tissue function
- In patients with fat mass disease, utilize diabetes mellitus therapies having neutral or body weight loss effects, such as metformin, glucagon-like peptide-1 (GLP-1) agonists, sodium glucose contransporter-2 (SGLT2) inhibitors, etc.
- Utilize lipid therapies most likely to reduce atherosclerotic coronary heart disease risk and least likely to increase body weight
- Utilize blood pressure therapy most likely to reduce cardiovascular disease risk, which may also provide other health benefits (e.g. diuretics, angiotensin converting enzyme inhibitors, etc.)
- Utilize non-steroidal anti-inflammatory agents to treat osteoarthritis
- Treat sleep apnea
- Utilize anti-depressant medications least likely to promote further weight gain
- Administer additional pharmaceuticals and/or treatment modalities as indicated

Reference/s: [19,70,243,258-263]

Obesity Medicine Association

Bariatric Surgery

GI Hormone Regulation of Caloric Balance, Food Digestion, and Nutrient Utilization

Before eating (during fasting): GI hormones may increase hunger

- Ghrelin
- Neuropeptide Y

Reference/s: [32,264]

Obesity Medicine Association

GI Hormone Regulation of Caloric Balance, Food Digestion, and Nutrient Utilization

After eating: GI hormones may decrease hunger/promote satiety

- Somatostatin
- Cholecystokinin
- Motilin
- Insulin
- Glucagon
- Pancreatic polypeptide

- Amylin
- Fibroblast growth factor19
- Glucagon like peptide-1
- Oxyntomodulin
- Peptide YY

Reference/s: [32,264]

Obesity Medicine Association

GI Hormone Regulation of Caloric Balance, Food Digestion, and Nutrient Utilization

After eating: GI hormones may help manage digestion through slowed gastric motility/emptying

- Cholecystokinin
- Amylin
- Glucagon like peptide-1
- Oxyntomodulin
- Peptide YY

Reference/s: [32,264]

Obesity Medicine Association

GI Hormone Regulation of Caloric Balance, Food Digestion, and Nutrient Utilization

After eating: GI hormones may stimulate the release of digestive enzymes

- Gastrin
- Cholecystokinin
- Secretin

Reference/s: [32,264]

Obesity Medicine Association

GI Hormone Regulation of Caloric Balance, Food Digestion, and Nutrient Utilization

After eating: GI hormones may have counter-regulatory functions impairing digestive enzyme release

- Somatostatin
- Secretin
- Pancreatic polypeptide
- Glucagon like peptide-2
- Oxyntomodulin
- Peptide YY

Reference/s: [32,264]

Obesity Medicine Association

GI Hormone Regulation of Caloric Balance, Food Digestion, and Nutrient Utilization

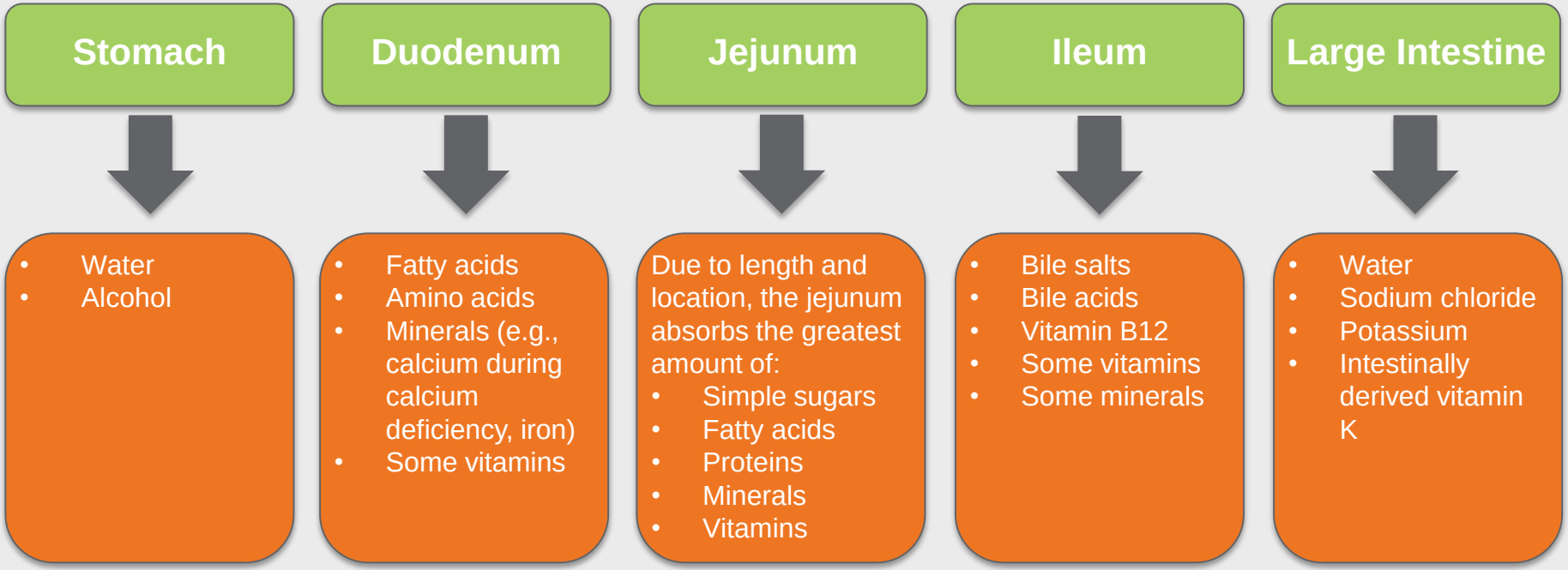
After eating: GI hormones may assist with post-absorptive nutrient management

- Somatostatin
- Insulin
- Glucagon
- Fibroblast growth factor19

Reference/s: [32,264]

Obesity Medicine Association

Nutrient Absorption



Reference/s: [32,264]

Potential Bariatric Surgery Patient

Does clinical evidence exist that the increase in body fat is pathogenic?

Did the patient make reasonable attempts to reduce body weight and improve health?

Was the patient evaluated by a physician trained in comprehensive management of overweight and obesity (e.g., certified by the American Board of Obesity Medicine)?

Does the patient demonstrate a commitment to follow post-operative recommendations, maintain necessary lifestyle changes and agree to life-long post-operative medical surveillance?

What are the specific insurance criteria that need to be met (e.g., documentation of prior unsuccessful weight loss attempts)?

- Surgical Candidate
  - Consider bariatric surgery *and* continue medical obesity management
- Non-surgical Candidate
  - Initiate, continue and/or intensify medical obesity management

Reference/s: [265-267]

Obesity Medicine Association

Bariatric Surgery

Regardless of the bariatric surgical procedure chosen, the surgery is best performed by an appropriately trained surgeon at an accredited surgery center.

The accreditation of a bariatric surgery center is determined by the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP).

Reference/s: [268]

Obesity Medicine Association

Potential Bariatric Surgery Candidate

What is the patient's BMI (in kg/m^2)?

Does clinical evidence exist confirming the presence of adverse health consequences (AHC) due to excessive and/or dysfunctional body fat?

- BMI ≥ 35 with one or more AHC
- BMI ≥ 40 with or without AHC

*BMI 30-34.9 with one or more AHC: Mounting evidence supports surgical intervention as a treatment option in this group

Reference/s: [13, 265-267, 269-274]

Obesity Medicine Association

Bariatric Surgery Pre-operative Evaluation

- Medical evaluation by physician specializing in the care of patients with overweight or obesity
- Surgical consultation by bariatric surgery specialist
- Cardiology, pulmonary, gastroenterology, and/or other specialty consultation as indicated
- Mental health assessment: underlying eating disorders; mood disorders; substance abuse; history of physical or emotional trauma; education regarding potential for increased suicide risk and transfer addictions post op; evaluation of existing coping mechanisms
- Nutritional assessment (e.g., dietitian)
- Educational support (e.g., pre-operative seminar)

Reference/s: [267]

Excess Weight Loss

- “Excess weight loss” is a term, mainly used in the surgical literature, to describe the percent amount of weight lost in excess of ideal body weight
- May have variances based upon how ideal body weight is determined
- It is challenging to directly compare “excess weight loss” often described in the surgical literature to the “weight loss” described in the medical literature, which is simply the percent of weight loss from baseline
- For the same amount of actual weight loss, the percent “excess weight loss” is often a higher reported value compared to “weight loss”

Reference/s: [275]

Obesity Medicine Association

Bariatric Surgical Procedures

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

*Excess body weight (EBW) = (total body weight) - (lean body weight)

Reference/s: [276,277]

Roux-en-Y Gastric Bypass (RNY)

A surgical procedure wherein the stomach is completely divided into a small proximal gastric pouch leaving a large “bypassed” gastric remnant in situ. The proximal gastric pouch is attached to a “roux” limb of small bowel, bypassing the large gastric remnant, all of the duodenum, and a portion of the proximal small intestine.

General

- Hospital stay = 1-4 days
- Recovery = 1-2 weeks
- Contra-indications:
  - Poor surgical candidate
  - Severe psychiatric disorder
  - Intolerance to general anesthesia
  - Pregnancy
  - Drug or alcohol addiction
  - Untreated gastric ulcer
  - Crohn’s disease
- Patient demonstrates an unwillingness or an inability to follow long term recommendations which can lead to life threatening micronutrient deficiencies

Most Common Acute Complications

- Nausea/Vomiting
- Dehydration
- Gastrointestinal obstruction
- Gastrointestinal bleeding
- Acute gout exacerbation
- Anastomotic leaks
- Infection
- Cardiac dysrhythmias
- Atelectasis and pneumonia
- Deep vein thrombosis
- Pulmonary emboli
- Death

Reference/s: [267, 278-280]

Obesity Medicine Association

Roux-en-Y Gastric Bypass (RNY)

Common Chronic Complications

- Weight regain
- Pouch/Anastomotic dilation
- Anastomotic/Marginal ulcers
- Esophageal dilation
- Dumping syndrome with reactive hypoglycemia
- Small bowel obstruction caused by internal hernias or adhesions
- Anastomotic stenosis/stricture
- Gallstones
- Calcium deficiency
- Secondary hyperparathyroidism
- Bacterial overgrowth
- Kidney stones (oxalosis)
- Metabolic acidosis
- Iron deficiency
- Protein malnutrition
- Other nutritional and mineral deficiencies (i.e., deficiencies of vitamins A, C, D, E, B, and K, folate, zinc, magnesium, thiamine)
- Anemia (often related to mineral and nutrition deficiencies)
- Neuropathies (resulting from nutritional deficiencies)
- Gout exacerbation
- Osteoporosis (often caused by calcium deficiency and chronically elevated parathyroid hormone levels)
- Depression
- Potential need for revision or conversion to another procedure

Reference/s: [267, 278-280]

Obesity Medicine Association

Vertical Sleeve Gastrectomy (VSG)

A surgical procedure wherein the stomach is reduced to about 25 percent of its original size by the surgical removal of a large portion of the stomach along the greater curvature, resulting in a narrower sleeve or tube-like structure.

General

- Hospital stay = 1-2 days
- Recovery = 1-2 weeks
- Contra-indications:
  - Poor surgical candidate
  - Severe psychiatric disorder
  - Intolerance to general anesthesia
  - Pregnancy
  - Drug or alcohol addiction
  - Untreated gastric ulcer
  - Barrett's esophagus
  - Achalasia
  - Previous gastrectomy
  - Previous gastric bypass
- Sometimes used as a staged approach to gastric bypass or doudenal switch

Most Common Acute Complications

- Nausea/Vomiting
- Dehydration
- Gastrointestinal obstruction
- Gastrointestinal bleeding
- Staple line leaks
- Infection
- GERD
- Cardiac dysrhythmias
- Atelectasis and pneumonia
- Deep vein thrombosis
- Pulmonary emboli
- Death

Reference/s: [276, 281]

Obesity Medicine Association

Vertical Sleeve Gastrectomy (VSG)

Most Common Chronic Complications

- Weight regain or lack of long-term weight loss
- Sleeve dilation
- Gastric ulcers
- Worsening GERD or de novo GERD
- Luminal stenosis/strictures
- Alkaline reflux gastritis
- Staple line leaks
- Fistula formation
- Gallstones
- Calcium deficiency
- Secondary hyperparathyroidism
- Iron deficiency
- Anemia (related to mineral and nutrition deficiencies)
- B12 & B1 deficiency(IF)
- Protein malnutrition uncommon
- Vitamin deficiencies uncommon
- Kidney stones (oxalosis)
- Depression
- Potential need for revision or conversion to another procedure

Reference/s: [276,281]

Obesity Medicine Association

Laparoscopic Adjustable Gastric Banding (LAGB)

A surgical procedure where an adjustable band is placed around the upper stomach creating a small pouch. The band diameter is adjustable through the percutaneous introduction of saline via a subcutaneous port which is accessed in the upper abdomen.

**Performance of LAGB has declined due to limited long-term efficacy and international removal rate of at least 25 percent at five years.*

General

- Outpatient procedure
- Recovery usually one week
- Food bolus obstruction (dry meat; starches)
- Contra-indications:
  - Poor surgical candidate
  - Severe psychiatric disorder
  - Intolerance to general anesthesia
  - Pregnancy
  - Drug or alcohol addiction
  - Untreated gastric ulcer, severe GERD, Barrett's disease
  - Autoimmune disease

Reference/s: [282,283]

Laparoscopic Adjustable Gastric Banding (LAGB)

Most Common Acute Complications

- Nausea/vomiting
- Dehydration
- Band too tight with gastrointestinal obstructive symptoms (i.e., dysphagia)
- Hemorrhage
- Gastrointestinal bleeding
- Infection
- Cardiac dysrhythmias
- Atelectasis and pneumonia
- Deep vein thrombosis

Most Common Chronic Complications

- No weight loss or weight regain
- Band slippage, erosion, ulceration, port infection, disconnection, and displacement
- Esophageal dilation
- Rare nutrient deficiencies if persistent vomiting or marked and sustained decrease in nutritional intake
- Depression
- Potential need for removal, revision or conversion to another procedure

Reference/s: [282,283]

Obesity Medicine Association

Biliopancreatic Diversion with Duodenal Switch (BPD/DS)

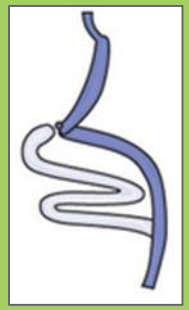
Procedure in which a partial gastrectomy (much like a sleeve) is performed, removing 70-80% greater curvature of the stomach sparing the pylorus and a small portion of the duodenum and the creation of a Roux-en-Y duodenenterostomy bypassing a large portion of the intestine.

General

- Hospital stay = 2-4 days
- Recovery = 2-4 weeks
- Contra-indications:
  - Poor surgical candidate
  - Severe psychiatric disorder
  - Intolerance to general anesthesia
  - Pregnancy
  - Drug or alcohol addiction
  - Untreated gastric ulcer
  - Crohn's disease
- Patient demonstrates an unwillingness or an inability to follow long term recommendations which can lead to life threatening micronutrient deficiencies

Most Common Acute Complications

- Nausea/Vomiting
- Dehydration
- Gastrointestinal obstruction
- Gastrointestinal bleeding
- Acute gout exacerbation
- Anastomotic leaks
- Infection
- Cardiac dysrhythmias
- Atelectasis and pneumonia
- Deep vein thrombosis
- Pulmonary emboli
- Death



Reference/s: [284,285]

Biliopancreatic Diversion with Duodenal Switch (BPD/DS)

Most Common Chronic Complications

- Weight regain
- Pouch dilation
- Anastomotic/Marginal ulcers
- Small bowel obstruction caused by internal hernias or adhesions
- Anastomotic stenosis/stricture
- Gallstones
- Calcium deficiency
- Secondary hyperparathyroidism
- Bacterial overgrowth
- Kidney stones (oxalosis)
- Metabolic acidosis
- Iron deficiency
- Protein malnutrition*
- Other nutritional and mineral deficiencies (i.e., deficiencies of vitamins A, C, D, E, B, and K, folate, zinc, magnesium, thiamine)*
- Anemia (often related to mineral and nutrition deficiencies)
- Neuropathies* (resulting from nutritional deficiencies)
- Gout exacerbation
- Osteoporosis (often caused by calcium deficiency and chronically elevated parathyroid hormone levels)
- Depression
- Potential need for revision

*The BPD/DS has a much higher incidence of both macro- and micronutrient deficiencies compared to other bariatric surgeries.

