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Contact Hours: **1.5**

# Metabolic Syndrome Risk, Diagnosis, and Treatment

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**LEARNING OUTCOME AND OBJECTIVES:** Upon completion of this continuing education course, you will demonstrate knowledge of evidence-based guidelines related to caring for patients with metabolic syndrome. Specific learning objectives to address potential knowledge gaps include:

- Describe the group of patient characteristics that make up metabolic syndrome.
- Discuss the causes and risk factors of metabolic syndrome, including comorbid conditions.
- Discuss how to recognize metabolic syndrome and diagnostic parameters.
- Outline management strategies for the treatment of metabolic syndrome.
- Explain recommended lifestyle changes for prevention of metabolic syndrome.

## WHAT IS METABOLIC SYNDROME?

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Metabolic syndrome (also called *insulin resistance syndrome* or *syndrome X*) is a preventable condition that reflects the modern world's way of living—a sedentary lifestyle and overnutrition, resulting in excess adiposity. With the number of people who are overweight or obese around the world, the incidence of metabolic syndrome is increasing. One quarter of the developed world's population is estimated to have this syndrome, including 3%–5% of children and adolescents, as well as about 1 in 3 adults in the United States (Anagnostics, 2023; NHLBI, 2022c; Noubiap et al., 2022).

A syndrome is a group of symptoms and physical findings that occur together and characterize a particular abnormality or condition for which a direct cause is not necessarily understood. The group of **characteristics that make up metabolic syndrome** include:

- Excess body fat, especially around the waist, defined as a waist circumference  $\geq 40$  inches in males and  $\geq 35$  inches in females
- Elevated serum triglycerides  $\geq 150$  mg/dL or on drug treatment to reduce triglycerides
- Low serum high-density lipoprotein (HDL) cholesterol,  $< 40$  mg/dL in males and  $< 50$  mg/dL in females, or on drug treatment for low HDL cholesterol
- Elevated blood pressure  $\geq 130/85$  mmHg or on drug treatment for hypertension
- Fasting plasma glucose  $\geq 100$  mg/dL or on drug treatment for elevated blood glucose

Having any three of these five criteria constitutes a diagnosis of metabolic syndrome and increases the risk of developing type 2 diabetes and heart disease (Meigs, 2023).

## Causes and Risk Factors for Metabolic Syndrome

There are several causes for metabolic syndrome, and each affects the other. Some of the causes can be controlled; others cannot.

The **major cause** of metabolic syndrome is an individual's weight, especially abdominal adiposity. These fat cells can raise levels of chemicals (fatty acids) that, in turn, can elevate levels of other chemicals and hormones affecting the way the body controls blood sugar levels. Additionally, the body may not respond well to the hormone insulin, affecting how much glucose muscles and organs absorb from blood. This is referred to as *insulin resistance*.

These two factors—free fatty acids and insulin resistance—can raise “bad” LDL cholesterol and lower “good” HDL cholesterol. Insulin resistance can raise blood pressure and blood triglyceride levels.

In addition, the immune system can cause the extra fat cells to produce chemicals that increase inflammation. This can result in atherosclerosis, a buildup of a waxy substance consisting of cholesterol, cellular waste products, calcium, and fibrin inside blood vessels. These “plaques” can rupture, break off, and obstruct blood vessels, culminating in a myocardial infarction or ischemic stroke. Inflammation can contribute to insulin resistance, high blood pressure, and heart and blood vessel diseases (NHLBI, 2022a).

**Risk factors that can be controlled** include:

- Lifestyle habits:
  - Inactivity
  - Unhealthy diet and large-sized portions



- Poor quality and inadequate amount of sleep
- Smoking
- Alcohol use
- Occupation (working long-term night shifts or on schedules that change or rotate, which increases risk of metabolic syndrome due to misalignment of circadian rhythm)

**Risk factors that may not be possible to control include:**

- Age
- Environment (e.g., low socioeconomic status)
- Family history or genetics (e.g., diabetes, metabolic syndrome)
- Other medical conditions or treatments:
  - Overweight and obesity
  - Chemotherapy
  - Hormone changes related to polycystic ovary syndrome
  - Nonalcoholic fatty liver disease, a contributor to diabetes pathophysiology
  - Immune system skin issues such as psoriasis
  - Sleep deprivation, obstructive sleep apnea, and circadian rhythm disorders
  - Some medications for treatment of allergies, bipolar disorder, depression, HIV, and schizophrenia
- Sex  
(NHLBI, 2022a)

## **Comorbid Diseases Associated With Metabolic Syndrome**

People with metabolic syndrome are at risk for a long list of health problems, including:

