



Nutrition & Diagnosis-Related Care

EIGHTH EDITION

SYLVIA ESCOTT-STUMP

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FOREWORD

This book is a valuable resource for registered dietitian-nutritionists, dietetic interns and students, and other health care professionals involved or interested in medical nutrition therapy. Efficient time management is required to deliver high-quality patient care. However, the registered dietitian-nutritionist (RDN) must be both efficient *and* effective. Tools such as Hot Topics related to inflammation will trigger important critical thinking, as will the content related to gene–nutrition interactions and the nutrition care process. Indeed, this latest edition provides key updates for prioritizing patient care and planning nutrition therapies.

The guidance provided by *Nutrition and Diagnosis-Related Care* charts the course for each patient, especially for clinical conditions that the practitioner does not routinely treat. This book presents an extensive yet succinct compilation of nutrition information. The most impressive attribute is that the germane information required by dietitians is presented in a single resource. This greatly simplifies the development of nutrition care plans and interventions. Thus, dietetic practitioners have this superb resource to provide evidence-based interventions and to achieve excellent patient outcomes.

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PREFACE

Health care professionals must identify all elements of patient care capable of affecting nutritional status and outcomes. The registered dietitian-nutritionist (RDN) must provide nutritional care in a practical, efficient, timely, and effective manner regardless of setting. Various environments provide unique and special considerations. The astute dietitian is sensitive to the patient/client's current status in the continuum of care, meticulously adapting the nutritional care plan. Communication between facilities saves time for screenings and assessments and will simplify making progress with interventions. With electronic health records, data and summary reports must be shared confidentially from one practitioner to the next.

Nutrition and Diagnosis-Related Care has evolved since 1985 to supplement other texts and references and to quickly assimilate and implement medical nutrition therapy (MNT). This guide can be used to help write protocols, establish nutrition priorities, and demonstrate cost-effective therapies. The majority of disorders are described where nutrition interventions can decrease complications, further morbidity, and lengthy hospital stays. Adequate nutritional intervention often results in financial savings for the patient, the family, and the health care system.

Evidence-based knowledge solidifies the role of nutrition as therapy and not just a basic daily requirement. The eighth edition updates and clarifies the current status of nutrition therapy guidance. A major factor influencing health is **inflammation**. For example, a recent study provided vitamin D, omega-3 fatty acids, melatonin, and methylated vitamin B_{12} to individuals with Alzheimer's disease. Results have shown improvement in overall functioning. Thus, **Hot Topic** boxes provided in this edition hone in on the current knowledge about the role of nutrition in reducing inflammatory conditions.

The format of the book continues to promote easy navigation for quick retrieval of information. Appendix A summarizes the nutrients, requirements, functions, and food sources. Appendix B highlights the nutrition care process for the profession of dietetics. Sample forms are included, including language related to the critical thinking involved with A-D-I (assessment, nutrition diagnosis, interventions) and M-E (monitoring and evaluation). The nutritional acuity level ranking for prioritizing dietitian services is found in Appendix C. As nutrition knowledge continues to evolve at a rapid pace, the Recommended Dietary Allowances (RDA) and Dietary Reference Intakes (DRI) tables included in prior editions of this text should now be accessed online to ensure that the most current information is used. The tables are available at http://fnic.nal.usda.gov/dietary-guidance/dietary-reference-intakes/dri-tables.

The field of dietetics continues to be a focus for health promotion and disease prevention. The profession is a top career choice for making a difference in people's lives: changing them for the better!

ASSUMPTIONS ABOUT THE READER

For this text, the following assumptions have been made:

1. The reader has an adequate background in nutrition sciences, physiology and pathophysiology, medical terminology, biochemistry, basic pharmacotherapy, and interpretation of biochemical data to understand the abbreviations, objectives, and interventions in this book.
2. An individualized drug history review is essential, as only a few medications are included here. Note as well that drugs are often removed from the market; check with a pharmacist for more guidance.
3. Herbs, botanicals, and dietary supplements are discussed because they are often used without prior consultation with a dietitian or a physician. They have side effects as well as perceived or real benefits. Products may be "natural" but not necessarily "safe" for an individual.
4. For teaching, the nutrition professional must provide appropriate handouts, printed materials, and teaching tools to prepare the patient for independent functioning. The educator must identify teachable moments and share what is needed at the time. "More information" is not always the best option for a single intervention. When possible, multiple visits should be scheduled to address nutrition and lifestyle changes.
5. The nutrition counselor must use evidence-based techniques with the patient and significant other(s). Follow-up interventions are highly recommended to evaluate successful behavioral changes by the patient/client. Appendix B provides a brief overview; the reader must devote adequate time to develop counseling skills that will achieve desirable outcomes.
6. Dietitians must prioritize nutritional diagnoses that can be managed within a given time frame. A realistic plan must be designed and goals should include a time frame.
7. With assignments in ambulatory centers, extended care facilities, subacute or rehabilitative centers, private practices, grocery stores, Web-based practices, rehabilitation facilities, and home care, the "seamless" continuum affords registered dietitian-nutritionists the possibility of lifelong patient relationships. The "patient-centered medical home" affords continuity through monitoring, follow-up, and evaluation by one team.
8. **Clinical Indicator** lists offer common tests, disease markers, and biochemical evaluations reviewed by physicians or dietitians for that condition. Because laboratory test results are not always available in nonhospital settings, changes in appetite, intake, and weight are the most viable screening factors. Physical changes and signs of malnutrition should always be noted during assessments and reassessments.
7. A current nutrition care manual or textbook should be used to write dietary modifications. Comprehensive lists are not included with this book.
8. Evidence-based guides provide predictable types of interventions over multiple visits. Identify and use relevant guidelines, such as those at http://www.andeal.org/default.cfm
9. Except where specifically noted for children, nutrition therapy plans in this book are for adults over the age of 18.
10. Vitamin and mineral supplements are needed in cases of a documented or likely deficiency. However, in large doses, they may cause food–drug interactions. Note all supplements when planning meals and nourishments to avoid

excessive intakes. Athletes, women, elderly individuals, and vegetarians tend to take vitamin and mineral supplements more often than other individuals.

11. Food from a healthy, varied diet is the best "nutritional medicine." Evidence points to the benefits of whole foods for their nutrient–chemical mix. A well-balanced diet follows the U.S. Department of Agriculture MyPlate food guidance system. Various ethnic, vegetarian, pediatric, geriatric, and diabetes food guides are available for menu planning and design.
12. With awareness of the interacting roles of diet and nutrients with genes and vice versa, greater emphasis has been placed on personalized nutrition counseling. It is no longer acceptable to prescribe a "one size fits all" nutrition plan. When genetic testing is available, the skilled RDN must provide advice that considers the ethical, legal, economic, and social implications for the patient/client and family.
13. Ethics, cultural sensitivity, and a concern for patient rights should be practiced at all times. When known, the wishes and advanced directives of the patient are to be followed, even if they preclude the administration of artificial nutrition.
14. Interesting and varied websites have been included for additional insights into various diseases, conditions, and nutritional interventions.
15. It is essential to use the current standardized nutrition language, as terms and definitions may change as the profession evolves. Access the latest information at http://www.eatright.org/NCP/. The electronic version (eNCPT) provides access to the terminology and many countries have translated the standardized terminology into their own language.