Reference/s: [284,285]

Obesity Medicine Association

Other FDA-approved Bariatric Technologies

Modified Percutaneous Endoscopic Gastrostomy (PEG)

- Mechanism: Drains 30% of ingested meal
- Indication: Body mass index 35-55 kg/m^2
- Efficacy: 12% excess weight loss at one year
- Safety: Potential tube site inflammation/infection

Electrical Vagal Blocking System

- Mechanism: Pacemaker-like implantable device surgically placed under skin, with lead wires placed around the vagus nerve just above the stomach; blocks vagal impulses to brain resulting in decreased hunger and increased satiety
- Indication: Body mass index > 40 kg/m^2 or > 35 kg/m^2 among those with adverse consequences of obesity
- Efficacy: 8.5% excess weight loss
- Safety: Potential gastroparesis (vagal trunk injury or entrapment)

Reference/s: [286,287]

Other FDA-approved Bariatric Technologies

Intragastric Balloons

- Mechanism: Balloon is inserted into stomach and filled
- Indication: Body mass index $\geq$ 30 and $\leq$ 40 kg/m^2; approved for up to 6 months
- Efficacy: 12-31% excess weight loss over 6 months
- Safety: Stomach blockage with uncomfortable fullness, vomiting, stomach ulcer, gastric hypertrophy

Endoscopic Plication Devices

- Mechanism: Endoscopic suturing of the stomach reduces gastric volume
- Indication: Investigational
- Efficacy: 30-50% excess weight loss for up to 1-2 years
- Safety: Stitch failure with weight regain

Reference/s: [286,287]

Bariatric Surgery: Early Complications (First 30 Days)

The complications listed here are unique to bariatric surgery and not inclusive of more general post-operative complications that can occur (e.g., pneumonia, PE).

Leak or Perforation (Typically after RNY, BPD/DS, VSG):

- Can lead to acute peritonitis
- Technical failure within the first 72 hours (with ischemia can occur up to 14 days post-op)
- Can also occur at any time due to ulcer perforation (avoid NSAIDS, steroids, nicotine, caffeine, alcohol)
- Often with acute and severe abdominal pain (may *NOT* have peritonitis symptoms if on steroids)
- Fever, tachycardia, abdominal or back pain, and leukocytosis
- Urgent surgical exploration may be required but can sometimes be managed with endoscopic stent and drain (in selected cases)
- Imaging not always diagnostic but when performed, water soluble contrast preferred (abdominal CT or Upper GI)
- *Immediate surgical consultation is critical for suspected leak or perforation EVEN if imaging is negative*

Reference/s: [292-293]

Obesity Medicine Association

Bariatric Surgery: Early Complications (First 30 Days)

The complications listed here are unique to bariatric surgery and not inclusive of more general post-operative complications that can occur (e.g., pneumonia, PE).

Bleeding at the Surgical Site or Rarely Intraluminal/Gastrointestinal (More Likely with RNY, BPD/DS, and VSG):

- Usually within 72 hours post-op, may require early intervention or reoperation
- Symptoms: tachycardia, hypotension, drop in hemoglobin/hematocrit, oliguria
- From three to seven days out, cause is more likely due to erosions and ulcerations at the anastomoses or along staple lines

Wound Infection (Possible after All Procedures):

- Abdominal pain, excessive drainage, fever/chills, decreased appetite, leukocytosis, change in bowel pattern
- Presence of intra-abdominal infection/abscess may require drainage percutaneously or by re-operation

Reference/s: [294]

Obesity Medicine Association

Bariatric Surgery: Late Complications (Beyond 30 Days)

The complications listed here are unique to bariatric surgery and not inclusive of more general post-operative complications that can occur (e.g., pneumonia, PE).

Gastro-gastric Fistula (RNY):

- Results in increased capacity to ingest food, and/or increased passing of food into the gastric remnant (where it is more completely digested and absorbed)
- Possible contributing factor to suboptimal weight loss/weight regain and recurrence of metabolic disease
- A non-healing ulcer should raise concern for a gastro-gastric fistula

Band Erosion through Gastric Wall into the Lumen (LAGB):

- Suspect if band is full but patient perceives no restriction or obstructive symptoms with empty or minimally filled band
- Can also present as infection with pain, fevers, leukocytosis
- Pain/infection may or may not be present
- Diagnose with EGD, surgical consult for removal is required for eroded band

Reference/s: [295-297]

Obesity Medicine Association

Bariatric Surgery: Late Complications (Beyond 30 Days)

The complications listed here are unique to bariatric surgery and not inclusive of more general post-operative complications that can occur (e.g., pneumonia, PE).

Incisional Hernias (More Common with Open Procedures):

- Pain at one of the incisional sites
- Maybe be palpable defect but due to body habitus this may be difficult to ascertain on exam and CT or US is needed to confirm
- Repair usually postponed until significant weight loss unless signs of bowel incarceration/strangulation (bowel obstruction)

Internal Hernias (RNY/BPD-DS):

- Usually accompanied by intermittent, post prandial pain and emesis, sometimes only pain
- Herniation through defect in the mesentery created during the surgical procedure
- Challenging to diagnose both clinically and radiographically- if suspected, diagnostic laparoscopy often needed
- *Surgical emergency if sudden/acute onset*

Reference/s: [298,299]

Obesity Medicine Association

Bariatric Surgery: Early *or* Late Complications

The complications listed here are unique to bariatric surgery and not inclusive of more general post-operative complications that can occur (e.g., pneumonia, PE).

Intestinal (Small Bowel) Obstruction (RNY, BPD-DS, or Open Procedure):

- Abdominal pain, nausea/vomiting, (constipation/obstipation not present if partial)
- Usually six months or longer out from surgery but can be anytime
- May be associated with an internal hernia, narrowing of the roux limb due to scarring, intussusception, and/or adhesions
- Evaluation: CT scan abdomen most common but can also be seen on plain flat/upright abdominal x-rays

Stricture (Stomal Stenosis) (RNY or BPD-DS):

- Post-prandial, epigastric abdominal pain and vomiting (often with frothy emesis)
- Usually 4-6 weeks following RNY
- May result from narrowing of the anastomosis or angulation of the intestinal limbs
- May be associated with anastomotic ulcer (RNY and BPD-DS)
- EGD +/- balloon dilation. Surgery only after multiple failed dilations

Band Obstruction: Band Too Tight, Band Slip/Prolapse (LAGB):

- Abdominal pain, reflux, and regurgitation of undigested food which occurs post-prandially
- Weight gain can occur due to dependence on liquid calories
- Diagnostic testing: Can be clinical diagnosis, or upper GI imaging/EGD
- Surgery indicated for a slip which is not relieved after the complete removal of all band fluid

Reference/s: [297,300-303]

Obesity Medicine Association

Bariatric Surgery: Early *or* Late Complications

The complications listed here are unique to bariatric surgery and not inclusive of more general post-operative complications that can occur (e.g., pneumonia, PE).

Dumping Syndrome (RNY):

- Unique complication of RNY (due to bypass of the pyloric emptying mechanism), which is common in the first 18 months postoperatively
- Occurs in approximately 70-85 percent of patients with RNY
- Symptoms: facial flushing, lightheadedness, fatigue, reactive hypoglycemia, and postprandial diarrhea
- Treatment: often includes avoidance of foods with high glycemic index/load, avoidance of drinking fluid with meals

Gallbladder or Gallstone Disease:

- Right upper quadrant or epigastric post-prandial or nocturnal pain (classically radiating to back or right shoulder)
- Diagnostic testing includes labs (if elevated white blood cell count, alkaline phosphatase, bilirubin, liver transaminases, or amylase lipase send to Emergency Room for urgent surgical consult)
- Imaging: Abdominal ultrasound (abdominal CT if abdominal wall thickness impairs ultrasound), consider HIDA scan if ultrasound is negative

Marginal Ulcer (at an anastomotic site-most common with RNY)

- Abdominal pain +/- vomiting
- Must stop NSAIDS, steroids, nicotine, caffeine, alcohol, and/or illicit drugs to heal
- Proton pump inhibitor 3 times/day plus Carafate 4 times/day; optimize protein intake; surgery for failed refractory ulcer
- Diagnose with upper endoscopy, consider surgery for refractory disease

Reference/s: [279,304,305]

Obesity Medicine Association

Bariatric Surgery: Common Micronutrient Deficiencies

	Vitamins							Minerals		
	A	B1	B9	B12	D*	E	K	Ca	Fe	Zn/Cu
RNY		X	X	X	X			X	X	
Sleeve		X	X	X	X				X	
LAGB		X			X					
BPD	X	X	X	X	X	X	X	X	X	X

*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.

For a complete explanation of micronutrient deficiencies, refer to “Clinical Practice Guidelines for the Perioperative Nutritional, Metabolic, and Nonsurgical Support of the Bariatric Surgery Patient” at www.asmbs.org.

Reference/s: [264,307]

Obesity Medicine Association

Micronutrients: Vitamins

Derived from plant and animal foods, and necessary for metabolic processes, such as serving as a non-protein facilitator (coenzyme) for protein enzymes.

Reference/s: [264]

Vitamin A Deficiency

Background

- Vitamin A is an essential fat-soluble nutrient important for vision
- Vitamin A deficiency may lead to night blindness
- Vitamin A is also involved with adipocyte function, as well as lipid and possibly glucose metabolism

Bariatric Surgery

- Vitamin A deficiency is rarely reported after laparoscopic adjustable gastric banding, gastric sleeve, or Roux-en-Y gastric bypass
- Vitamin A deficiency is reasonably common with biliopancreatic diversion/duodenal switch
- Retinol levels are often routinely monitored after biliopancreatic diversion/duodenal switch

Reference/s: [264]

Obesity Medicine Association

Vitamin B1 (Thiamine) Deficiency

Background

- Vitamin B1/thiamine is an essential water-soluble nutrient involved in cellular processes such as mitochondrial function (fatty acid oxidation)
- Vitamin B1 deficiency is known as beriberi, which may present as weakness
- “Dry” beriberi includes Wernicke-Korsakoff encephalopathy (e.g., ophthalmoplegia, dementia, ataxia, amnesia)
- “Wet” beriberi includes congestive heart failure
- Patients with alcoholism are at risk for Vitamin B1 deficiency

Bariatric Surgery

- Preoperative thiamine deficiency is more common in African-American and Hispanic patients
- Vitamin B1 deficiency is sometimes reported after laparoscopic adjustable gastric banding, gastric sleeve, Roux-en-Y gastric bypass, or biliopancreatic diversion/duodenal switch
- The risk of thiamine deficiency is increased with post-operative vomiting, which sometimes requires monitoring post-operative thiamine levels

Reference/s: [264]

Obesity Medicine Association

Vitamin B2 (Riboflavin) Deficiency

Background

- Vitamin B2/riboflavin is an essential water-soluble nutrient involved with many cellular processes
- Its deficiency may cause a distinctive bright pink tongue, cracked lips, throat swelling, scleral erythema, lowered blood cell count, coma, and death

Bariatric Surgery

- Vitamin B2 deficiency is rarely reported after laparoscopic adjustable gastric banding, sleeve gastrectomy, Roux-en-Y gastric bypass, or biliopancreatic diversion / duodenal switch
- Vitamin B2 deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative riboflavin levels are usually monitored only with signs and symptoms of deficiency

Reference/s: [264]

Obesity Medicine Association

Vitamin B3 (Niacin) Deficiency

Background

- Vitamin B3/niacin is an essential water-soluble nutrient highly expressed in adipose tissue
- Niacin deficiency is known as pellagra
- Presentation includes the “4 Ds” of diarrhea, dermatitis, dementia, and death
- Mainly located in sun-exposed areas, the dermatologic manifestations include erythema, desquamation, scaling, and keratosis

Bariatric Surgery

- Vitamin B3 deficiency is rarely reported with laparoscopic adjustable gastric banding, sleeve gastrectomy, Roux-en-Y gastric bypass, or biliopancreatic diversion/duodenal switch
- Vitamin B3 deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative niacin levels are usually monitored only if signs and symptoms of deficiency

Reference/s: [264]

Obesity Medicine Association

Vitamin B5 (Pantothenic Acid) Deficiency

Background

- Vitamin B5/pantothenic acid is an essential water-soluble nutrient used to synthesize coenzyme-A, as well as proteins, carbohydrates, and fats
- Pantothenic acid is derived from a Greek word meaning “from everywhere,” is found in most foods, and its deficiency may cause numerous, wide-ranging adverse effects, such as paresthesias and other signs and symptoms

Bariatric Surgery

- Vitamin B5 deficiency is rarely reported with laparoscopic adjustable gastric banding, sleeve gastrectomy, Roux-en-Y gastric bypass, or biliopancreatic diversion / duodenal switch
- Vitamin B5 deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative pantothenic acid levels are usually monitored only if signs and symptoms of deficiency

Reference/s: [264]

Obesity Medicine Association

Vitamin B6 (Pyridoxine) Deficiency

Background

- Vitamin B6/pyridoxine is an essential water-soluble nutrient important for nutrient metabolism and neurologic function
- Pyridoxine deficiency can cause skin eruptions resembling seborrheic dermatitis, intertrigo, atrophic glossitis, angular cheilitis, conjunctivitis, sideroblastic anemia, and neurologic symptoms (e.g., somnolence, confusion, and peripheral neuropathy)

Bariatric Surgery

- Vitamin B6 deficiency is rarely reported with either laparoscopic adjustable gastric banding, sleeve gastrectomy, Roux-en-Y gastric bypass, or biliopancreatic diversion / duodenal switch
- Vitamin B6 deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative pyridoxine levels are usually monitored only if signs and symptoms of deficiency

Reference/s: [264]

Obesity Medicine Association

Vitamin B7 (Biotin) Deficiency

Background

- Vitamin B7/biotin is an essential water-soluble nutrient important in fatty acid synthesis, amino acid catabolism, and gluconeogenesis
- Biotin is usually produced in more than adequate amounts by intestinal bacteria
- Biotin deficiency causes hair loss, conjunctivitis, scaly/erythematous rash (around eyes, nose, mouth, and genital area), anemia, and central/peripheral nervous system disorders
- Biotin deficiency can be exacerbated by consumption of raw eggs, which bind vitamin B7, making it relatively inactive

Bariatric Surgery

- Vitamin B7 deficiency is rarely reported with laparoscopic adjustable gastric banding, sleeve gastrectomy, Roux-en-Y gastric bypass, or biliopancreatic diversion / duodenal switch
- Vitamin B7 deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative pyridoxine levels are usually monitored only if signs and symptoms of deficiency

Reference/s: [264]

Obesity Medicine Association

Vitamin B9 (Folate) Deficiency

Background

- Vitamin B9/folic acid is an essential water-soluble nutrient absorbed in the duodenum and proximal jejunum
- Folic acid deficiency may cause megaloblastic anemia, as well as loss of appetite and weight loss
- Preconception folate deficiency is associated with fetal neural tube defects

Bariatric Surgery

- Vitamin B9 deficiency is sometimes reported with laparoscopic adjustable gastric banding, sleeve gastrectomy, Roux- en-Y gastric bypass, or biliopancreatic diversion / duodenal switch
- Vitamin B9 deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative folic acid levels (red blood cell folate) are often routinely monitored
- Folic acid supplements are often administered after bariatric surgeries, especially in premenopausal, menstruating women of childbearing potential