- Type 2 diabetes mellitus
- Carotid atherosclerosis, arterial aging, aortic stiffening, and vascular conditions, including stroke, peripheral vascular disease, and coronary artery disease
- Nonalcoholic fatty liver disease (NAFLD) and nonalcoholic steatohepatitis, which can lead to cirrhosis, liver failure, or liver cancer
- Gall bladder and kidney damage
- Endothelial dysfunction, vascular remodeling, and thrombosis, including deep vein thrombosis (DVT) and pulmonary embolism (PE)
- Pregnancy complications



- Erectile dysfunction
- Serious complications from infections  
(Alshammary et al., 2021; ALF, 2023; Stewart & Kline, 2020)

## RECOGNIZING AND DIAGNOSING METABOLIC SYNDROME

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The first step in making a diagnosis of metabolic syndrome requires the recognition of cues (signs and symptoms), followed by interpretation and validation of the interpretation with diagnostic studies.

### Signs and Symptoms of Metabolic Syndrome

A patient who presents with the following signs and symptoms raises the concern for metabolic syndrome and leads to further exploration. These signs and symptoms may include:

- **Obesity**, particularly abdominal adiposity
- **Symptoms of hyperglycemia**, including polyuria, polyphagia, blurry vision, restlessness, fatigue especially after eating a meal, and poor wound healing
- **Retinopathy**, which can result in visual impairment
- **Peripheral neuropathy**, including numbness, impairment of balance, weakness, tremors, cramps, and gait abnormalities
- **Chest pain (angina)**
- **Shortness of breath**
- **Acanthosis nigricans**, a brown to black hyperpigmentation of the skin with poorly defined margins and a velvety texture usually found in skin folds (axilla, navel, groin, neck)
- **Xanthomas** and **xanthelasmas**, yellow lipid deposits under the skin of the elbows, joints, tendons, knees, hands, feet, buttocks, and eyelids (xanthelasmas)
- **Female hirsutism** (male-patterned hair growth)  
(Wang, 2020; Ikomi, 2022; Davidson & Pradeep, 2023; Dahl, 2021; Culala, 2021)

### Diagnosing Metabolic Syndrome

Assessment for a diagnosis of metabolic syndrome begins with a medical and social history, review of systems, and physical examination.



## HISTORY AND REVIEW OF SYMPTOMS

A **medical history** offers important information that can help to confirm the diagnosis and determine the extent of the problem. A person who has metabolic syndrome may already have been diagnosed with some components of the syndrome, such as obesity, hypertension, or dyslipidemia. A major complication of the syndrome (e.g., atherosclerotic artery disease, ischemic heart disease, diabetes) may also be present.

Because metabolic syndrome involves a patient's diet and lifestyle, a history should include dietary habits as well as exercise and level of activity. A history of polycystic ovary syndrome (PCOS), immune system diseases such as psoriasis or treatment for cancer (both of which affect regulation of systemic metabolic homeostasis), history of gestational diabetes, sleep problems such as apnea, as well as medications used to treat allergies, bipolar disorder, depression, HIV, and schizophrenia should be obtained, all of which elevate risk for metabolic syndrome.

**Family history** is important because genetics can play a major role in the development of the syndrome. A family history that includes obesity, type 2 diabetes, and/or insulin resistance greatly increases the chance that the patient will develop metabolic syndrome.

**Social history** can be significant, providing clues to other risk factors, such as smoking, which reduces insulin sensitivity and contributes to abdominal obesity in both sexes. Heavy alcohol consumption (five or more drinks on any day or 15 or more per week for men, and four or more on any day or eight or more drinks per week for women) correlates with low serum HDL cholesterol levels, raised serum triglycerides, higher waist circumferences, and hyperinsulinemia. In contrast, mild-to-moderate consumption (no more than one to two drinks per day for men and no more than one drink per day for women) lowers the level of insulin and serum lipids. Obstructive sleep apnea decreases the level of HDL besides increasing the level of glucose, body weight, insulin resistance, and cardiovascular risk.

A thorough **review of systems** can be helpful for identifying related problems such as menstrual irregularities seen in polycystic ovarian syndrome (Swarup et al., 2022; Mohamed et al., 2023).

**A list of current medications** can help assess causes for overweight or obesity. Medications known to increase body weight can include:

- Psychiatric medications
  - Antipsychotics (e.g., risperidone, haloperidol)
  - Lithium
  - Antidepressants
    - SSRIs (e.g., citalopram)
    - SNRIs (e.g., venlafaxine)
    - Tricyclics (e.g., imipramine)
- Antiepileptic medications (e.g., valproate, carbamazepine, gabapentin)



- Antidiabetic medications (e.g., rosiglitazone, insulin)
- Steroids (e.g., prednisone, hormonal contraceptives, inhaled corticosteroids)
- Antihistamines (e.g., diphenhydramine, cetirizine)  
(Singh et al., 2021; Kumar, 2022; Watson, 2022)

### ***Assessing Children and Adolescents***

Since 1980, the prevalence of obesity among children and adolescents has almost tripled. Thirty-two percent of children in the United States are now overweight or obese (Johns Hopkins Medicine, 2023).