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COMMON ABBREVIATIONS

A_{1c}	A_{1c} test (glycosylated hemoglobin)
AA	amino acid
abd	abdomen, abdominal
ADIME	assessment-diagnosis-intervention-monitoring-evaluation
ABW	average body weight
ACE	angiotensin-converting enzyme
ACO	affordable care organization
ACTH	adrenocorticotropic hormone
Alb	albumin
ALP	alkaline phosphatase
ALT	alanine aminotransferase
amts	amounts
ARF	acute renal failure
ASHD	atherosclerotic heart disease
AST	aspartate aminotransferase
ATP	adenosine triphosphate
BCAAs	branched-chain amino acids
BEE	basal energy expenditure
BF	breastfeeding
BMR	basal metabolic rate
BP	blood pressure
BS	blood sugar
BSA	body surface area
BUN	blood urea nitrogen
BW	body weight
bx	biopsy
c	cup(s)
C	coffee
CA	cancer
Ca^{++}	calcium
CABG	coronary artery bypass grafting
CBC	complete blood count
CF	cystic fibrosis
CHD	cardiovascular heart disease
CHF	congestive heart failure
CHI	creatinine-height index
CHO	carbohydrate
Chol	cholesterol
Cl^{-}	chloride
CNS	central nervous system
CO_2	carbon dioxide
CPK	creatine phosphokinase
CPR	cardiopulmonary resuscitation
CrCl	creatine clearance
CRP	C-reactive protein
CT	computed tomography
Cu	copper
CVA	cerebrovascular accident
DAT	diet as tolerated
dec	decreased
decaf	decaffeinated
def	deficiency
DJD	degenerative joint disease
dL	deciliter
DM	diabetes mellitus
DNA	deoxyribonucleic acid
DOB	date of birth
DRI	dietary reference intakes
DV	daily value
D5W	5% dextrose solution in water
EAA	essential amino acid
ECG, EKG	electrocardiogram
EEG	electroencephalogram
EFAs	essential fatty acids
Elec	electrolytes
EN	enteral nutrition
eNCPT	electronic nutrition terminology reference manual
ESRD	end-stage renal disease
ETOH	ethanol/ethyl alcohol
Fe^{++}	iron
F & V	fruits and vegetables
FSH	follicle-stimulating hormone
FTT	failure to thrive
FUO	fever of unknown origin
G, g	gram(s)
GA	gestational age
GBD	gallbladder disease
GE	gastroenteritis
gest	gestational
GFR	glomerular filtration rate
GI	gastrointestinal
Gluc	glucose
GN	glomerular nephritis
GTT	glucose tolerance test
H&H	hemoglobin and hematocrit
HbA_{1c}	hemoglobin A_{1c} test
HBV	high biological value
HBW	healthy body weight
HCl	hydrochloric acid
Hct	hematocrit
HDL	high-density lipoprotein
HEN	home enteral nutrition
HLP	hyperlipoproteinemia or hyperlipidemia
HPN	home parenteral nutrition
HTN	hypertension
Ht	height
I	infant
I&O	intake and output
IBD	inflammatory bowel disease
IBS	irritable bowel syndrome
IBW	ideal body weight
IEM	inborn error of metabolism
INR	international normalized ratio (coagulation)
IU	international units
IUD	intrauterine device
IV	intravenous
K^{+}	potassium
kcal	food kilocalories
kg	kilogram(s)
L	liter(s)
lb	pound(s)

LBM	lean body mass
LBV	low biological value
LBW	low birth weight
LCT	long-chain triglycerides
LDH	lactate dehydrogenase
LDL	low-density lipoproteins
LE	lupus erythematosus
LGA	large for gestational age
LH	luteinizing hormone
lytes	electrolytes
M	milk
MAC	midarm circumference
MAMC	midarm muscle circumference
MAO	monoamine oxidase
MCH	mean cell hemoglobin
MCT	medium-chain triglycerides
MCV	mean cell volume
Mg^{++}	magnesium
mg	milligram(s)
μg	microgram(s)
MI	myocardial infarction
mm	millimeter(s)
MODS	multiple organ dysfunction syndrome
MSG	monosodium glutamate
MUFA	monounsaturated fatty acids
N&V	nausea and vomiting
N	nitrogen
Na	sodium
NCEP	National Cholesterol Education Program
NCP	Nutrition Care Process
NEC	necrotizing enterocolitis
NG	nasogastric
NPO	nil per os (nothing by mouth)
NSI	Nutrition Screening Initiative
O_2	oxygen
OP	outpatient
OT	occupational therapist
oz	ounce(s)
P	phosphorus
PAD	peripheral artery disease
PCMH	patient-centered medical home
PCM	protein-calorie malnutrition
PEM	protein-energy malnutrition
pCO_2	partial pressure of carbon dioxide
PG	pregnant, pregnancy
PKU	phenylketonuria
PN	parenteral nutrition
pO_2	partial pressure of oxygen
PRN	pro re nata (as needed)
Prot	protein
PT	prothrombin time; physical therapy
PTH	parathormone
PUFA	polyunsaturated fatty acid(s)
RAST	radioallergosorbent test
RBC	red blood cell count
RDA	recommended dietary allowance (specific)
RDS	respiratory distress syndrome
REE	resting energy expenditure
RQ	respiratory quotient
RRT	renal replacement therapy
Rx	treatment
SFA	saturated fatty acids
SGA	small for gestational age
SI	small intestine
SIADH	syndrome of inappropriate antidiuretic hormone
SIDS	sudden infant death syndrome
SOB	shortness of breath
Sx	symptoms
t, tsp	teaspoon(s)
T, tbsp	tablespoon(s)
TB	tuberculosis
TF	tube feeding; tube fed
TIBC	total iron-binding capacity
TLC	total lymphocyte count
TPN	total parenteral nutrition
Trig	triglycerides
TSF	triceps skinfold
UA	uric acid
UTI	urinary tract infection
UUN	urinary urea nitrogen
VMA	vanillylmandelic acid
VO_{2max}	maximum oxygen intake
WBC	white blood cell count
WNL	within normal limits
Zn	zinc