Reference/s: [264,308]

Obesity Medicine Association

Vitamin B12 (Cyanocobalamin) Deficiency

Background

- Vitamin B12/cyanocobalamin is an essential water-soluble nutrient cleaved from its protein by the hydrochloric acid in the stomach, then combined with a protein called intrinsic factor, and then absorbed in the terminal ileum
- Vitamin B12 deficiency may induce sterol regulatory element binding, protein-mediated cholesterol biosynthesis, and impaired metabolism of odd-chain fatty acids
- Vitamin B12 deficiency may also cause megaloblastic anemia and contribute to central nervous system disorders

Bariatric Surgery

- Vitamin B12 deficiency is commonly reported with laparoscopic adjustable gastric banding, sleeve gastrectomy, Roux-en-Y gastric bypass, or biliopancreatic diversion / duodenal switch
- Vitamin B12 deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative vitamin B12 levels are often routinely monitored
- Vitamin B12 supplements are often administered after bariatric surgeries

Reference/s: [264]

Obesity Medicine Association

Vitamin C Deficiency

Background

- Vitamin C is an essential water-soluble nutrient and cofactor for many enzymatic processes
- Vitamin deficiency is known as scurvy
- Signs and symptoms include lethargy, weight loss, dry hair and skin, bruising, bleeding gums, loss of teeth, fever, and death

Bariatric Surgery

- Vitamin C deficiency is rarely reported with laparoscopic adjustable gastric banding, sleeve gastrectomy, Roux-en-Y gastric bypass, or biliopancreatic diversion / duodenal switch
- Vitamin C deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative vitamin C levels are usually monitored only if signs and symptoms of deficiency

Reference/s: [264]

Obesity Medicine Association

Vitamin D Deficiency

Background

- Vitamin D is an essential fat-soluble nutrient important for calcium metabolism (and other minerals), bone health, and adipocyte function
- Vitamin D deficiency may result in decreased bone mineralization, osteopenia, secondary hyperparathyroidism, and hypocalcemia

Bariatric Surgery

- Vitamin D deficiency is common among pre-operative patients with overweight or obesity
- Vitamin D deficiency is rarely reported to worsen with laparoscopic adjustable gastric banding
- Vitamin D deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Vitamin D deficiency sometimes occurs with sleeve gastrectomy and Roux-en-Y gastric bypass and commonly occurs with biliopancreatic diversion/duodenal switch
- After bariatric procedures, 25-hydroxy- (OH)-vitamin D, calcium, phosphorous, and parathyroid hormone are often monitored post-operatively
- Calcium and vitamin supplements are commonly administered after bariatric surgeries

Reference/s: [264]

Obesity Medicine Association

Vitamin E Deficiency

Background

- Vitamin E is an essential fat-soluble nutrient important for antioxidant and enzymatic activities, and gene expressions, as well as neurologic function and adipocyte function
- Vitamin E deficiency may cause neuropathy and ataxia

Bariatric Surgery

- Vitamin E deficiency is rarely reported with laparoscopic adjustable gastric banding, sleeve gastrectomy, or Roux-en-Y gastric bypass.
- Vitamin E deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Vitamin E deficiency may more often occur in patients undergoing biliopancreatic diversion/duodenal switch
- Alpha-tocopherol levels are often routinely monitored after biliopancreatic diversion/duodenal switch.

Reference/s: [264]

Obesity Medicine Association

Vitamin K Deficiency

Background

- Vitamin K is an essential fat-soluble nutrient important for blood coagulation
- Vitamin K deficiency may cause bruising and increased risk for bleeding

Bariatric Surgery

- Vitamin K deficiency is rarely reported with laparoscopic adjustable gastric banding, sleeve gastrectomy, or Roux-en-Y gastric bypass
- Vitamin K deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Vitamin K deficiency is reasonably common with biliopancreatic diversion/duodenal switch
- Prothrombin time is often routinely measured after biliopancreatic diversion/duodenal switch

Reference/s: [264]

Obesity Medicine Association

Micronutrients: Minerals and Trace Elements

Minerals

- Non-organic substances necessary for important biological processes (e.g., vital part of an enzyme)
- Calcium, phosphorous, magnesium, potassium, and sodium

Trace Elements

- Non-organic substances required by the body for biological functions (e.g., vital part of an enzyme), but only in minute amounts
- Iron, cobalt, zinc, selenium, molybdenum, and iodine

Reference/s: [264]

Obesity Medicine Association

Calcium Deficiency

Background

- Calcium is an essential mineral necessary for proper nerve transmission, muscle contraction, bone structure, and cellular function
- Concurrent magnesium deficiency may worsen hypocalcemia by impairing parathyroid hormone secretion (hypomagnesemia may also promote hypokalemia)
- Calcium deficiency may result in decreased bone mineralization, osteopenia, and secondary hyperparathyroidism
- Severe hypocalcemia can lead to tetany (e.g., muscle contractions, spasms, paresthesias)

Bariatric Surgery

- Calcium deficiency is rarely reported with laparoscopic adjustable gastric banding
- Relative calcium deficiency is sometimes reported with gastric sleeve or Roux-en-Y gastric bypass, when assessed by elevated parathyroid levels (even if calcium levels are within normal limits)
- Calcium deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Calcium deficiency commonly occurs with biliopancreatic diversion/duodenal switch
- Although calcium levels may not be decreased in all patients with overweight or obesity, vitamin D deficiency may be present
- 25-hydroxy-(OH)-vitamin D, calcium, phosphorous, and parathyroid hormone are often monitored post-operatively
- Calcium and vitamin D supplements are commonly administered after bariatric surgeries

Reference/s: [264]

Obesity Medicine Association

Copper Deficiency

Background

- Copper is a trace element absorbed from the small intestine
- Copper deficiency (which may accompany iron deficiency) may clinically manifest by anemia, neuropathies, difficulty walking, increased muscle tone or spasticity, and cardiomegaly

Bariatric Surgery

- Copper deficiency is rarely reported with laparoscopic adjustable gastric banding, gastric sleeve, Roux-en-Y gastric bypass, or biliopancreatic diversion/duodenal switch
- Copper deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative copper levels are usually monitored only if signs and symptoms of deficiency

Reference/s: [264]

Iron Deficiency

Background

- Iron is a trace element and is normally absorbed in the duodenum and jejunum of the intestine
- Iron deficiency can result in microcytic anemia (possibly manifested clinically by pica), with low iron levels, low ferritin levels, and increased transferrin or total iron-binding capacity

Bariatric Surgery

- Iron deficiency is rarely reported with laparoscopic adjustable gastric banding
- Iron deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Iron deficiency commonly occurs with gastric sleeve, Roux-en-Y gastric bypass and biliopancreatic diversion/duodenal switch
- After bariatric procedures, iron, ferritin, transferrin, and total iron binding capacity are often monitored
- Iron supplements are often administered after bariatric surgeries, especially among premenopausal, menstruating women of childbearing potential

Reference/s: [264]

Obesity Medicine Association

Selenium Deficiency

Background

- Selenium is a trace element that helps protect cells from free radical damage
- Selenium deficiency may cause cardiomyopathy (Keshan disease)

Bariatric Surgery

- Selenium deficiency is rarely reported after laparoscopic adjustable gastric banding, gastric sleeve, Roux-en-Y gastric bypass, or biliopancreatic diversion/duodenal switch
- Selenium deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Post-operative selenium levels are usually monitored only if signs and symptoms of deficiency

Reference/s: [264]

Obesity Medicine Association

Zinc Deficiency

Background

- Zinc is a trace element and is important for intestinal mucosal function
- Zinc deficiency can cause poor wound healing, hair loss, acrodermatitis enteropathica-like rash, taste alterations, glossitis, and impaired folate absorption (potentially contributing to folic acid deficiency)

Bariatric Surgery

- Zinc deficiency is rarely reported after laparoscopic adjustable gastric banding
- Zinc deficiency can be mitigated with appropriate nutrition and a high-quality multivitamin supplement
- Zinc deficiency sometimes occurs with sleeve gastrectomy, Roux-en-Y gastric bypass and is common with biliopancreatic diversion/duodenal switch
- Post-operative zinc levels are usually monitored only if signs and symptoms of deficiency

Reference/s: [264]

Obesity Medicine Association

Nutritional Principles Following Bariatric Surgery

- Nutritional advice will depend upon type of bariatric procedure
- Three to five small meals a day
- Chew small bites of food thoroughly
- Avoid consuming liquids during meals, delay for at least 30 minutes after meals
- Protein: At least 60 grams/day, optimally 1.2 to 1.5 grams/kg/day
- Avoid concentrated sweets to minimize dumping and to reduce caloric intake
- High-quality multivitamins are routinely recommended after bariatric procedures, irrespective of deficiencies, which are often recommended to be chewable or liquid
- Other routine supplements often include:
  - Vitamin B12 500 µg/d tablet or sublingual, or 1000 µg/mo IM
  - Iron at least 27 mg of elemental iron daily, with at least 500 mg vitamin C
  - Calcium citrate 1200 mg/d, preferably with vitamin D

Reference/s: [264]

Micronutrient Deficiency Replacement after Bariatric Surgery: Vitamins/Minerals

Vitamin/ Mineral	Assessment	Replacement of Deficiency
Vitamin A	Retinol	• If corneal keratinization, ulceration or necrosis: 50-100,000 IU IM for 3 days, followed by IU IM for 2 weeks • If no corneal changes: 10-25,000 IU orally for 1-2 weeks • Further treatment depends on persistent malabsorptive effects, as may most be a concern with biliopancreatic diversion/duodenal switch
Vitamin B1 (Thiamine)	Thiamine	• If hyperemesis, then 100mg IV for 7 days, then 50 mg/d until thiamine in normal range
Vitamin B9 (Folate)	Red blood cell (RBC) folate	• If daily multivitamin has 400ug of folic acid, then replacement dose for deficiency is an additional 800 ug/d orally (total of 1200 ug/d of folic acid until RBC folate in normal range, and then a multivitamin with at least 400 ug/d of folic acid
B12 (Cobalamin)	Vitamin B12	• A typical dose to treat B12 deficiency 1000 ug/mo IM, 1000 ug/wk sublingually, or 350-500 ug/d orally until B12 in normal range
Calcium	Calcium	• In addition to ensuring adequate vitamin D, calcium deficiency is typically treated with calcium citrate 1200-1800 mg/d. Calcium citrate may be better absorbed than calcium carbonate • Calcium should be taken at least 1 hour apart from other supplements, especially iron
Iron	Ferritin, iron, total iron binding capacity	• For moderate deficiency, menstruating women, or patients at risk for iron deficiency anemia, total elemental iron intake (including in a multivitamin) should be 50-100 mg/d • Minimum iron supplementation should be 18 mg/d, which may be more effective with vitamin C supplementation 500 mg/d • For severe deficiency, IV iron is sometimes required, which is provided in multiple different formulations, some of which require test doses.

Reference/s: [264]

Obesity Medicine Association

Micronutrient Deficiency Replacement after Bariatric Surgery: Vitamins/Minerals

Vitamin/Mineral	Assessment	Replacement of Deficiency
Vitamin D	25-hydroxyl-(OH)-vitamin D	• A typical dose for mild deficiency of vit. D is 1000 IU/d after gastric bypass and 2000 IU/d after biliopancreatic diversion/duodenal switch • For severe deficiency, a single dose of vit. D 50,000 IU/wk orally can be given until vit. D levels in normal range, then 3000 IU if still with substantial malabsorptive signs and symptoms, of if stable, 1000 IU/d after gastric bypass and 2000 IU/d after biliopancreatic diversion/duodenal switch • Regarding formulation, vit. D2 (ergocalciferol) is a form of dietary vit. D found in plants. Vit.D3 (cholecalciferol) is found in foods of animal origin and is similar to the vit. D3 generated when 7-dehydrocholesterol in the skin is converted by ultraviolet radiation from sunlight. Both D2 and D3 are reported as 25-hydroxyvitamin D, which is then converted by the kidneys into the more active 1,25 dihydroxyvitamin D (calcitriol). Vit. D3 may be preferred (longer half-life and potentially more potent) than vit. D2. Although the most potent, calcitriol is more rarely used (.25 or .50 mcg/d orally)
Vitamin E	A-Tocopherol	• A typical dose to treat vitamin E deficiency is 400 to 800 IU/d orally.
Vitamin K	Prothrombin time	• If vitamin K deficiency occurs during substantial gastrointestinal malabsorption, then vitamin K can be replaced 10 mg by slow IV. Otherwise, typical oral replacement dose is 300 ug/d. Continued treatment depends on persistent malabsorptive effects, as may most be a concern with biliopancreatic diversion/duodenal switch.
Zinc	Zinc	• A typical replacement dose for zinc deficiency is 60 mg of elemental zinc twice daily. Zinc consumption may impair copper absorption, thus 1 mg of copper should be given per each 10 mg of zinc administered. Once zinc is in normal range, if malabsorption remains a risk, a typical supplemental dose is zinc 30 mg/d.

Reference/s: [264]

Obesity Medicine Association

Microbiome: Gut Flora Basics

Microbiome = Collection of micro-organisms

Microbiota = Organisms themselves

Reference/s: [32]

Obesity Medicine Association

Microbiome: Gut Flora Basics

- Humans organism has ~10 trillion human cells
- Human gut is colonized by 100 trillion cells (bacteria, fungi and viruses)
- Unless due to a pathogenic infection, the gut microbiome is usually neither healthy or unhealthy; the clinical implications are dependent upon the individual
  - Individuals who are underweight may benefit from microbiota that promote more efficient absorption of nutrients
  - Individuals who are overweight or with obesity may not benefit from microbiota that promote more efficient absorption of nutrients

Reference/s: [32]

Microbiome: Gut Flora Bacteria

- Over 1,000 bacterial species, with over 90% anaerobic
- Substrates: Sloughed intestinal cells, plant polysaccharides, starch cellulose, and bile components
- Functions include:
  - Metabolizing essential nutrients
  - Synthesizing vitamin K
  - Fermentation of sugars to acids, gasses, or alcohol
  - Digesting cellulose
  - Promoting angiogenesis
  - Enhancing enteric nerve function

Reference/s: [32]

Obesity Medicine Association

Microbiome: Gut Flora Bacteria

- Stomach and proximal small intestine = limited amounts of bacteria (e.g., acid-tolerant lactobacilli and streptococci bacteria)
- Ileum and colon = trillions of bacteria
- Major phyla of intestinal microbiome
  - Gram Negative Bacteroidetes: May assist with epithelial cell maturation and function
  - Gram Positive Firmicutes: May more efficiently extract calories from carbohydrates through fermentation of indigestible foods into short-chain fatty acids
- Obesity = Firmicutes proportionally increases compared to Bacteroidetes

Reference/s: [32]

Microbiome: Gut Microbiota Promotion of Increased Body Fat

Increased Nutrient Absorption

- Enhanced monosaccharide intestinal uptake through enriched carbohydrate enzymes in the gut (e.g., microbial glycoside hydrolases, polysaccharide lyases, and carbohydrate esterases)
- Increased fermentation of nutrients to short-chain fatty acids, which are absorbed and utilized for gluconeogenesis, lipogenesis, and which may increase the permeability of the intestinal epithelium, increasing absorption of macromolecules from the intestine
- Increased density of small intestinal villi capillaries allowing for greater nutrient absorption

Reference/s: [32]

Microbiome: Gut Microbiota Promotion of Increased Body Fat

Increased Lipogenesis

- Increased Sterol Regulatory Element Binding Protein-1 (SREBP-1) activity, promoting lipogenesis
- Reduced hepatic and muscle fatty acid oxidation

Reference/s: [32]