While assessment of metabolic syndrome in adults relies on criteria established by national or international agencies, assessment among children and adolescents has not been as clear. Most assessments have relied on adaptations based on adult criteria.

Child and adolescent assessment includes:

- General medical history
- Prenatal and birth history:
  - Maternal obesity
  - Maternal gestational diabetes
  - Maternal smoking
  - Gestational age
  - Birth weight
  - Neonatal concerns
- Developmental history, including:
  - Any delays in motor, speech, or cognitive developmental and therapy received
  - Infant feeding, including breastfeeding and duration
  - Timing of introduction of complementary foods
- Current medications, such as:
  - Glucocorticoids
  - Antiepileptics
  - Antipsychotics
- Growth history:
  - Height and weight growth trajectories
  - Onset of obesity and timing of weight concerns of child, adolescent, and family
  - Previous obesity management, whether supervised or self-initiated



- Previous and current dieting and exercise behaviors
- Use of supplements
- Sleep routines, presence of snoring, or possible sleep apnea
- Exercise tolerance
- Specific signs and symptoms, including:
  - Acne
  - Hirsutism (girls)
  - Morning headache and visual disturbance
  - Nocturnal enuresis
  - Constipation
  - Hip and knee joint pain
  - Gastrointestinal complaints
  - Menstrual history
- Social history, including:
  - Use of tobacco, alcohol, or recreational drugs
  - Family income and food insecurity
- Behavioral risk factors:
  - Nutrition and eating behaviors
  - Physical activity
  - Sedentary behaviors
    - Time spent sitting
    - Screen time per day
    - Patterns of screen viewing
    - Use of social media

(Jebeile et al., 2022)

### **METABOLIC SYNDROME AND FETAL BRAIN DEVELOPMENT**

Large studies have shown consistent associations between maternal-fetal hyperglycemia and consequent fetal hyperinsulinemia, chronic intrauterine tissue hypoxia, inflammation, and other factors that play a role in abnormal fetal and offspring brain development in the setting of maternal diabetes and metabolic syndrome (Edlow, 2021).



## PHYSICAL EXAM

The physical examination provides crucial information, including elevated blood pressure and abdominal obesity, which are two of the five diagnostic criteria for metabolic syndrome.

The patient is also assessed for physical manifestations of insulin resistance and dyslipidemia (peripheral neuropathy, retinopathy, acanthosis nigricans, hirsutism, xanthomas, xanthelasma). The clinician listens for arterial bruits, which may indicate atherosclerotic disease (Swarup et al., 2022).

### *Measuring for Obesity*

The most commonly used measure of obesity is **body mass index (BMI)**, which is measured using the formula:

$$\text{BMI} = \text{weight in kilograms} \div \text{height in meters squared}$$

**or**

$$\text{BMI} = \text{weight in pounds} \times 703 \div \text{height in inches squared}$$

BODY MASS INDEX CLASSIFICATIONS		
Classification	BMI (kg/m <sup>2</sup> )	
Normal	18.5–24.9	
Overweight	25.0–29.9	
Obese	Class 1	30.0–34.9
	Class 2	35.0–39.9
	Class 3 (extreme obesity)	>40.0
(CDC, 2022a)		

BMI is interpreted differently for children and teens even though it is calculated with the same formula. Due to changes in weight and height with age, as well as their relation to body fatness, BMI levels among children and adolescents are expressed relative to other children of the same sex and age (CDC, 2022b).

Body mass index, though common, is a controversial method, as it cannot differentiate fat mass from lean mass or subcutaneous from visceral fat. Also, abdominal adiposity is harmful even when BMI is low. Because it matters where excess weight is carried, **waist-to-hip ratio (WHR)** is recommended as a more accurate measurement than BMI for determining the risk for developing serious health conditions. WHR has a stronger causal effect on risk of mortality regardless of the levels of adiposity and body composition (Kahn et al., 2022b).





### HOW TO DETERMINE WAIST-TO-HIP RATIO

- Measure the waist circumference at the mid-point between the last palpable rib and the top of the iliac crest.
- Measure the hip circumference around the widest portion of the buttocks with the tape measure parallel to the floor.
- Calculate waist-to-hip ratio by dividing waist circumference by hip circumference ( $W \div H$ ).

Example: A 28-inch waist divided by 35-inch hip = WHR of 0.8.

(Koperska, 2023)

METABOLIC SYNDROME AND WAIST-TO-HIP RATIO		
Risk level	WHR (men)	WHR (women)
Low	$\leq 0.95$	$\leq 0.80$
Moderate	0.96–1.0	0.81–0.85
High	$> 1.0$	$\geq 0.86$

(Koperska, 2023)

### Measuring Blood Pressure

The second component of metabolic syndrome that can be picked up in a physical exam is high blood pressure. To be used as a diagnostic condition for metabolic syndrome, an adult's blood pressure must be  $>130/85$  mmHg (AHA, 2023). If a person is already taking antihypertensive medication, it is assumed that their blood pressure would normally be  $>130/85$  mmHg.

BLOOD PRESSURE RANGES (mmHg)			
Level	Systolic	And/or	Diastolic
Normal	$<120$	and	$<80$
Elevated	120–129	and	$<80$
Hypertension, stage 1	130–139	or	80–89
Hypertension, stage 2	$\geq 140$	or	$\geq 90$
Hypertensive crisis	$>180$	and/or	$>120$

(AHA, 2023)

A child or adolescent is diagnosed with hypertension when their average blood pressure is at or above the 95th percentile for their age, sex, and height when measured multiple times over three visits or more (Johns Hopkins Medicine, 2023).



## DIAGNOSTIC STUDIES

The most common diagnostic studies for metabolic syndrome are for dyslipidemias, as shown in the table below.

BLOOD LIPID TESTING	
Test	Concentrations (in mg/dL)
Fasting blood glucose	Normal: 70–100
Fasting triglycerides	Normal: <150 Borderline high: 150–199 High: 200–299 Very high: >500
Fasting total cholesterol	Normal: <200 Borderline high: 200–239 High: ≥240
Fasting HDL cholesterol	Poor: <40 for men, <50 for women Better: 40–50 for men, 50–59 for women Best: ≥60
LDL cholesterol	Normal: <70 Optimal: <100 Near optimal: 100–129 Borderline high: 130–159 High: 160–189 Very high: ≥190

Metabolic syndrome is characterized by fasting blood triglycerides >150 mg/dL and fasting blood HDL cholesterol <40 mg/dL in men and <50 mg/dL in women (Meigs, 2023).

**Additional studies** to consider include:

- Hemoglobin A1C (HbA1c)
- Thyroid studies
- Oral glucose tolerance test (AGTT)
- Serum BUN and creatinine
- Uric acid
- Liver studies (alanine transaminase [ALT], aspartate transaminase [AST])

Although not routinely done for the diagnosis of metabolic syndrome, **imaging studies** may be appropriate for patients with signs and symptoms of complications of the syndrome, such as chest pain, dyspnea, claudication, or obstructive sleep apnea. These may include:

- Rest/stress ECG
- Vascular or rest/stress echocardiography



- Stress single-photon emission computed tomography (SPECT)
- Cardiac positron emission tomography (PET)
- Nocturnal polysomnography testing for sleep-related breathing disorder (Wang, 2020; Johns Hopkins Medicine, 2023)

## DIFFERENTIAL DIAGNOSES

Additional diagnoses are considered for each of the criteria used to identify patients with metabolic syndrome. For example, in patients with hypertension, investigation for secondary causes—such as obstructive sleep apnea or other sleep-related breathing disorders, renovascular disease, or disorders of renin and aldosterone metabolism—may be warranted under appropriate circumstances.

Alternative causes of hyperglycemia may include not only diabetes mellitus but also thyroid dysfunction, Cushing’s syndrome, and rarer endocrinopathies, such as glucagonomas and pheochromocytomas (Wang, 2020).

### CASE

#### Assessment and Diagnosis

Sharon is a 52-year-old female patient who has come to the physician’s office for follow-up after a recent blood pressure reading obtained at her local pharmacy was elevated. She is initially seen by Maria, the RN. The patient also reports a gradual onset of raised yellowy, waxy-appearing papules on her arms, legs, and torso. She complains of excessive thirst and having to get up several times during the night to urinate.

As part of her family history, Sharon expresses concern that she may have diabetes, since her mother has diabetes and has had those same symptoms. Sharon also reveals that her father has heart disease and that both her parents have high cholesterol and are taking medication for it. She states that for the past 10 years, she has had increasing problems keeping her weight under control and even more so now that she has gone through menopause. She states that she would like to exercise more, but with the excess weight, some joint pain, and shortness of breath, she has not been able to perform any regular exercise.

Maria asks Sharon about her dietary and behavioral habits, and Sharon reports that she is a carbohydrate lover, especially pasta dishes, and likes to do a lot of baking. She does not eat many fruits and vegetables, prefers quick-to-prepare processed foods, and loves pizza and other takeout meals. She drinks two glasses of wine everyday with her dinner and has no history of smoking.