Obesity Medicine Association

Microbiome: Gut Microbiota Promotion of Increased Body Fat

Increased Inflammation

- Pro-inflammatory signaling, such as that generated in response to lipopolysaccharide component of bacterial outer membranes, may affect neurobehavioral brain centers, and adversely affect adipocyte function leading to adiposopathy and increased risk for metabolic disease

Reference/s: [32]

Obesity Medicine Association

Microbiome: Gut Microbiota Promotion of Increased Body Fat

Alterations in Bile Acid Metabolism

- Relationship between microbiota and bile acids are interdependent, with the types of bile acids delivered by the liver affecting the microbiome, and the microbiome affecting bile acid structure once in the gut, and thus affecting the types of bile acids composing the bile-acid pool
- Gut microbiota promotes bile acid deconjugation, dehydrogenation, and dehydroxylation, increasing the chemical diversity of intestinal and systemic bile acids
- Bile acids affect glucose and lipid metabolism via interactions with bile acid receptors such as farnesoid X receptor (FXR), takeda G protein coupled receptor 5 (TGR5), and fibroblast growth factor 19 (FGF19)

Reference/s: [32]

Microbiome: Gut Microbiota Promotion of Increased Body Fat

Alterations in Gut Hormones

- Suppressed secretion of fasting-induced adipose factor (angiopoietin-like protein), which may reduce adipose tissue fatty-acid oxidation, reduce uncoupling of the process of mitochondrial adipose tissue adenosine triphosphate generation, and reduce thermogenesis
- Decreased glucagon-like peptide 1, which may impair increased satiety after meals

Reference/s: [32]

Microbiome: “Favorable” Weight and Metabolic Effects of Bariatric Surgery

Bariatric Surgery May:

- Reduce availability of nutrients delivered to the gut
- Reduce lipogenic signaling (gut and systemic)
- Reduce inflammation (gut and systemic)
- Alter bile-acid metabolism and increase bile-acid pool favoring metabolic processes involving glucose and lipids
- Alter gut hormones favoring metabolic processes involving glucose and lipids
- Decrease the Firmicutes:Bacteroidetes ratio, potentially reducing the efficiency of extracting calories from gut carbohydrates

Reference/s: [32]

Obesity Medicine Association

Executive Summary

Assess for the Presence of Obesity, Adiposopathy, Fat Mass Disease

Obesity may be assessed using several criteria (thresholds vary based on gender and ethnic differences):

Body Mass Index (BMI)	18.5-24.9 kg/m^2	25.0-29.9 kg/m^2	≥30 kg/m^2
Percent Body Fat	Male: <25% Female: <32%		Male: >25% Female: >32%
Waist Circumference	Male: <40 in. Female: <35 in.		Male: >40 in. Female: >35 in.
Edmonton Obesity Staging System	Stage 0, 1, 2, 3, 4		

No Obesity	**Overweight**	**Obesity** Class I: BMI 30.0-34.9 Class II: BMI 35-39.9 Class III: BMI ≥ 40.0
Prevention	Primary care provider or dietitian	
	If treatment is ineffective, refer to an obesity medicine specialist.	Consider referring to an obesity medicine specialist.

Reference/s: [1]

Obesity Medicine Association

Assess for the Presence of Obesity, Adiposopathy, Fat Mass Disease

Body Mass Index	BMI = (weight in kg)/(height in m)^2 *OR* 703 x (weight in pounds)/(height in inches)^2
Percent Body Fat	Can be calculated using bio-impedance, near infrared reactance, DEXA scan or whole body air-displacement plethysmography.
Waist Circumference	Can be measured by tape measure around the abdomen at the level of the anterior superior iliac crests, parallel to the floor. Tape should be snug against skin without compressing.
Edmonton Obesity Staging System	STAGE 0: No apparent risk factors, no physical symptoms, functional limitations, and/or impairment of well-being STAGE 1: Presence of obesity-related subclinical risk factors, mild physical symptoms, mild psychopathology, mild functional limitations, and/or mild impairment of well-being STAGE 2: Presence of established obesity-related chronic disease, moderate psychopathology, moderate functional limitations, and/or impairment of well-being STAGE 3: Established end-organ damage, significant psychopathology, significant functional limitations, and/or impairment of well-being STAGE 4: Severe (potentially end-stage) disabilities from obesity-related chronic diseases, severe disabling psychopathology, severe functional limitations, and/or severe impairment of well-being

Obesity medicine specialists, certified by the American Board of Obesity Medicine, dedicate a portion or all of their practice to the treatment of obesity. They perform a medical evaluation (history, physical, laboratory, body composition) and provide medical supervision for lifestyle change (nutrition, activity, behavior change), medications, or very low-calorie diets. Obesity is a chronic medical disease and often requires lifelong treatment.

Reference/s: [1,309]

Obesity Medicine Association

Evaluation and Treatment Summary

Comprehensive Evaluation of the Patient with Overweight/Obesity

History	Weight history, past medical history, family history, social history, screening for weight-promoting medications, food intake, activity, review of systems
Physical Examination	Height, weight, blood pressure, body composition analysis, waist measurement, complete physical examination
Laboratory Tests*	Complete blood count, electrolytes, liver function, kidney function, fasting lipid profile, thyroid tests, hemoglobin A1c, uric acid, vitamin D
Diagnostic Testing*	EKG, echocardiogram, exercise stress test, sleep study, barium swallow or esophagoduodenoscopy

*lab and diagnostic testing should be individualized

Individualized Treatment Plans*

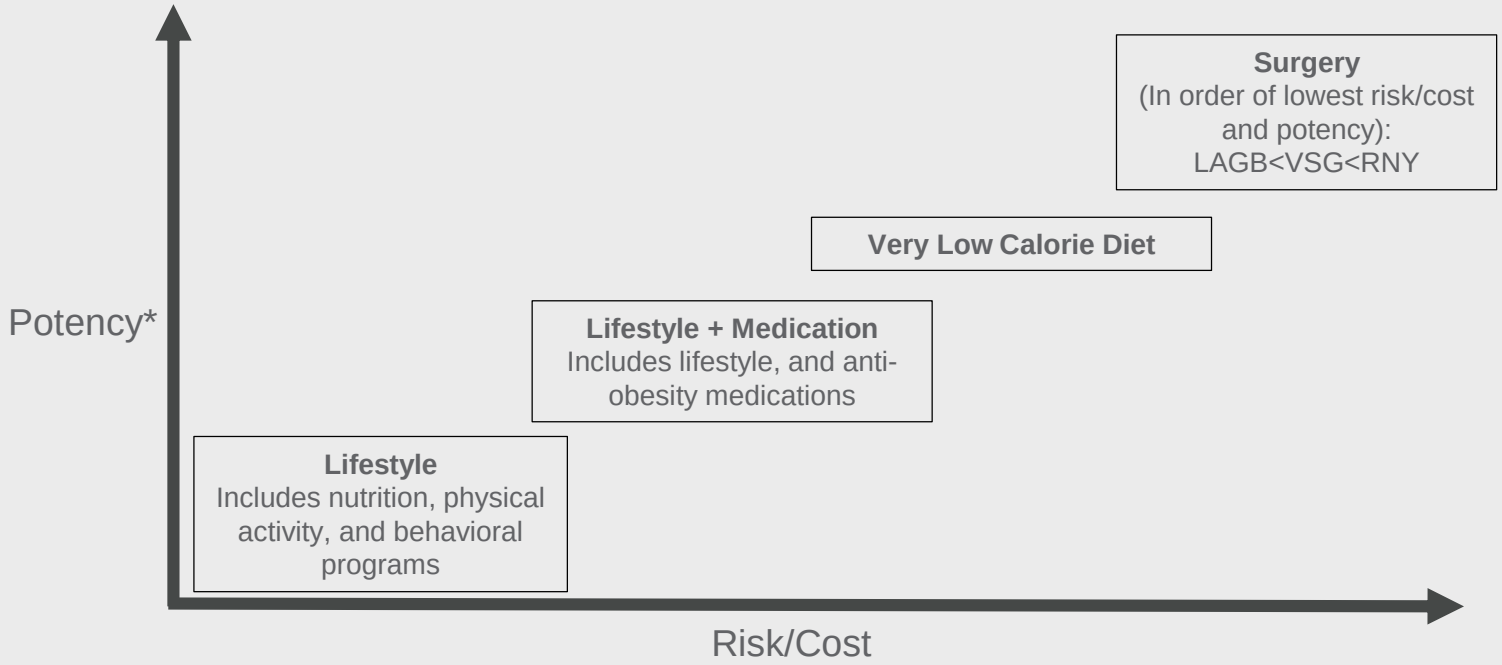
Diet	Use calorie restriction, carbohydrate restriction, food journaling, very low-calorie diet programs
Activity	Give exercise prescription, use pedometers, limit TV and computer time, decrease sedentary time, initial goal of 150 minutes per week of moderate-intensity physical activity
Counseling	Eliminate provider bias and stigma, identify self-sabotage, develop strong support, address stress management, sleep optimization, other psychological support as needed
Pharmacotherapy	Use pharmacotherapy as part of a comprehensive program
Referral	Consider referral to an obesity medicine specialist

*If ineffective, consider referral to a metabolic and bariatric surgeon. Optimal pre- and post-operative care includes an obesity medicine specialist.

Reference/s: [1]

Obesity Medicine Association

Current Treatment Options for Obesity



*Potency includes many factors, such as the amount, rate, and sustainability of weight loss, and the long-term resolution of adiposopathy and fat mass disease. Potency varies greatly for each individual (i.e., long-term adherence to a lifestyle program can be as potent as gastric bypass surgery).

Reference/s: [1]

Obesity Medicine Association

References

Journal References: 1-10

1. Bays HE, Seger JC, Primack C, McCarthy W, Long J, Schmidt SL, Daniel S, Horn DB,Westman EC: Obesity Algorithm, presented by the American Society of Bariatric Physicians. . 2016 - 2017. www.obesityalgorithm.org (Accessed = January 1, 2017)

2. Puhl R, Peterson JL,Luedicke J: Motivating or stigmatizing? Public perceptions of weight-related language used by health providers. Int J Obes (Lond) 2013 37:612-619

3. Ravussin E,Ryan D: Response to "The need for people-first language in our Obesity journal". Obesity (Silver Spring) 2015 23:918

4. National Institute of Diabetes and Digestive and Kidney Diseases. Health Information: Talking with patients about weight loss. https://www.niddk.nih.gov/health-information/health-topics/weight-control/medical/Pages/medical-care-for-patients-with-obesity.aspx (Accessed August 20, 2016).

5. American Society of Metabolic and Bariatric Surgeons Standards Manual version 2.0. Resources for Optimal Care of the Metabolic and Bariatric Surgery Patient 2016 https://www.facs.org/~/media/files/quality%20programs/bariatric/mbsaqip%20standardsmanual.ashx (Accessed September 10, 2016).

6. Bays H,Scinta W: Adiposopathy and epigenetics: an introduction to obesity as a transgenerational disease. Curr Med Res Opin 2015 31:2059-2069

7. Chung WK: An overview of mongenic and syndromic obesities in humans. Pediatr Blood Cancer 2012 58:122-128

8. Youngson NA,Morris MJ: What obesity research tells us about epigenetic mechanisms. Philos Trans R Soc Lond B Biol Sci 2013 368:20110337

9. Curley JP, Mashoodh R,Champagne FA: Epigenetics and the origins of paternal effects. Horm Behav 2011 59:306-314.

10. Bays HE: "Sick fat," metabolic disease, and atherosclerosis. Am J Med 2009 122:S26-37

Journal References: 11-20

11. Bays HE: Adiposopathy is "sick fat" a cardiovascular disease? J Am Coll Cardiol 2011 57:2461-2473
12. Bays HE: Adiposopathy, diabetes mellitus, and primary prevention of atherosclerotic coronary artery disease: treating "sick fat" through improving fat function with antidiabetes therapies. Am J Cardiol 2012 110:4B-12B
13. De Lorenzo A, Soldati L, Sarlo F, Calvani M, Di Lorenzo N,Di Renzo L: New obesity classification criteria as a tool for bariatric surgery indication. World J Gastroenterol 2016 22:681-703
14. Rahman M,Berenson AB: Accuracy of current body mass index obesity classification for white, black, and Hispanic reproductive-age women. Obstet Gynecol 2010 115:982-988
15. Misra A,Shrivastava U: Obesity and dyslipidemia in South Asians. Nutrients 2013 5:2708-2733
16. American Council on Exercise: What are the guidelines for percentage of body fat loss? http://www.acefitness.org/acefit/healthy-living-article/60/112/what-are-the-guidelines-for-percentage-of-body-fat (Accessed August 20, 2016). 2009
17. U.S. Army Deputy Chief of Staff. Army Body Composition Program: Army Regulation 600-9. http://asamra.hqda.pentagon.mil/hr/bodyComposition/ (Accessed August 20 ,2016).
18. Vergun D: ARNEWS. Army tightens body fat standards for some recruits. July 24, 2012. https://www.army.mil/article/84224 (Accessed August 20, 2016).
19. Jacobson TA IM, Maki KC, Orringer CE, Bays HE, Jones PH, McKenney JM, Grundy SM, Gill EA, Wild RA, Wilson DP, Brown WV. : National Lipid Association recommendations for patient-centered management of dyslipidemia: Part 1 - executive summary. J Clin Lipidol. 2014 8:473 - 488
20. Bays H: Central obesity as a clinical marker of adiposopathy; increased visceral adiposity as a surrogate marker for global fat dysfunction. Curr Opin Endocrinol Diabetes Obes 2014 21:345-351

Journal References: 21-30

21. Carroll JF, Chiapa AL, Rodriquez M, Phelps DR, Cardarelli KM, Vishwanatha JK, Bae S,Cardarelli R: Visceral fat, waist circumference, and BMI: impact of race/ethnicity. Obesity (Silver Spring) 2008 16:600-607

22. Wang Z, Ma J,Si D: Optimal cut-off values and population means of waist circumference in different populations. Nutr Res Rev 2010 23:191-199

23. ICD10Data.com. Overweight and Obesity. http://www.icd10data.com/ICD10CM/Codes/E00-E89/E65-E68/E66-/E66 (Accessed August 20, 2016).