Sharon’s vital signs are taken and show a blood pressure of 187/93 mmHg after resting for 5 minutes and pulse and respirations within normal range.

Sharon appears to be obese, prompting Maria to measure her waist circumference (41 inches) and hip circumference (46 inches). Her waist-to-hip ratio (0.89) places Sharon in the high-risk



category for serious health conditions. The physical exam reveals clear lungs, soft and nontender abdomen, absence of edema, and presence of retinopathy. Her arms, legs, and torso show multiple xanthomas.

Maria suspects that Sharon may have metabolic syndrome due to hypertension, presence of xanthomas, possible diabetes, and dyslipidemia. She discusses her findings with the physician, who agrees with Maria's suspicion of metabolic syndrome. Blood samples for laboratory testing are obtained and sent to the lab. Sharon is scheduled for a return visit to review the results of her lab tests and for a repeat blood pressure reading.

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## TREATING METABOLIC SYNDROME

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The individual components of metabolic syndrome—abdominal obesity, high triglycerides, low HDL cholesterol, high blood pressure, and high fasting glucose—would not always be treated if found in isolation. When found together, however, metabolic syndrome is typically diagnosed, indicating the need for treatment. Treatment begins with lifestyle modifications, and pharmacotherapy may be introduced when those changes are insufficient.

**Treatment goals** for metabolic syndrome are:

- Lowering the risk of heart disease
- Preventing the development of type 2 diabetes (NHLBI, 2022b)

Treating metabolic syndrome requires a **disciplinary team**, including:

- Primary care practitioners, who screen and diagnose metabolic syndrome, treat different components of the syndrome, and make referrals to other professionals
- Endocrinologists, whose goal is to restore hormonal balance and restore metabolism
- Cardiologists, who play an advisory role or a coordinating role as specialists in the overall management of patients with increased cardiometabolic risks
- Nurses, who develop management strategies including education, planning and recommendations for physical exercise, dietary education and planning, medication management, and psychosocial support
- Occupational therapists, who provide knowledge and expertise in environmental supports, barriers, and modifications to support habit formation and change
- Physical therapists, who provide exercise training to improve factors underlying metabolic syndrome
- Dietitians and nutritionists, who counsel patients on nutrition issues and healthy eating



habits

(Dobrowolski et al., 2022; Epley et al., 2021; Noghabi, 2021; Physiopedia, 2023)

## Therapeutic Lifestyle Changes

Heart-healthy lifestyle changes, including smoking cessation, are the first line of treatment for metabolic syndrome. Weight loss and increased physical activity are aimed at reversing the direct causes of the condition, and nutrition management is focused on a diet of heart-healthy foods (NHLBI, 2022b).

### PHYSICAL ACTIVITY AND EXERCISE

All aspects of metabolic syndrome benefit from increased physical activity. Physical exercise helps with losing weight and maintaining weight loss, and it has additional independent metabolic effects that directly reduce insulin resistance. Physical activity is usually a safe and beneficial treatment for people with metabolic syndrome and its associated consequences of atherosclerotic cardiovascular disease and type 2 diabetes.

The American Heart Association (2021) recommends the following physical activity for adults for overall cardiovascular health:

- Getting at least 150 minutes per week of moderate-intensity aerobic activity or 75 minutes per week of vigorous aerobic activity (or a combination of both), preferably spread through the week
- Moving more and sitting less throughout the day to offset the serious health risks of being sedentary
- Adding intensity, since moderate to vigorous aerobic exercise is best
- Adding muscle by including moderate-to-high-intensity muscle-strengthening activity

Patients may also benefit from partnering with others in activities such as swimming, biking, or walking groups to motivate and support one another to reach their goals.

### DIETARY MODIFICATIONS

Exercise alone rarely leads to significant weight loss. A heart-healthy diet is usually also necessary, and nutrition planning is the second critical component of the initial treatment of metabolic syndrome.

#### **FOODS TO AVOID**

When recommending dietary changes, it is beneficial at the start to help the patient focus on foods to be phased out, including:



- **Refined carbs:**
  - White flour
  - Sugary snacks
  - Beverages containing sugar
- **Saturated fats** (found in):
  - Red meat
  - Whole-milk dairy products
  - Many baked goods
- **Trans fats** (found in):
  - Fried foods
  - Margarine
  - Baked goods
  - Snack foods
  - Refrigerated doughs
  - Coffee creamers
- **Cured meats** (which are high in sodium):
  - Hot dogs
  - Bacon
  - Deli meats
  - Sausages
- **Processed foods**, such as packaged foods and fast foods, which contain refined carbs, added sugar, high sodium content, hydrogenated oils, corn syrup, and saturated fats

### ***HEART-HEALTHY FOODS***

Once “unhealthy” foods are removed from the diet, meals can be built around heart-healthy alternatives, particularly whole, plant-based foods. A heart-healthy, balanced diet includes:

- **Vegetables** rich in complex carbohydrates that can help prevent blood sugar spikes, help in weight loss, and lower LDL cholesterol:
  - Nonstarchy vegetables (e.g., salad greens, broccoli, peppers)
  - Starchy vegetables that are higher in fiber (e.g., beans, lentils, chickpeas)
- **Whole grains** that reduce postprandial blood glucose and peripheral insulin resistance (e.g., barley; bulgur [cracked wheat]; farro; millet; quinoa; black, brown, and red rice; oats)



- **Omega-3 fatty acids** to help increase HDL, lower LDL cholesterol, and reduce triglycerides (e.g., nuts, seeds, and fatty fish such as salmon, mackerel, sardines, albacore tuna, anchovies)  
(Cleveland Clinic, 2021)

**Diet plans** recommended for metabolic syndrome include:

- Mediterranean diet
- Low-carbohydrate diets
- Vegetarian diet
- Intermittent fasting
- DASH diet  
(Cleveland Clinic, 2021)

## SMOKING CESSATION

Smoking is a lifestyle factor that can increase the risk for metabolic syndrome since it exerts negative effects on abdominal obesity, blood pressure, blood glucose concentrations, and blood lipid profiles. Smoking may also negatively affect other factors that influence glucose and lipid metabolism. Metabolic syndrome risk may initially increase after smoking cessation possibly due to weight gain (Cleveland Clinic, 2023).

### CASE

*(Continued)*

#### **Treatment Planning**

Today Sharon returns for a follow-up appointment. At her previous appointment, Sharon's blood pressure was 187/93 mmHg. Today nurse Maria again obtains an elevated blood pressure reading of 189/94 mmHg.

Sharon's blood test results are also in and show elevated levels of blood triglycerides (160 mg/dL), HDL cholesterol (43 mg/dL), total cholesterol (220 mg/dL), LDL cholesterol (148 mg/dL), and fasting blood glucose (142 mg/dL). Reviewing the laboratory results and the physical examination findings, the physician confirms the suspected diagnosis of metabolic syndrome.

Next, the physician and nurse discuss possible therapeutic recommendations with Sharon, including both lifestyle changes and medications to control her blood pressure. A treatment plan is outlined, with prescriptions for an antihypertensive, a cholesterol lowering medication. An appointment is made for a repeat fasting blood glucose test.

Maria then discusses dietary and physical activity measures to help Sharon lose weight and improve her diet. Maria describes the benefits of the Mediterranean diet for managing the



various components of metabolic syndrome. While reviewing the components of the diet, they look together at an educational booklet that outlines how to follow the Mediterranean diet model, with practical menu suggestions and a baseline assessment about knowledge of the healthy food choices included in the model. Sharon mentions that the diet seems easier than she imagined to follow and states that she will start to shop and plan her meals better with this information. Maria also makes an appointment for Sharon to see a physical therapist to develop an exercise plan.

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## Pharmacologic Management

When lifestyle changes in diet and exercise are insufficient, medications may be introduced to manage the condition's various components of hypertension, hyperglycemia, dyslipidemia, obesity, and prothrombotic state. Drugs prescribed for metabolic syndrome are listed in the table below.

MEDICATIONS FOR METABOLIC SYNDROME	
Drug class	Examples
Antihypertensives	<ul style="list-style-type: none"><li>• ACE inhibitors</li><li>• Angiotensin II receptor blockers</li><li>• Diuretics</li><li>• Beta blockers</li><li>• Calcium channel blockers</li></ul>
Dyslipidemia medications	<ul style="list-style-type: none"><li>• Statins such as Lipitor and simvastatin</li><li>• Niacin</li><li>• Bile acid resins such as Questran</li></ul>
Hyperglycemia medications	<ul style="list-style-type: none"><li>• Metformin (Glucophage)</li><li>• Rosiglitazone (Avandia)</li><li>• GLP-1 inhibitors (Ozempic injectable, Trulicity injectable)</li></ul>
Anti-obesity medications	<ul style="list-style-type: none"><li>• Liraglutide (Saxenda) injectable</li><li>• Orlistat (Xenical by prescription, low-dose over-the-counter Alli)</li><li>• Phentermine (Adipex-P, Lomaira)</li><li>• Phentermine-Topiramate (Qsymia)</li><li>• Semaglutide (Wegovy injectable)</li></ul>





Prothrombin state medication	<ul style="list-style-type: none"><li>• Low-dose aspirin to reduce heart attacks and stroke</li></ul>
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(NHLBI, 2022b; Mayo Clinic, 2022a; Meigs, 2023)

## Cognitive Behavioral Therapy

Changing one's lifestyle requires guidance and determination. Losing weight and making other lifestyle changes is challenging. The therapeutic process often involves working with a practitioner, such as an occupational therapist, to identify and alter recurring negative patterns of thought and behavior.