24. Sun Q, van Dam RM, Spiegelman D, Heymsfield SB, Willett WC,Hu FB: Comparison of dual-energy x-ray absorptiometric and anthropometric measures of adiposity in relation to adiposity-related biologic factors. Am J Epidemiol 2010 172:1442-1454

25. Kushner RF,Blatner DJ: Risk assessment of the overweight and obese patient. J Am Diet Assoc 2005 105:S53-62

26. Kushner RF,Roth JL: Assessment of the obese patient. Endocrinol Metab Clin North Am 2003 32:915-933

27. Bays HE: Current and investigational antiobesity agents and obesity therapeutic treatment targets. Obes Res 2004 12:1197-1211

28. Shamsuzzaman AS, Gersh BJ,Somers VK: Obstructive sleep apnea: implications for cardiac and vascular disease. JAMA 2003 290:1906-1914

29. Gileles-Hillel A, Kheirandish-Gozal L,Gozal D: Biological plausibility linking sleep apnoea and metabolic dysfunction. Nat Rev Endocrinol 2016 12:290-298

30. Nagappa M, Liao P, Wong J, Auckley D, Ramachandran SK, Memtsoudis S, Mokhlesi B,Chung F: Validation of the STOP-Bang Questionnaire as a Screening Tool for Obstructive Sleep Apnea among Different Populations: A Systematic Review and Meta-Analysis. PLoS One 2015 10:e0143697

Obesity Medicine Association

Journal References: 31-40

31. Weaver TE, Calik MW, Farabi SS, Fink AM, Galang-Boquiren MT, Kapella MC, Prasad B,Carley DW: Innovative treatments for adults with obstructive sleep apnea. Nat Sci Sleep 2014 6:137-147
32. Bays HE, Jones PH, Jacobson TA, Cohen DE, Orringer CE, Kothari S, Azagury DE, Morton J, Nguyen NT, Westman EC, Horn DB, Scinta W,Primack C: Lipids and bariatric procedures part 1 of 2: Scientific statement from the National Lipid Association, American Society for Metabolic and Bariatric Surgery, and Obesity Medicine Association: FULL REPORT. J Clin Lipidol 2016 10:33-57
33. Bays H: Adiposopathy, "Sick Fat," Ockham's Razor, and Resolution of the Obesity Paradox. Curr Atheroscler Rep 2014 16:409
34. Kloting N,Bluher M: Adipocyte dysfunction, inflammation and metabolic syndrome. Rev Endocr Metab Disord 2014 15:277-287
35. Bluher M: Adipose tissue dysfunction contributes to obesity related metabolic diseases. Best Pract Res Clin Endocrinol Metab 2013 27:163-177
36. Bays HE, Gonzalez-Campoy JM, Henry RR, Bergman DA, Kitabchi AE, Schorr AB,Rodbard HW: Is adiposopathy (sick fat) an endocrine disease? Int J Clin Pract 2008 62:1474-1483
37. Bays HE, Gonzalez-Campoy JM, Bray GA, Kitabchi AE, Bergman DA, Schorr AB, Rodbard HW,Henry RR: Pathogenic potential of adipose tissue and metabolic consequences of adipocyte hypertrophy and increased visceral adiposity. Expert Rev Cardiovasc Ther 2008 6:343-368
38. Fauser BC, Tarlatzis BC, Rebar RW, Legro RS, Balen AH, Lobo R, Carmina E, Chang J, Yildiz BO, Laven JS, Boivin J, Petraglia F, Wijeyeratne CN, Norman RJ, Dunaif A, Franks S, Wild RA, Dumesic D,Barnhart K: Consensus on women's health aspects of polycystic ovary syndrome (PCOS): the Amsterdam ESHRE/ASRM-Sponsored 3rd PCOS Consensus Workshop Group. Fertil Steril 2012 97:28-38 e25
39. Lim SS, Norman RJ, Davies MJ,Moran LJ: The effect of obesity on polycystic ovary syndrome: a systematic review and meta-analysis. Obes Rev 2013 14:95-109
40. Bays HE, Gonzalez-Campoy JM,Schorr AB: What men should know about metabolic syndrome, adiposopathy and 'sick fat'. Int J Clin Pract 2010 64:1735-1739

Journal References: 41-50

41. Chetrite GS,Feve B: Preface to special issue on: Adiposopathy in Cancer and (Cardio)Metabolic Diseases: an Endocrine Approach - Part 4. Horm Mol Biol Clin Investig 2015 23:1-4
42. Booth A, Magnuson A, Fouts J,Foster M: Adipose tissue, obesity and adipokines: role in cancer promotion. Horm Mol Biol Clin Investig 2015 21:57-74
43. Hursting SD,Dunlap SM: Obesity, metabolic dysregulation, and cancer: a growing concern and an inflammatory (and microenvironmental) issue. Ann N Y Acad Sci 2012 1271:82-87
44. Whiteman DC,Wilson LF: The fractions of cancer attributable to modifiable factors: A global review. Cancer Epidemiol 2016
45. Lauby-Secretan B, Scoccianti C, Loomis D, Grosse Y, Bianchini F,Straif K: Body Fatness and Cancer--Viewpoint of the IARC Working Group. N Engl J Med 2016 375:794-798
46. Subak LL, Richter HE,Hunskaar S: Obesity and urinary incontinence: epidemiology and clinical research update. J Urol 2009 182:S2-7
47. Kudish BI, Iglesia CB, Sokol RJ, Cochrane B, Richter HE, Larson J, Hendrix SL,Howard BV: Effect of weight change on natural history of pelvic organ prolapse. Obstet Gynecol 2009 113:81-88
48. American College of O,Gynecologists: ACOG Committee opinion no. 549: obesity in pregnancy. Obstet Gynecol 2013 121:213-21749] Pasquali R, Patton L,Gambineri A: Obesity and infertility. Curr Opin Endocrinol Diabetes Obes 2007 14:482-48750] Yu Z, Han S, Zhu J, Sun X, Ji C,Guo X: Pre-pregnancy body mass index in relation to infant birth weight and offspring overweight/obesity: a systematic review and meta-analysis. PLoS One 2013 8:e61627
49. Pasquali R, Patton L, Gambineri A: Obesity and infertility. Curr Opin Endocrinol Diabetes Obes 2007 14:482-487.
50. Yu Z, Han S, Zhu J, Sun X, Ji C, Guo X: Pre-pregnancy body mass index in relation to infant birth weight and offspring overweight/obesity: a systematic review and meta-analysis. PLoS One 2013 8:e61627.

Obesity Medicine Association

Journal References: 51-60

51. Lavie CJ, De Schutter A, Parto P, Jahangir E, Kokkinos P, Ortega FB, Arena R, Milani RV: Obesity and Prevalence of Cardiovascular Diseases and Prognosis-The Obesity Paradox Updated. Prog Cardiovasc Dis 2016 58:537-547.
52. Smith KB, Smith MS: Obesity Statistics. Prim Care 2016 43:121-135, ix.
53. Akin I, Nienaber CA: "Obesity paradox" in coronary artery disease. World J Cardiol 2015 7:603-608.
54. Steele L, Lloyd A, Fotheringham J, Sultan A, Iqbal J, Grech ED: A retrospective cross-sectional study on the association between tobacco smoking and incidence of ST-segment elevation myocardial infarction and cardiovascular risk factors. Postgrad Med J 2015 91:492-496.
55. Rallidis LS, Triantafyllis AS, Tsirebolos G, Katsaras D, Rallidi M, Moutsatsou P, Lekakis J: Prevalence of heterozygous familial hypercholesterolaemia and its impact on long-term prognosis in patients with very early ST-segment elevation myocardial infarction in the era of statins. Atherosclerosis 2016 249:17-21.
56. Niederdeppe J, Roh S, Shapiro MA: Acknowledging individual responsibility while emphasizing social determinants in narratives to promote obesity-reducing public policy: a randomized experiment. PLoS One 2015 10:e0117565.
57. Harrell CS, Gillespie CF, Neigh GN: Energetic stress: The reciprocal relationship between energy availability and the stress response. Physiol Behav 2015
58. Yau YH, Potenza MN: Stress and eating behaviors. Minerva Endocrinol 2013 38:255-267.
59. Thaler JP, Guyenet SJ, Dorfman MD, Wisse BE, Schwartz MW: Hypothalamic inflammation: marker or mechanism of obesity pathogenesis? Diabetes 2013 62:2629-2634.
60. Moore CJ, Cunningham SA: Social position, psychological stress, and obesity: a systematic review. J Acad Nutr Diet 2012 112:518-526.

Journal References: 61-70

61. Capuron L, Lasselin J, Castanon N: Role of Adiposity-Driven Inflammation in Depressive Morbidity. Neuropsychopharmacology 2016
62. Nesbitt S, Palomarez RE: Review: Increasing Awareness and Education on Health Disparities for Health Care Providers. Ethn Dis 2016 26:181-190.
63. Rusin M, Arsand E, Hartvigsen G: Functionalities and input methods for recording food intake: a systematic review. Int J Med Inform 2013 82:653-664.
64. Jaworowska A, Blackham T, Davies IG, Stevenson L: Nutritional challenges and health implications of takeaway and fast food. Nutr Rev 2013 71:310-318.
65. Beechy L, Galpern J, Petrone A, Das SK: Assessment tools in obesity - psychological measures, diet, activity, and body composition. Physiol Behav 2012 107:154-171.
66. Horn DB, O'Neill JR, Pfeiffer KA, Dowda M, Pate RR: Predictors of physical activity in the transition after high school among young women. J Phys Act Health 2008 5:275-285.
67. Vanhees L, De Sutter J, Gelada SN, Doyle F, Prescott E, Cornelissen V, Kouidi E, Dugmore D, Vanuzzo D, Borjesson M, Doherty P: Importance of characteristics and modalities of physical activity and exercise in defining the benefits to cardiovascular health within the general population: recommendations from the EACPR (Part I). Eur J Prev Cardiol 2012 19:670-686.
68. Vanhees L, Geladas N, Hansen D, Kouidi E, Niebauer J, et al: Importance of characteristics and modalities of physical activity and exercise in the management of cardiovascular health in individuals with cardiovascular risk factors: recommendations from the EACPR. Part II. Eur J Prev Cardiol 2012 19:1005-1033.
69. Steelman GM, Westman EC: Obesity: Evaluation and Treatment Essentials. New York: Informa Healthcare 2010
70. Bays HE, Toth PP, Kris-Etherton PM, Abate N, Aronne LJ, Brown WV, Gonzalez-Campoy JM, Jones SR, Kumar R, La Forge R, Samuel VT: Obesity, adiposity, and dyslipidemia: A consensus statement from the National Lipid Association. J Clin Lipidol 2013 7:304-383.

Obesity Medicine Association

Journal References: 71-80

71. Kim JJ, Choi YM: Dyslipidemia in women with polycystic ovary syndrome. Obstet Gynecol Sci 2013 56:137-142.
72. Corona G, Rastrelli G, Monami M, Saad F, Luconi M, Lucchese M, Facchiano E, Sforza A, Forti G, Mannucci E, Maggi M: Body weight loss reverts obesity-associated hypogonadotropic hypogonadism: a systematic review and meta-analysis. Eur J Endocrinol 2013 168:829-843.
73. Hochberg I, Hochberg Z: Expanding the definition of hypothalamic obesity. Obes Rev 2010 11:709-721.
74. Lim SP, Arasaratnam P, Chow BJ, Beanlands RS, Hessian RC: Obesity and the challenges of noninvasive imaging for the detection of coronary artery disease. Can J Cardiol 2015 31:223-226.
75. Garcia-Labbe D, Ruka E, Bertrand OF, Voisine P, Costerousse O, Poirier P: Obesity and coronary artery disease: evaluation and treatment. Can J Cardiol 2015 31:184-194.
76. Ginde SR, Geliebter A, Rubiano F, Silva AM, Wang J, Heshka S, Heymsfield SB: Air displacement plethysmography: validation in overweight and obese subjects. Obes Res 2005 13:1232-1237.
77. Beam JR, Szymanski DJ: Validity of 2 skinfold calipers in estimating percent body fat of college-aged men and women. J Strength Cond Res 2010 24:3448-3456.
78. Muller MJ, Bosy-Westphal A, Lagerpusch M, Heymsfield SB: Use of balance methods for assessment of short-term changes in body composition. Obesity (Silver Spring) 2012 20:701-707.
79. Kendler DL, Borges JL, Fielding RA, Itabashi A, Krueger D, Mulligan K, Camargos BM, Sabowitz B, Wu CH, Yu EW, Shepherd J: The Official Positions of the International Society for Clinical Densitometry: Indications of Use and Reporting of DXA for Body Composition. J Clin Densitom 2013 16:496-507.
80. Goni L, Cuervo M, Milagro FI, Martinez JA: Future Perspectives of Personalized Weight Loss Interventions Based on Nutrigenetic, Epigenetic, and Metagenomic Data. J Nutr 2016

Obesity Medicine Association

Journal References: 81-90

81. Heymsfield SB, Ebbeling CB, Zheng J, Pietrobelli A, Strauss BJ, Silva AM, Ludwig DS: Multi-component molecular-level body composition reference methods: evolving concepts and future directions. Obes Rev 2015 16:282-294.
82. Kendall KL, Fukuda DH, Hyde PN, Smith-Ryan AE, Moon JR, Stout JR: Estimating fat-free mass in elite-level male rowers: a four-compartment model validation of laboratory and field methods. J Sports Sci 2016 1-10.
83. Muller MJ, Braun W, Pourhassan M, Geisler C, Bosy-Westphal A: Application of standards and models in body composition analysis. Proc Nutr Soc 2016 75:181-187.
84. Dulloo AG, Jacquet J, Solinas G, Montani JP, Schutz Y: Body composition phenotypes in pathways to obesity and the metabolic syndrome. Int J Obes (Lond) 2010 34 Suppl 2:S4-17.
85. Even PC, Nadkarni NA: Indirect calorimetry in laboratory mice and rats: principles, practical considerations, interpretation and perspectives. Am J Physiol Regul Integr Comp Physiol 2012 303:R459-476.
86. Harvard School of Public Health. Measuring Obesity: From Calipers to CAT Scans, Ten Ways to Tell Whether a Body Is Fat or Leanhttps://www.hsph.harvard.edu/obesity-prevention-source/obesity-definition/how-to-measure-body-fatness/ (Accessed August 20, 2016).
87. Williams CA, Bale P: Bias and limits of agreement between hydrodensitometry, bioelectrical impedance and skinfold calipers measures of percentage body fat. Eur J Appl Physiol Occup Physiol 1998 77:271-277.
88. Clarys JP, Provyn S, Marfell-Jones MJ: Cadaver studies and their impact on the understanding of human adiposity. Ergonomics 2005 48:1445-1461.
89. Choi YJ: Dual-Energy X-Ray Absorptiometry: Beyond Bone Mineral Density Determination. Endocrinol Metab (Seoul) 2016 31:25-30.
90. Silva DR, Ribeiro AS, Pavao FH, Ronque ER, Avelar A, Silva AM, Cyrino ES: Validity of the methods to assess body fat in children and adolescents using multi-compartment models as the reference method: a systematic review. Rev Assoc Med Bras (1992) 2013 59:475-486.

Obesity Medicine Association

Journal References: 91-100

91. Fields DA, Hunter GR, Goran MI: Validation of the BOD POD with hydrostatic weighing: influence of body clothing. Int J Obes Relat Metab Disord 2000 24:200-205.
92. Smith S, Madden AM: Body composition and functional assessment of nutritional status in adults: a narrative review of imaging, impedance, strength and functional techniques. J Hum Nutr Diet 2016
93. Rotella CM, Dicembrini I: Measurement of body composition as a surrogate evaluation of energy balance in obese patients. World J Methodol 2015 5:1-9.
94. International Atomic Energy Agency. IAEA Human Health Series No. 12 Introduction To Body Composition Assessment Using The Deuterium Dilution Technique With Analysis Of Saliva Samples By Fourier Transform Infrared Spectrometry (2010) http://www-pub.iaea.org/MTCD/publications/PDF/Pub1450_web.pdf (Accessed August 20, 2016).
95. Heymsfield SB, Adamek M, Gonzalez MC, Jia G, Thomas DM: Assessing skeletal muscle mass: historical overview and state of the art. J Cachexia Sarcopenia Muscle 2014 5:9-18.
96. Seabolt LA, Welch EB, Silver HJ: Imaging methods for analyzing body composition in human obesity and cardiometabolic disease. Ann N Y Acad Sci 2015 1353:41-59.
97. Fosbol MO, Zerahn B: Contemporary methods of body composition measurement. Clin Physiol Funct Imaging 2015 35:81-97.
98. Ruggiero C, Ferrucci L: The endeavor of high maintenance homeostasis: resting metabolic rate and the legacy of longevity. J Gerontol A Biol Sci Med Sci 2006 61:466-471.
99. Donahoo WT, Levine JA, Melanson EL: Variability in energy expenditure and its components. Curr Opin Clin Nutr Metab Care 2004 7:599-605.
100. Hamasaki H, Yanai H, Mishima S, Mineyama T, Yamamoto-Honda R, Kakei M, Ezaki O, Noda M: Correlations of non-exercise activity thermogenesis to metabolic parameters in Japanese patients with type 2 diabetes. Diabetol Metab Syndr 2013 5:26.

Journal References: 101-110

101. Levine JA: Non-exercise activity thermogenesis (NEAT). Best Pract Res Clin Endocrinol Metab 2002 16:679-702.
102. Flatt JP: Differences in basal energy expenditure and obesity. Obesity (Silver Spring) 2007 15:2546-2548.
103. Pourhassan M, Bosy-Westphal A, Schautz B, Braun W, Gluer CC, Muller MJ: Impact of body composition during weight change on resting energy expenditure and homeostasis model assessment index in overweight nonsmoking adults. Am J Clin Nutr 2014 99:779-791.
104. Jequier E, Acheson K, Schutz Y: Assessment of energy expenditure and fuel utilization in man. Annu Rev Nutr 1987 7:187-208.
105. Psota T, Chen KY: Measuring energy expenditure in clinical populations: rewards and challenges. Eur J Clin Nutr 2013 67:436-442.
106. Sabounchi NS, Rahmandad H, Ammerman A: Best-fitting prediction equations for basal metabolic rate: informing obesity interventions in diverse populations. Int J Obes (Lond) 2013 37:1364-1370.
107. Ellis AC, Hyatt TC, Hunter GR, Gower BA: Respiratory quotient predicts fat mass gain in premenopausal women. Obesity (Silver Spring) 2010 18:2255-2259.
108. Park J, Kazuko IT, Kim E, Kim J, Yoon J: Estimating free-living human energy expenditure: Practical aspects of the doubly labeled water method and its applications. Nutr Res Pract 2014 8:241-248.
109. Byham-Gray L, Parrott JS, Ho WY, Sundell MB, Ikizler TA: Development of a predictive energy equation for maintenance hemodialysis patients: a pilot study. J Ren Nutr 2014 24:32-41.
110. Evenson KR, Goto MM, Furberg RD: Systematic review of the validity and reliability of consumer-wearable activity trackers. Int J Behav Nutr Phys Act 2015 12:159.

Obesity Medicine Association

Journal References: 111-120

111. Allison KC, Grilo CM, Masheb RM, Stunkard AJ: High self-reported rates of neglect and emotional abuse, by persons with binge eating disorder and night eating syndrome. Behav Res Ther 2007 45:2874-2883.
112. St-Onge MP: The role of sleep duration in the regulation of energy balance: effects on energy intakes and expenditure. J Clin Sleep Med 2013 9:73-80.
113. Apovian CM, Aronne LJ, Bessesen DH, McDonnell ME, Murad MH, Pagotto U, Ryan DH, Still CD, Endocrine S: Pharmacological management of obesity: an endocrine Society clinical practice guideline. J Clin Endocrinol Metab 2015 100:342-362.
114. Bays H: From victim to ally: the kidney as an emerging target for the treatment of diabetes mellitus. Curr Med Res Opin 2009 25:671-681.
115. DeFronzo RA, Buse JB, Kim T, Burns C, Skare S, Baron A, Fineman M: Once-daily delayed-release metformin lowers plasma glucose and enhances fasting and postprandial GLP-1 and PYY: results from two randomised trials. Diabetologia 2016 59:1645-1654.
116. Mahmood K, Naeem M, Rahimnajjad NA: Metformin: the hidden chronicles of a magic drug. Eur J Intern Med 2013 24:20-26.
117. Johnson NP: Metformin use in women with polycystic ovary syndrome. Ann Transl Med 2014 2:56.
118. Anisimov VN: Do metformin a real anticarcinogen? A critical reappraisal of experimental data. Ann Transl Med 2014 2:60.
119. Astrup A, Caterson I, Zelissen P, Guy-Grand B, Carruba M, Levy B, Sun X, Fitchet M: Topiramate: long-term maintenance of weight loss induced by a low-calorie diet in obese subjects. Obes Res 2004 12:1658-1669.
120. Bostwick JM: A generalist's guide to treating patients with depression with an emphasis on using side effects to tailor antidepressant therapy. Mayo Clin Proc 2010 85:538-550.

Journal References: 121-130

121. Hasnain M, Vieweg WV: Weight considerations in psychotropic drug prescribing and switching. Postgrad Med 2013 125:117-129.
122. Hasnain M, Vieweg WV, Hollett B: Weight gain and glucose dysregulation with second-generation antipsychotics and antidepressants: a review for primary care physicians. Postgrad Med 2012 124:154-167.
123. Christinat A, Di Lascio S, Pagani O: Hormonal therapies in young breast cancer patients: when, what and for how long? J Thorac Dis 2013 5 Suppl 1:S36-46.
124. Lake JE, Currier JS: Switching antiretroviral therapy to minimize metabolic complications. HIV Ther 2010 4:693-711.
125. U.S. Department of Agriculture. https://fnic.nal.usda.gov/how-many-calories-are-one-gram-fat-carbohydrate-or-protein. Food and Nutrition Information Center (Accessed August 20, 2016).
126. Gonzalez-Campoy JM, St Jeor ST, Castorino K, Ebrahim A, Hurley D, Jovanovic L, Mechanick JI, Petak SM, Yu YH, Harris KA, Kris-Etherton P, Kushner R, Molini-Blandford M, Nguyen QT, Plodkowski R, Sarwer DB, Thomas KT: Clinical practice guidelines for healthy eating for the prevention and treatment of metabolic and endocrine diseases in adults: cosponsored by the American Association of Clinical Endocrinologists/the American College of Endocrinology and the Obesity Society. Endocr Pract 2013 19 Suppl 3:1-82.
127. Clifton PM: Dietary treatment for obesity. Nat Clin Pract Gastroenterol Hepatol 2008 5:672-681.
128. Brown T, Avenell A, Edmunds LD, Moore H, Whittaker V, Avery L, Summerbell C: Systematic review of long-term lifestyle interventions to prevent weight gain and morbidity in adults. Obes Rev 2009 10:627-638.
129. Tsai AG, Wadden TA: Systematic review: an evaluation of major commercial weight loss programs in the United States. Ann Intern Med 2005 142:56-66.
130. Westman EC, Yancy WS, Jr., Mavropoulos JC, Marquart M, McDuffie JR: The effect of a low-carbohydrate, ketogenic diet versus a low-glycemic index diet on glycemic control in type 2 diabetes mellitus. Nutr Metab (Lond) 2008 5:36.

Journal References: 131-140

131. Westman EC, Feinman RD, Mavropoulos JC, Vernon MC, Volek JS, Wortman JA, Yancy WS, Phinney SD: Low-carbohydrate nutrition and metabolism. Am J Clin Nutr 2007 86:276-284.
132. Volek JS, Phinney SD, Forsythe CE, Quann EE, Wood RJ, Puglisi MJ, Kraemer WJ, Bibus DM, Fernandez ML, Feinman RD: Carbohydrate restriction has a more favorable impact on the metabolic syndrome than a low fat diet. Lipids 2009 44:297-309.
133. Foster GD, Wyatt HR, Hill JO, Makris AP, Rosenbaum DL, Brill C, Stein RI, Mohammed BS, Miller B, Rader DJ, Zemel B, Wadden TA, Tenhave T, Newcomb CW, Klein S: Weight and metabolic outcomes after 2 years on a low-carbohydrate versus low-fat diet: a randomized trial. Ann Intern Med 2010 153:147-157.
134. Tirosh A, Golan R, Harman-Boehm I, Henkin Y, Schwarzfuchs D, Rudich A, Kovsan J, Fiedler GM, Bluher M, Stumvoll M, Thiery J, Stampfer MJ, Shai I: Renal function following three distinct weight loss dietary strategies during 2 years of a randomized controlled trial. Diabetes Care 2013 36:2225-2232.
135. Lutas A, Yellen G: The ketogenic diet: metabolic influences on brain excitability and epilepsy. Trends Neurosci 2013 36:32-40.
136. Schwingshackl L, Hoffmann G: Long-term effects of low-fat diets either low or high in protein on cardiovascular and metabolic risk factors: a systematic review and meta-analysis. Nutr J 2013 12:48.
137. Meckling KA, O'Sullivan C, Saari D: Comparison of a low-fat diet to a low-carbohydrate diet on weight loss, body composition, and risk factors for diabetes and cardiovascular disease in free-living, overweight men and women. J Clin Endocrinol Metab 2004 89:2717-2723.
138. Mulholland Y, Nicokavoura E, Broom J, Rolland C: Very-low-energy diets and morbidity: a systematic review of longer-term evidence. Br J Nutr 2012 108:832-851.
139. Johansson K, Sundstrom J, Marcus C, Hemmingsson E, Neovius M: Risk of symptomatic gallstones and cholecystectomy after a very-low-calorie diet or low-calorie diet in a commercial weight loss program: 1-year matched cohort study. Int J Obes (Lond) 2013 May 22 [Epub ahead of print]
140. Teegala SM, Willett WC, Mozaffarian D: Consumption and health effects of trans fatty acids: a review. J AOAC Int 2009 92:1250-1257.

Journal References: 141-150

141. Nestel P: Trans fatty acids: are its cardiovascular risks fully appreciated? Clin Ther 2014 36:315-321.
142. Ferro-Luzzi A, Sette S: The Mediterranean Diet: an attempt to define its present and past composition. Eur J Clin Nutr 1989 43 Suppl 2:13-29.
143. Fito M, Konstantinidou V: Nutritional Genomics and the Mediterranean Diet's Effects on Human Cardiovascular Health. Nutrients 2016 8:
144. Estruch R, Ros E, Salas-Salvado J, Covas MI, Corella D, Aros F, Gomez-Gracia E, Ruiz-Gutierrez V, Fiol M, Lapetra J, Lamuela-Raventos RM, Serra-Majem L, Pinto X, Basora J, Munoz MA, Sorli JV, Martinez JA, Martinez-Gonzalez MA, Investigators PS: Primary prevention of cardiovascular disease with a Mediterranean diet. N Engl J Med 2013 368:1279-1290.
145. Kris-Etherton P, Eckel RH, Howard BV, St Jeor S, Bazzarre TL, Nutrition Committee Population Science C, Clinical Science Committee of the American Heart A: AHA Science Advisory: Lyon Diet Heart Study. Benefits of a Mediterranean-style, National Cholesterol Education Program/American Heart Association Step I Dietary Pattern on Cardiovascular Disease. Circulation 2001 103:1823-1825.
146. Expert Panel on Detection E, Treatment of High Blood Cholesterol in A: Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, And Treatment of High Blood Cholesterol In Adults (Adult Treatment Panel III). JAMA 2001 285:2486-2497.
147. U.S. Department Of Health And Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute. Your guide to lowering your cholesterol with TLC. NIH Publication No. 06–5235. Bethesda, MD: National Heart, Lung, and Blood Institute; 2005.
148. Scrutinio D: The potential of lifestyle changes for improving the clinical outcome of patients with coronary heart disease: mechanisms of benefit and clinical results. Rev Recent Clin Trials 2010 5:1-13.
149. Gibson AA, Seimon RV, Lee CM, Ayre J, Franklin J, Markovic TP, Caterson ID, Sainsbury A: Do ketogenic diets really suppress appetite? A systematic review and meta-analysis. Obes Rev 2015 16:64-76.
150. Bueno NB, de Melo IS, de Oliveira SL, da Rocha Ataide T: Very-low-carbohydrate ketogenic diet v. low-fat diet for long-term weight loss: a meta-analysis of randomised controlled trials. Br J Nutr 2013 1-10.

Journal References: 151-160

151. Mansoor N, Vinknes KJ, Veierod MB, Retterstol K: Effects of low-carbohydrate diets v. low-fat diets on body weight and cardiovascular risk factors: a meta-analysis of randomised controlled trials. Br J Nutr 2016 115:466-479.
152. Ornish D, Brown SE, Scherwitz LW, Billings JH, Armstrong WT, Ports TA, McLanahan SM, Kirkeeide RL, Brand RJ, Gould KL: Can lifestyle changes reverse coronary heart disease? The Lifestyle Heart Trial. Lancet 1990 336:129-133.
153. Gardner CD, Kiazand A, Alhassan S, Kim S, Stafford RS, Balise RR, Kraemer HC, King AC: Comparison of the Atkins, Zone, Ornish, and LEARN diets for change in weight and related risk factors among overweight premenopausal women: the A TO Z Weight Loss Study: a randomized trial. JAMA 2007 297:969-977.
154. Ornish D, Scherwitz LW, Billings JH, Brown SE, Gould KL, Merritt TA, Sparler S, Armstrong WT, Ports TA, Kirkeeide RL, Hogeboom C, Brand RJ: Intensive lifestyle changes for reversal of coronary heart disease. JAMA 1998 280:2001-2007.
155. U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute. Your guide to lowering your blood pressure with DASH. NIH Publication No. 06-4082. Bethesda, MD: National Heart, Lung, and Blood Institute; 2006.
156. Appel LJ, Sacks FM, Carey VJ, Obarzanek E, Swain JF, et al, OmniHeart Collaborative Research G: Effects of protein, monounsaturated fat, and carbohydrate intake on blood pressure and serum lipids: results of the OmniHeart randomized trial. JAMA 2005 294:2455-2464.
157. Manheimer EW, van Zuuren EJ, Fedorowicz Z, Pijl H: Paleolithic nutrition for metabolic syndrome: systematic review and meta-analysis. Am J Clin Nutr 2015 102:922-932.
158. Jonsson T, Granfeldt Y, Lindeberg S, Hallberg AC: Subjective satiety and other experiences of a Paleolithic diet compared to a diabetes diet in patients with type 2 diabetes. Nutr J 2013 12:105.
159. Jonsson T, Granfeldt Y, Ahren B, Branell UC, Palsson G, Hansson A, Soderstrom M, Lindeberg S: Beneficial effects of a Paleolithic diet on cardiovascular risk factors in type 2 diabetes: a randomized cross-over pilot study. Cardiovasc Diabetol 2009 8:35.
160. Craig WJ: Health effects of vegan diets. Am J Clin Nutr 2009 89:1627S-1633S.

Journal References: 161-170

161. Dinu M, Abbate R, Gensini GF, Casini A, Sofi F: Vegetarian, vegan diets and multiple health outcomes: a systematic review with meta-analysis of observational studies. Crit Rev Food Sci Nutr 2016 0.
162. Warburton DE, Nicol CW, Bredin SS: Health benefits of physical activity: the evidence. CMAJ 2006 174:801-809.
163. Stanford KI, Middelbeek RJ, Goodyear LJ: Exercise Effects on White Adipose Tissue: Beiging and Metabolic Adaptations. Diabetes 2015 64:2361-2368.
164. Jeremic N, Chatuverdi P, Tyagi SC: Browning of White Fat: Novel Insight into Factors, Mechanisms and Therapeutics. J Cell Physiol 2016
165. Jakicic JM, Davis KK: Obesity and physical activity. Psychiatr Clin North Am 2011 34:829-840.
166. Meriwether RA, Lee JA, Lafleur AS, Wiseman P: Physical activity counseling. Am Fam Physician 2008 77:1129-1136.
167. Vincent HK, Raiser SN, Vincent KR: The aging musculoskeletal system and obesity-related considerations with exercise. Ageing Res Rev 2012 11:361-373.
168. Parr EB, Coffey VG, Hawley JA: 'Sarcobesity': a metabolic conundrum. Maturitas 2013 74:109-113.
169. Strasser B: Physical activity in obesity and metabolic syndrome. Ann N Y Acad Sci 2013 1281:141-159.
170. Carlson SA, Fulton JE, Schoenborn CA, Loustalot F: Trend and prevalence estimates based on the 2008 Physical Activity Guidelines for Americans. Am J Prev Med 2010 39:305-313.