Cognitive behavioral therapy (CBT) trains individuals to recognize automatic thoughts, assess them objectively, and develop alternative, more balanced, and rational thoughts. CBT concentrates on modifying problematic behaviors through:

- Setting mutually agreed-upon goals
- Eliminating maladaptive behaviors that prevent goal achievement
- Replacing maladaptive behaviors with constructive behaviors that meet the agreed-upon goals

Research has shown that CBT focused on changes in lifestyle are effective in the reduction of metabolic syndrome and cardiovascular risk factors (Nash, 2022).

### CASE

*(Continued)*

#### Supporting Lifestyle Changes

Sharon returns to the clinic for repeat fasting blood sugar, which shows an elevated reading of 156 mg/dL, and meets with the nurse, Maria. Her blood pressure reading today was 134/82 mmHg, showing improvement with the antihypertensive medication. Maria discusses Sharon's latest blood glucose reading with the physician, who provides Sharon with a prescription for Metformin. Maria discusses the side effects of this medication with Sharon.

Maria then asks Sharon how well she's been managing her dietary and exercise regimen. Sharon states that she has not yet had a chance to try out the Mediterranean diet. She asks Maria to remind her about what strategies she should try at home, since she is "getting all confused about these new foods." Maria asks Sharon if she would like to set up an appointment with a dietitian to help her develop a more specific dietary plan, and Sharon gives a sigh of relief, saying that she has always had "difficulty losing weight and exercising" on her own.



Maria asks Sharon about her upcoming appointment with the physical therapist to develop an exercise plan. Sharon suddenly bursts out in tears and reveals that she feels overwhelmed. She is afraid that she'll never lose weight or get in shape and that she's "going to get diabetes just like my mom" or "heart disease just like my dad."

Assessing that Sharon may benefit from additional therapy to make such big lifestyle changes, Maria asks if she would be interested in meeting with an occupational therapist who can help her learn how to tackle the big challenges she is facing. Again, Sharon gives a sigh of relief and jokes that she "can use all the help I can get!"

## Surgery

Bariatric surgery may be recommended when diet and exercise have failed to effectively reduce severe obesity and when the patient has serious health problems because of excessive weight. Some surgical procedures limit how much a person can eat, while others work by reducing the body's ability to absorb nutrients. Some procedures do both. It is important that patients who undergo bariatric surgery receive life-long lifestyle support and medical monitoring.

### TYPES OF BARIATRIC SURGERY

- **Roux-en-Y gastric bypass** (gastric bypass) is one of the most common bariatric surgical procedures. The surgeon creates a small pouch the size of a walnut at the top of the stomach and attaches a narrow portion of the small intestine directly to the pouch. Since the pouch can hold only about 1 ounce of food, this limits the amount of food a person can eat as well as the calories and nutrients absorbed.
- **Laparoscopic adjustable gastric banding** (lap banding) is a procedure that involves placing a band with an inflatable balloon around the upper part of the stomach. The band restricts the size of the stomach as well as narrows the opening to the rest of the stomach. A port placed under the skin in the abdominal area is connected and used to inflate or deflate the band to adjust the size. This procedure restricts the amount of food intake with an early feeling of fullness.
- **Sleeve gastrectomy** (gastric sleeve) is a procedure involving the surgical removal of about 80% of the stomach. The remaining part of the stomach is formed into a smaller tube-like structure. The smaller stomach restricts the amount of food intake and decreases the production of ghrelin (a hormone that regulates the appetite).
- **Duodenal switch with biliopancreatic diversion** begins with the removal of a large part of the stomach, leaving the connection to the first part of the small intestine (duodenum). The middle section of the small intestine is closed off and reattached to the end of the intestine, allowing the bile and pancreatic juices to flow normally. As a result, the patient has a smaller stomach, restricting food intake as well as limiting absorption because food bypasses most of the small intestine.  
(Mayo Clinic, 2022b)



## POSTSURGICAL MANAGEMENT

Patients must be educated preoperatively so that they understand they will require lifelong follow-up by a multidisciplinary team to monitor body weight and compliance with the post-surgical regimen necessary for long-term success and micronutrient deficiency detection.

Post discharge, patient management includes assessment of hydration and micronutrient status, as well as assessment of medical comorbid conditions, such as hypertension, diabetes, and sleep apnea. Additional comorbid illness that may develop long-term include:

- Dumping syndrome
- Marginal or gastrojejunal ulcers
- Cholelithiasis
- Nephrolithiasis
- Depression
- Post sleeve gastrectomy stenosis (Hamad, 2023)

## PREVENTING METABOLIC SYNDROME

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At each stage of life, strategies can be implemented to reduce the chance of developing metabolic syndrome. Many metabolic disorders cannot be prevented, as their causes are either genetic or unknown. Metabolic syndrome, however, can be prevented by applying the same measures recommended for management of the syndrome after it has developed.