Journal References: 171-180

171. Garland T, Jr., Schutz H, Chappell MA, Keeney BK, Meek TH, Copes LE, Acosta W, Drenowatz C, Maciel RC, van Dijk G, Kotz CM, Eisenmann JC: The biological control of voluntary exercise, spontaneous physical activity and daily energy expenditure in relation to obesity: human and rodent perspectives. J Exp Biol 2011 214:206-229.
172. Ng SW, Popkin BM: Time use and physical activity: a shift away from movement across the globe. Obes Rev 2012 13:659-680.
173. Bushman BA: Determining the I (Intensity) for a FITT-VP Aerobic Exercise Prescription. ACSM's Health & Fitness Journal 2014 18:4-7.
174. Lakoski SG, Barlow CE, Farrell SW, Berry JD, Morrow JR, Jr., Haskell WL: Impact of body mass index, physical activity, and other clinical factors on cardiorespiratory fitness (from the Cooper Center longitudinal study). Am J Cardiol 2011 108:34-39.
175. Jette M, Sidney K, Blumchen G: Metabolic equivalents (METS) in exercise testing, exercise prescription, and evaluation of functional capacity. Clin Cardiol 1990 13:555-565.
176. Van Camp CM, Hayes LB: Assessing and increasing physical activity. J Appl Behav Anal 2012 45:871-875.
177. Butte NF, Ekelund U, Westerterp KR: Assessing physical activity using wearable monitors: measures of physical activity. Med Sci Sports Exerc 2012 44:S5-12.
178. Mercer K, Li M, Giangregorio L, Burns C, Grindrod K: Behavior Change Techniques Present in Wearable Activity Trackers: A Critical Analysis. JMIR Mhealth Uhealth 2016 4:e40.
179. Allen LN, Christie GP: The Emergence of Personalized Health Technology. J Med Internet Res 2016 18:e99.
180. Ries AV, Blackman LT, Page RA, Gizlice Z, Benedict S, Barnes K, Kelsey K, Carter-Edwards L: Goal setting for health behavior change: evidence from an obesity intervention for rural low-income women. Rural Remote Health 2014 14:2682.

Obesity Medicine Association

Journal References: 181-190

181. Giannisi F, Pervanidou P, Michalaki E, Papanikolaou K, Chrousos G, Yannakoulia M: Parental readiness to implement life-style behaviour changes in relation to children's excess weight. J Paediatr Child Health 2014 50:476-481.
182. Tyler DO, Horner SD: Family-centered collaborative negotiation: a model for facilitating behavior change in primary care. J Am Acad Nurse Pract 2008 20:194-203.
183. Miller WR, Rose GS: Toward a theory of motivational interviewing. Am Psychol 2009 64:527-537.
184. Teixeira PJ, Silva MN, Mata J, Palmeira AL, Markland D: Motivation, self-determination, and long-term weight control. Int J Behav Nutr Phys Act 2012 9:22.
185. Pollak KI, Alexander SC, Tulsky JA, Lyna P, Coffman CJ, Dolor RJ, Gulbrandsen P, Ostbye T: Physician empathy and listening: associations with patient satisfaction and autonomy. J Am Board Fam Med 2011 24:665-672.
186. Williams DM, Rhodes RE: The confounded self-efficacy construct: conceptual analysis and recommendations for future research. Health Psychol Rev 2014 1-16.
187. Westra HA, Aviram A: Core skills in motivational interviewing. Psychotherapy (Chic) 2013 50:273-278.
188. Pollak KI, Coffman CJ, Alexander SC, Ostbye T, Lyna P, Tulsky JA, Bilheimer A, Dolor RJ, Lin PH, Bodner ME, Bravender T: Weight's up? Predictors of weight-related communication during primary care visits with overweight adolescents. Patient Educ Couns 2014 96:327-332.
189. Pantalon MV, Sledge WH, Bauer SF, Brodsky B, Giannandrea S, Kay J, Lazar SG, Mellman LA, Offenkrantz WC, Oldham J, Plakun EM, Rockland LH: Important medical decisions: Using brief motivational interviewing to enhance patients' autonomous decision-making. J Psychiatr Pract 2013 19:98-108.
190. Codern-Bove N, Pujol-Ribera E, Pla M, Gonzalez-Bonilla J, Granollers S, Ballve JL, Fanlo G, Cabezas C: Motivational interviewing interactions and the primary health care challenges presented by smokers with low motivation to stop smoking: a conversation analysis. BMC Public Health 2014 14:1225.

Journal References: 191-200

191. Williams AA, Wright KS: Engaging families through motivational interviewing. Pediatr Clin North Am 2014 61:907-921.
192. Resnicow K, McMaster F: Motivational Interviewing: moving from why to how with autonomy support. Int J Behav Nutr Phys Act 2012 9:19.
193. Miller ST, Oates VJ, Brooks MA, Shintani A, Gebretsadik T, Jenkins DM: Preliminary efficacy of group medical nutrition therapy and motivational interviewing among obese African American women with type 2 diabetes: a pilot study. J Obes 2014 2014:345941.
194. Elwyn G, Dehlendorf C, Epstein RM, Marrin K, White J, Frosch DL: Shared decision making and motivational interviewing: achieving patient-centered care across the spectrum of health care problems. Ann Fam Med 2014 12:270-275.
195. Carcone AI, Naar-King S, Brogan KE, Albrecht T, Barton E, Foster T, Martin T, Marshall S: Provider communication behaviors that predict motivation to change in black adolescents with obesity. J Dev Behav Pediatr 2013 34:599-608.
196. Windham ME, Hastings ES, Anding R, Hergenroeder AC, Escobar-Chaves SL, Wiemann CM: "Teens talk healthy weight": the impact of a motivational digital video disc on parental knowledge of obesity-related diseases in an adolescent clinic. J Acad Nutr Diet 2014 114:1611-1618.
197. Saelens BE, Lozano P, Scholz K: A randomized clinical trial comparing delivery of behavioral pediatric obesity treatment using standard and enhanced motivational approaches. J Pediatr Psychol 2013 38:954-964.
198. Kushner RF, Ryan DH: Assessment and lifestyle management of patients with obesity: clinical recommendations from systematic reviews. JAMA 2014 312:943-952.
199. Kisely S, Ligate L, Roy MA, Lavery T: Applying Motivational Interviewing to the initiation of long-acting injectable atypical antipsychotics. Australas Psychiatry 2012 20:138-142.
200. Goldberg JH, Kiernan M: Innovative techniques to address retention in a behavioral weight-loss trial. Health Educ Res 2005 20:439-447.

Obesity Medicine Association

Journal References: 201-210

201. Miller NH: Motivational interviewing as a prelude to coaching in healthcare settings. J Cardiovasc Nurs 2010 25:247-251.
202. Vallis M, Piccinini-Vallis H, Sharma AM, Freedhoff Y: Clinical review: modified 5 As: minimal intervention for obesity counseling in primary care. Can Fam Physician 2013 59:27-31.
203. Alexander SC, Cox ME, Boling Turer CL, Lyna P, Ostbye T, Tulsky JA, Dolor RJ, Pollak KI: Do the five A's work when physicians counsel about weight loss? Fam Med 2011 43:179-184.
204. Searight R: Realistic approaches to counseling in the office setting. Am Fam Physician 2009 79:277-284.
205. Foote J, DeLuca A, Magura S, Warner A, Grand A, Rosenblum A, Stahl S: A group motivational treatment for chemical dependency. J Subst Abuse Treat 1999 17:181-192.
206. Schneeberger M, Gomis R, Claret M: Hypothalamic and brainstem neuronal circuits controlling homeostatic energy balance. J Endocrinol 2014 220:T25-46.
207. Cruwys T, Bevelander KE, Hermans RC: Social modeling of eating: A review of when and why social influence affects food intake and choice. Appetite 2014
208. Neymotin F, Nemzer LR: Locus of control and obesity. Front Endocrinol (Lausanne) 2014 5:159.
209. Kemps E, Tiggemann M: Approach bias for food cues in obese individuals. Psychol Health 2014 1-11.
210. Johnson PM, Kenny PJ: Dopamine D2 receptors in addiction-like reward dysfunction and compulsive eating in obese rats. Nat Neurosci 2010 13:635-641.

Journal References: 211-220

211. Adam TC, Epel ES: Stress, eating and the reward system. Physiol Behav 2007 91:449-458.
212. Monteleone P, Piscitelli F, Scognamiglio P, Monteleone AM, Canestrelli B, Di Marzo V, Maj M: Hedonic eating is associated with increased peripheral levels of ghrelin and the endocannabinoid 2-arachidonoyl-glycerol in healthy humans: a pilot study. J Clin Endocrinol Metab 2012 97:E917-924.
213. Amianto F, Ottone L, Abbate Daga G, Fassino S: Binge-eating disorder diagnosis and treatment: a recap in front of DSM-5. BMC Psychiatry 2015 15:70.
214. Rikani AA, Choudhry Z, Choudhry AM, Ikram H, Asghar MW, Kajal D, Waheed A, Mobassarah NJPD: A critique of the literature on etiology of eating disorders. Ann Neurosci 2013 20:157-161.
215. Brauhardt A, de Zwaan M, Hilbert A: The therapeutic process in psychological treatments for eating disorders: a systematic review. Int J Eat Disord 2014 47:565-584.
216. Reas DL, Grilo CM: Current and emerging drug treatments for binge eating disorder. Expert Opin Emerg Drugs 2014 19:99-142.
217. Aigner M, Treasure J, Kaye W, Kasper S, Disorders WTFOE: World Federation of Societies of Biological Psychiatry (WFSBP) guidelines for the pharmacological treatment of eating disorders. World J Biol Psychiatry 2011 12:400-443.
218. Flament MF, Bissada H, Spettigue W: Evidence-based pharmacotherapy of eating disorders. Int J Neuropsychopharmacol 2012 15:189-207.
219. Lisdexamfetamine dimesylate (VYVANSE) Prescribing Information http://pi.shirecontent.com/PI/PDFs/Vyvanse_USA_ENG.pdf (Accessed August 20, 2016).
220. Allison KC, Lundgren JD, O'Reardon JP, Geliebter A, Gluck ME, Vinai P, Mitchell JE, Schenck CH, Howell MJ, Crow SJ, Engel S, Latzer Y, Tzischinsky O, Mahowald MW, Stunkard AJ: Proposed diagnostic criteria for night eating syndrome. Int J Eat Disord 2010 43:241-247.

Journal References: 221-230

221. Gallant AR, Lundgren J, Drapeau V: The night-eating syndrome and obesity. Obes Rev 2012 13:528-536.
222. Milano W, De Rosa M, Milano L, Capasso A: Night eating syndrome: an overview. J Pharm Pharmacol 2012 64:2-10.
223. Stunkard AJ, Allison KC, Geliebter A, Lundgren JD, Gluck ME, O'Reardon JP: Development of criteria for a diagnosis: lessons from the night eating syndrome. Compr Psychiatry 2009 50:391-399.
224. Gupta H: Barriers to and Facilitators of Long Term Weight Loss Maintenance in Adult UK People: A Thematic Analysis. Int J Prev Med 2014 5:1512-1520.
225. Peterson JA: Get moving! Physical activity counseling in primary care. J Am Acad Nurse Pract 2007 19:349-357.
226. Cornier MA: Is your brain to blame for weight regain? Physiol Behav 2011 104:608-612.
227. Sainsbury A, Zhang L: Role of the hypothalamus in the neuroendocrine regulation of body weight and composition during energy deficit. Obes Rev 2012 13:234-257.
228. Rosenbaum M, Leibel RL: Adaptive thermogenesis in humans. Int J Obes (Lond) 2010 34 Suppl 1:S47-55.
229. Maclean PS, Bergouignan A, Cornier MA, Jackman MR: Biology's response to dieting: the impetus for weight regain. Am J Physiol Regul Integr Comp Physiol 2011 301:R581-600.
230. Richardson LA: Bariatric society is here to help. J Fam Pract 2010 59:488.

Journal References: 231-240

231. Jacob JJ, Isaac R: Behavioral therapy for management of obesity. Indian J Endocrinol Metab 2012 16:28-32.
232. Van Dorsten B, Lindley EM: Cognitive and behavioral approaches in the treatment of obesity. Med Clin North Am 2011 95:971-988.
233. Karasu SR: Psychotherapy-lite: obesity and the role of the mental health practitioner. Am J Psychother 2013 67:3-22.
234. Rutledge T, Groesz LM, Linke SE, Woods G, Herbst KL: Behavioural weight management for the primary careprovider. Obes Rev 2011 12:e290-297.
235. Jeffery RW, Bjornson-Benson WM, Rosenthal BS, Lindquist RA, Johnson SL: Behavioral treatment of obesity with monetary contracting: two-year follow-up. Addict Behav 1984 9:311-313.
236. Brambila-Macias J, Shankar B, Capacci S, Mazzocchi M, Perez-Cueto FJ, Verbeke W, Traill WB: Policy interventions to promote healthy eating: a review of what works, what does not, and what is promising. Food Nutr Bull 2011 32:365-375.
237. Dobkin BH: Wearable motion sensors to continuously measure real-world physical activities. Curr Opin Neurol 2013 26:602-608.
238. Chou WY, Prestin A, Kunath S: Obesity in social media: a mixed methods analysis. Transl Behav Med 2014 4:314-323.
239. Bray GA: Why do we need drugs to treat the patient with obesity? Obesity (Silver Spring) 2013 21:893-899.
240. Bays HE: Lorcaserin: drug profile and illustrative model of the regulatory challenges of weight-loss drug development. Expert Rev Cardiovasc Ther 2011 9:265-277.

Journal References: 241-250

241. Food and Drug Administration. Pregnancy and Lactation Labeling (Drugs) Final Rule. December 3, 2014. http://www.fda.gov/Drugs/DevelopmentApprovalProcess/DevelopmentResources/Labeling/ucm093307.htm (Accessed August 21, 2016).
242. American College of Obstetricians and Gynecologists. Obesity and Pregnancy. Frequently asked Questions. https://www.acog.org/-/media/For-Patients/faq182.pdf (Accessed September 10, 2016).
243. Garvey WT, Mechanick JI, Brett EM, Garber AJ, Hurley DL, Jastreboff AM, Nadolsky K, Pessah-Pollack R, Plodkowski R, Reviewers of the AACEOCPG: American Association of Clinical Endocrinologists and American College of Endocrinology Comprehensive Clinical Practice Guidelines for Medical Care of Patients with Obesity. Endocr Pract 2016 22 Suppl 3:1-203.
244. Bays H, Rodbard HW, Schorr AB, Gonzalez-Campoy JM: Adiposopathy: treating pathogenic adipose tissue to reduce cardiovascular disease risk. Curr Treat Options Cardiovasc Med 2007 9:259-271.
245. Hendricks EJ, Greenway FL, Westman EC, Gupta AK: Blood pressure and heart rate effects, weight loss and maintenance during long-term phentermine pharmacotherapy for obesity. Obesity (Silver Spring) 2011 19:2351-2360.
246. Cercato C, Roizenblatt VA, Leanca CC, Segal A, Lopes Filho AP, Mancini MC, Halpern A: A randomized double-blind placebo-controlled study of the long-term efficacy and safety of diethylpropion in the treatment of obese subjects. Int J Obes (Lond) 2009 33:857-865.
247. Le Riche WH, Van Belle G: Study of phendimetrazine bitartrate as an appetite suppressant in relation to dosage, weight loss and side effects. Can Med Assoc J 1962 87:29-31.
248. Fujioka K: Current and emerging medications for overweight or obesity in people with comorbidities. Diabetes Obes Metab 2015 17:1021-1032.
249. Kumar RB, Aronne LJ: Efficacy comparison of medications approved for chronic weight management. Obesity (Silver Spring) 2015 23 Suppl 1:S4-7.
250. Lorcaserin (BELVIQ) Prescribing Information. http://www.belviq.com/pdf/Belviq_Prescribing_information.pdf (Accessed August 21, 2016).

Journal References: 251-260

251. Bays HE: Lorcaserin and adiposopathy: 5-HT2c agonism as a treatment for 'sick fat' and metabolic disease. Expert Rev Cardiovasc Ther 2009 7:1429-1445.
252. Phentermine HCL/Topiramate Extended Release Prescribing Information (QSYMIA) http://www.vivus.com/docs/QsymiaPI.pdf (Accessed August 21, 2016).
253. Bays H: Phentermine, topiramate and their combination for the treatment of adiposopathy ('sick fat') and metabolic disease. Expert Rev Cardiovasc Ther 2010 8:1777-1801.
254. Bays HE, Gadde KM: Phentermine/topiramate for weight reduction and treatment of adverse metabolic consequences in obesity. Drugs Today (Barc) 2011 47:903-914.
255. Naltrexone HCL/Bupropion HCL Extended Release Prescribing Information (CONTRAVE). http://general.takedapharm.com/content/file.aspx?filetypecode=CONTRAVEPI&cacheRandomizer=c5f9d506-7c0a-4c03-b357-2a926ba14990 (Accessed August 21, 2016).
256. Liraglutide Prescribing Information (SAXENDA) http://novo-pi.nnittest.com/saxenda.pdf (Accessed August 21, 2016).
257. Jensen MD, Ryan DH, Apovian CM, Ard JD, Comuzzie AG, et al, American College of Cardiology/American Heart Association Task Force on Practice G, Obesity S: 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. J Am Coll Cardiol 2014 63:2985-3023.
258. Bays HE, Jones PH, Orringer CE, Brown WV, Jacobson TA: National Lipid Association Annual Summary of Clinical Lipidology 2016. J Clin Lipidol 2016 10:S1-S43.
259. Garber AJ, Abrahamson MJ, Barzilay JI, Blonde L, Bloomgarden ZT, et al: American Association of Clinical Endocrinologists' comprehensive diabetes management algorithm 2013 consensus statement--executive summary. Endocr Pract 2013 19:536-557.
260. Stone NJ, Robinson J, Lichtenstein AH, Bairey Merz CN, Lloyd-Jones DM, et al: 2013 ACC/AHA Guideline on the Treatment of Blood Cholesterol to Reduce Atherosclerotic Cardiovascular Risk in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol 2013

Journal References: 261-270

261. Standards of Medical Care in Diabetes-2016: Summary of Revisions. Diabetes Care 2016 39 Suppl 1:S4-5.
262. James PA, Oparil S, Carter BL, Cushman WC, Dennison-Himmelfarb C, et al: 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). JAMA 2014 311:507-520.
263. Landsberg L, Aronne LJ, Beilin LJ, Burke V, Igel LI, Lloyd-Jones D, Sowers J: Obesity-related hypertension: pathogenesis, cardiovascular risk, and treatment--a position paper of the The Obesity Society and The American Society of Hypertension. Obesity (Silver Spring) 2013 21:8-24.
264. Bays H, Kothari SN, Azagury DE, Morton JM, Nguyen NT, et al: Lipids and bariatric procedures Part 2 of 2: scientific statement from the American Society for Metabolic and Bariatric Surgery (ASMBS), the National Lipid Association (NLA), and Obesity Medicine Association (OMA). Surg Obes Relat Dis 2016
265. Neff KJ, Olbers T, le Roux CW: Bariatric surgery: the challenges with candidate selection, individualizing treatment and clinical outcomes. BMC Med 2013 11:8.
266. Dixon JB: Referral for a bariatric surgical consultation: it is time to set a standard of care. Obes Surg 2009 19:641-644.
267. Mechanick JI, Youdim A, Jones DB, Garvey WT, Hurley DL, et al: Clinical practice guidelines for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient--2013 update: cosponsored by American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery. Obesity (Silver Spring) 2013 21 Suppl 1:S1-27.
268. American College of Surgeons (ACS) and the American Society for Metabolic and Bariatric Surgery (ASMBS). Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program https://www.facs.org/quality-programs/mbsaqip (Accessed August 21, 2016).
269. Appachi S, Kashyap SR: 'Adiposopathy' and cardiovascular disease: the benefits of bariatric surgery. Curr Opin Cardiol 2013 28:540-546.
270. Abbatini F, Capoccia D, Casella G, Soricelli E, Leonetti F, Basso N: Long-term remission of type 2 diabetes in morbidly obese patients after sleeve gastrectomy. Surg Obes Relat Dis 2013 9:498-502.

Obesity Medicine Association

Journal References: 271-280

271. Choi J, Digiorgi M, Milone L, Schrope B, Olivera-Rivera L, Daud A, Davis D, Bessler M: Outcomes of laparoscopic adjustable gastric banding in patients with low body mass index. Surg Obes Relat Dis 2010 6:367-371.
272. Gianos M, Abdemur A, Fendrich I, Gari V, Szomstein S, Rosenthal RJ: Outcomes of bariatric surgery in patients with body mass index <35 kg/m2. Surg Obes Relat Dis 2012 8:25-30.
273. Parikh M, Duncombe J, Fielding GA: Laparoscopic adjustable gastric banding for patients with body mass index of <or=35 kg/m2. Surg Obes Relat Dis 2006 2:518-522.
274. Scopinaro N, Adami GF, Papadia FS, Camerini G, Carlini F, Fried M, Briatore L, D'Alessandro G, Andraghetti G, Cordera R: Effects of biliopancreatic diversion on type 2 diabetes in patients with BMI 25 to 35. Ann Surg 2011 253:699-703.
275. Scinta W: Measuring Success: A Comparison of Weight Loss Calculations. Bariatric Times 2012 9:18-20.
276. Albaugh VL, Flynn CR, Tamboli RA, Abumrad NN: Recent advances in metabolic and bariatric surgery. F1000Res 2016 5:
277. O'Brien P: Surgical Treatment of obesity http://www.ncbi.nlm.nih.gov/books/NBK279090/ (Accessed August 22, 2016). Endotext 2000
278. Zepeda Mejia IA, Rogula T: Laparoscopic single-incision gastric bypass: initial experience, technique and short-term outcomes. Ann Surg Innov Res 2015 9:7.
279. Palermo M, Acquafresca PA, Rogula T, Duza GE, Serra E: Late surgical complications after gastric by-pass: a literature review. Arq Bras Cir Dig 2015 28:139-143.
280. Weng TC, Chang CH, Dong YH, Chang YC, Chuang LM: Anaemia and related nutrient deficiencies after Roux-en-Y gastric bypass surgery: a systematic review and meta-analysis. BMJ Open 2015 5:e006964.

Journal References: 281-290

281. Stefater MA, Wilson-Perez HE, Chambers AP, Sandoval DA, Seeley RJ: All bariatric surgeries are not created equal: insights from mechanistic comparisons. Endocr Rev 2012 33:595-622.
282. Kodner C, Hartman DR: Complications of adjustable gastric banding surgery for obesity. Am Fam Physician 2014 89:813-818.
283. Dixon JB, Straznicky NE, Lambert EA, Schlaich MP, Lambert GW: Laparoscopic adjustable gastric banding and other devices for the management of obesity. Circulation 2012 126:774-785.
284. Anderson B, Gill RS, de Gara CJ, Karmali S, Gagner M: Biliopancreatic diversion: the effectiveness of duodenal switch and its limitations. Gastroenterol Res Pract 2013 2013:974762.
285. Billeter AT, Fischer L, Wekerle AL, Senft J, Muller-Stich B: Malabsorption as a Therapeutic Approach in Bariatric Surgery. Viszeralmedizin 2014 30:198-204.
286. Sullivan S, Stein R, Jonnalagadda S, Mullady D, Edmundowicz S: Aspiration therapy leads to weight loss in obese subjects: a pilot study. Gastroenterology 2013 145:1245-1252.e1241-1245.
287. Sarr MG, Billington CJ, Brancatisano R, Brancatisano A, Toouli J, Kow L, Nguyen NT, Blackstone R, Maher JW, Shikora S, Reeds DN, Eagon JC, Wolfe BM, O'Rourke RW, Fujioka K, Takata M, Swain JM, Morton JM, Ikramuddin S, Schweitzer M, Chand B, Rosenthal R: The EMPOWER study: randomized, prospective, double-blind, multicenter trial of vagal blockade to induce weight loss in morbid obesity. Obes Surg 2012 22:1771-1782.
288. Celio AC, Pories WJ: A History of Bariatric Surgery: The Maturation of a Medical Discipline. Surg Clin North Am 2016 96:655-667.
289. Kim SH, Chun HJ, Choi HS, Kim ES, Keum B, Jeen YT: Current status of intragastric balloon for obesity treatment. World J Gastroenterol 2016 22:5495-5504.
290. Imaz I, Martinez-Cervell C, Garcia-Alvarez EE, Sendra-Gutierrez JM, Gonzalez-Enriquez J: Safety and effectiveness of the intragastric balloon for obesity. A meta-analysis. Obes Surg 2008 18:841-846.

Obesity Medicine Association

Journal References: 291-300

291. Frattini F, Rausei S, Boni L, Rovera F, Marco F, Corrado C, Moalli S, Fraschini A, Dionigi G: Gastric plication: how to decrease the size of the stomach without transection. Surg Technol Int 2013 23:84-87.
292. Herron D, Roohipour R: Complications of Roux-en-Y gastric bypass and sleeve gastrectomy. Abdom Imaging 2012 37:712-718.
293. Rogalski P, Daniluk J, Baniukiewicz A, Wroblewski E, Dabrowski A: Endoscopic management of gastrointestinal perforations, leaks and fistulas. World J Gastroenterol 2015 21:10542-10552.
294. Chivot C, Robert B, Lafaye N, Fuks D, Dhahri A, Verhaeghe P, Regimbeau JM, Yzet T: Laparoscopic sleeve gastrectomy: imaging of normal anatomic features and postoperative gastrointestinal complications. Diagn Interv Imaging 2013 94:823-834.
295. Davidson JP, Connelly TM, Libove E, Tappouni R: Gastropericardial fistula: radiologic findings and literature review. J Surg Res 2016 203:174-182.
296. Pauli EM, Beshir H, Mathew A: Gastrogastric fistulae following gastric bypass surgery-clinical recognition and treatment. Curr Gastroenterol Rep 2014 16:405.
297. Spivak H, Favretti F: Avoiding postoperative complications with the LAP-BAND system. Am J Surg 2002 184:31s-37s.
298. Rausa E, Bonavina L, Asti E, Gaeta M, Ricci C: Rate of Death and Complications in Laparoscopic and Open Roux-en-Y Gastric Bypass. A Meta-analysis and Meta-regression Analysis on 69,494 Patients. Obes Surg 2016 26:1956-1963.
299. Karcz WK, Blazejczyk K, Wellner UF, Keck T: [Internal hernias after bariatric surgery]. Chirurg 2015 86:855-860.
300. Azagury D, Liu RC, Morgan A, Spain DA: Small bowel obstruction: A practical step-by-step evidence-based approach to evaluation, decision making, and management. J Trauma Acute Care Surg 2015 79:661-668.

Obesity Medicine Association

Journal References: 301-308

301. Levine MS, Carucci LR: Imaging of bariatric surgery: normal anatomy and postoperative complications. Radiology 2014 270:327-341.
302. Lewis KD, Takenaka KY, Luber SD: Acute Abdominal Pain in the Bariatric Surgery Patient. Emerg Med Clin North Am 2016 34:387-407.
303. Merkle EM, Hallowell PT, Crouse C, Nakamoto DA, Stellato TA: Roux-en-Y gastric bypass for clinically severe obesity: normal appearance and spectrum of complications at imaging. Radiology 2005 234:674-683.
304. Mancini MC: Bariatric surgery--an update for the endocrinologist. Arq Bras Endocrinol Metabol 2014 58:875-888.
305. Ritz P, Hanaire H: Post-bypass hypoglycaemia: a review of current findings. Diabetes Metab 2011 37:274-281.
306. Monkhouse SJ, Morgan JD, Norton SA: Complications of bariatric surgery: presentation and emergency management--a review. Ann R Coll Surg Engl 2009 91:280-286.
307. Mechanick JI, Kushner RF, Sugerman HJ, Gonzalez-Campoy JM, Collazo-Clavell ML, Guven S, Spitz AF, Apovian CM, Livingston EH, Brolin R, Sarwer DB, Anderson WA, Dixon J: American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery Medical Guidelines for Clinical Practice for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. Surg Obes Relat Dis 2008 4:S109-184.
308. Jans G, Matthys C, Bogaerts A, Lannoo M, Verhaeghe J, Van der Schueren B, Devlieger R: Maternal micronutrient deficiencies and related adverse neonatal outcomes after bariatric surgery: a systematic review. Adv Nutr 2015 6:420-429.
309. Sharma AM, Kushner RF. A proposed clinical staging system for obesity. Int J Obesity 2009;33:289-295

Obesity Medicine Association

Disclosures

Disclosures

Harold E. Bays, MD, FTOS, FACC, FACE, FNLA: Dr. Harold Bays and his affiliated research center do not own pharmaceutical stocks or patents. In the past 12 months, Dr. Harold Bays' research site has received research grants from Amarin, Amgen, Alere, Allergan, Arisaph, AstraZeneca, Bristol Meyers Squibb, Catabasis, Cymabay, Dr. Reddy, Eisai, Elcelyx, Eli Lilly, Esperion, Ferrer/Chiltern, Gemphire, Gilead, GSK, Janssen, Johnson and Johnson, Kowa, Merck, Necktar, Nichi-Iko, Novartis, NovoNordisk, Orexigen, Pfizer, Pronova, Regeneron, Sanofi, Selecta, Takeda, and TIMI. In the past 12 months, Dr. Harold Bays has served as a consultant/advisor for Alnylam, Akcea, Amgen, AstraZeneca, Eli Lilly, Ionis (ISIS), Janssen, Johnson & Johnson, Merck, Moderna, Novartis, Procter & Gamble, Regeneron, Sanofi, Teva, and Takeda. In the past 12 months, Dr. Harold Bays has served as a speaker for Amarin, Amgen, Astra Zeneca, Eisai, Orexigen, Regeneron, Sanofi, and Takeda.

Craig Primack, MD, FACP, FAAP: Eisai (advisory board/speaker); Nestle Nutrition; Novo Nordisk (speaker); Takeda/Orexigen (advisory board/speaker); Vivus (advisory board/speaker)

Eric C. Westman, MD, MHS, MFOMA: Adapt Your Life Inc.; HEAL Diabetes & Medical Weight Loss Clinics; Book royalties for *Keto Clarity*, *Cholesterol Clarity*, and *The Adapt Program*

Deborah Bade Horn, DO, MPH, MFOMA: Novo Nordisk (consultant/speaker); Orexigen (consultant/speaker)

Joshua Long, MD, FASMBS: Titan Medical Inc.

Sunil Daniel, MD, FTOS: Novo Nordisk (speaker)

Jennifer Seger, MD: Nothing to disclose

Stacy L. Schmidt, PhD: Nothing to disclose

William McCarthy, MD: Nothing to disclose

Historic Acknowledgement

Historic Citation and Authorship

2016-2017
Bays HE, Seger JC, Primack C, McCarthy W, Long J, Schmidt SL, Daniel S, Horn DB, Westman EC: Obesity Algorithm, presented by the Obesity Medicine Association. www.obesityalgorithm.org. 2016-2017. www.obesityalgorithm.org (Accessed = Insert date)

2015-2016
Seger JC, Horn DB, Westman EC, Primack C, Long J, Clark T, McCarthy W, Bays HE. Obesity Algorithm, presented by the Obesity Medicine Association, 2015-2016.

2014-2015
Seger JC, Horn DB, Westman EC, Primack C, Schmidt SL, Ravasia D, McCarthy W, Ferguson U, Sabowitz BN, Scinta W, Bays HE. Obesity Algorithm, presented by the American Society of Bariatric Physicians, 2014-2015.

2013-2014
Seger JC, Horn DB, Westman EC, Lindquist R, Scinta W, Richardson LA, Primack C, Bryman DA, McCarthy W, Hendricks E, Sabowitz BN, Schmidt SL, Bays HE. Obesity Algorithm, presented by the American Society of Bariatric Physicians, 2013-2014.