Prevention measures for **adults** include:

- Eating heart-healthy foods
- Aiming for and maintaining a healthy weight
- Reducing sedentary time and getting regular physical activity
- Managing stress
- Quitting smoking and avoiding secondhand smoke
- Limiting alcohol intake
- Getting enough good-quality sleep (NHLBI, 2022b)

In order to prevent metabolic syndrome in **children and adolescents**, the American Academy of Pediatrics recommends:

- Improving what children and adolescents eat and drink to help prevent obesity and the



development of insulin resistance

- Encouraging physical activity, which can improve blood pressure, cholesterol, and sensitivity to the effects of insulin
- Monitoring screen time, since the number of hours a child spends daily in front of a screen is directly related to body mass index and calories consumed per day
- Getting adequate sleep, since short sleep duration inversely predicts cardiometabolic risk in teens
- Avoiding tobacco smoke exposure, which greatly increases a child's risk for developing heart disease  
(Magge, 2021)

## CONCLUSION

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Metabolic syndrome is a common health problem and has reached epidemic proportions in the United States and around the world. Having metabolic syndrome increases the risk that a person may develop diabetes and cardiovascular disease, especially in men over 45 years of age and women over 55 years of age. The syndrome is the combination of:

- Insulin resistance
- Excess intra-abdominal fat
- Unhealthy levels of fats in the blood (high triglycerides and low HDL cholesterol)
- High blood pressure

Treatment of metabolic syndrome begins with therapeutic lifestyle changes. Weight loss, improved diet, and regular physical exercise are important elements of the initial treatment program as well as key measures for prevention. Medications may be recommended to treat those components of metabolic syndrome (e.g., high blood pressure, hypercholesterolemia) that do not improve sufficiently with therapeutic lifestyle changes alone. More drastic measures to reduce obesity include different forms of bariatric surgery.



## RESOURCES

Metabolic syndrome (Mayo Clinic)

<https://www.mayoclinic.org/diseases-conditions/metabolic-syndrome/symptoms-causes/syc-20351916>

Metabolic syndrome (MedicineNet.com)

[https://www.medicinenet.com/metabolic\\_syndrome/article.htm](https://www.medicinenet.com/metabolic_syndrome/article.htm)

Metabolic syndrome (National Library of Medicine)

<https://medlineplus.gov/metabolicsyndrome.html>

What is metabolic syndrome? (American Heart Association)

<https://www.yourethecure.org/what-is-metabolic-syndrome>

What is metabolic syndrome? (National Heart, Blood, and Lung Institute)

<https://www.nhlbi.nih.gov/health/metabolic-syndrome>

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## TEST

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1. 1. In addition to excess body fat around the waist and obesity, which characteristics constitute a diagnosis of metabolic syndrome?
  - a. a. Hypoglycemia and high HDL cholesterol
  - b. b. Hypertension and low HDL cholesterol
  - c. c. Pulmonary hypertension and insulin sensitivity
  - d. d. Hypotension and low LDL cholesterol
  
2. 2. Which two comorbidities are commonly associated with metabolic syndrome?
  - a. a. Colon cancer and stroke
  - b. b. Coronary heart disease and type 2 diabetes
  - c. c. Pulmonary hypertension and portal hypertension
  - d. d. Breast cancer and prostate cancer
  
3. 3. Which information is added to a standard assessment when assessing a child or adolescent for metabolic syndrome?
  - a. a. List of current medications
  - b. b. Prenatal and developmental history
  - c. c. Sleep routines
  - d. d. Nutrition and eating behaviors
  
4. 4. Which clinical measurement is the **most** useful for diagnosing metabolic syndrome?
  - a. a. Body mass index
  - b. b. Blood pressure
  - c. c. Waist measurement
  - d. d. Waist-to-hip ratio
  
5. 5. Which outcome is associated with physical exercise by patients with metabolic syndrome?
  - a. a. Increased blood levels of LDL cholesterol
  - b. b. Reduced blood levels of HDL cholesterol
  - c. c. Reduced insulin resistance
  - d. d. Increased blood pressure
  
6. 6. Which two lifestyle changes can help prevent metabolic syndrome?
  - a. a. Increasing calories and adding more dietary fats
  - b. b. Drinking more fruit juices and taking a multivitamin
  - c. c. Maintaining a healthy weight and exercising regularly
  - d. d. Avoiding alcohol and reducing salt intake