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S E C T I O N 1

Normal Life Stages

CHIEF ASSESSMENT FACTORS

- Priority factors: unintentional weight loss with appetite changes in adults, protein-energy deficiency or growth retardation in children
- Body fat and muscle mass: weight, height, body mass index (BMI), percentage of healthy body weight (HBW) for height, loss of lean body mass (LBM), previous weight percentile or curve, weight changes, waist circumference, skinfold measurements, visceral proteins, estimated basal energy expenditure, and nitrogen balance
- Illiteracy or low educational level: low socioeconomic status, food insecurity
- Hair or nails: changes, rashes, itching, lesions, turgor, petechiae, pallor
- Eyes: glasses, blurred vision, glaucoma, cataracts, or macular degeneration
- Ears, nose: hearing loss, chronic otitis media, altered sense of smell, nasal obstruction, sinusitis
- Dental and mouth: ill-fitting dentures, loose or missing teeth, caries, bleeding gums, severe gum disease, poor oral hygiene, taste alterations, dysphagia
- Neurologic: headache, seizures, convulsions, altered speech, paralysis, altered gait, anxiety, memory loss, altered sleep patterns, depression, substance abuse, low motivation, fatigue, weakness, fever or chills, excessive sweating, tremors
- Heart: chest pain, dyspnea, wheezing, cough, hemoptysis, ventilator support, altered blood gas levels, abnormal blood pressure, electrolyte imbalance, cyanosis, edema, ascites, low cardiac output
- Blood: anemias, altered heart rate, arrhythmias, blood loss
- Gastrointestinal (GI): cachexia, anorexia, nausea, diarrhea, vomiting, jaundice, constipation, indigestion, ulcers, hemorrhoids, melena, altered stool characteristics, gluten intolerance, lactase insufficiency
- Therapies: radiation, chemotherapy, physical therapy, dialysis, recent surgery or hospitalizations
- Urinary and renal: hematuria, fluid requirements, specific gravity, urinary tract infections, renal disease or stones
- Hormonal balance: altered blood glucose, hyper- or hypothyroidism, goiter, glucose intolerance or metabolic syndrome
- Immunity: food allergies or intolerances, sensitivities, cellular immunity, HIV or other chronic infections, inflammation
- Musculoskeletal system: pain, arthritis, numbness, amputations, limited range of motion or muscular strength
- Phenotype or genotype
- Nutrition: any special diets or nutrition support, dietary pattern, typical intake of food and alcohol, use of vitamin/minerals/herbs/botanicals/supplements, over-the-counter and prescribed medications, knowledge of food and nutrition

OVERVIEW

Noncommunicable diseases (NCD) contribute to morbidity and mortality in both developed and developing countries; most are preventable through modification of lifestyle and nutrition. Alleviating undernutrition, correcting nutritional deficiencies, promoting better quality diets, and incorporating functional foods may alleviate chronic disease burden (Lenoir-Wijnkoop et al, 2013). Food intake, lifestyle behaviors, and obesity are linked to the development of chronic diseases and certain life stages are especially important for health promotion efforts (Fitzgerald et al, 2013). Public health measures have been established to promote wellness and reduce disease for all ages (Table 1-1).

Demographic shifts in the age and racial/ethnic composition of the U.S. population will require new medical nutrition therapies that are cost effective, health promoting, and culturally appropriate (Haughton and Stang, 2012). Because primary prevention is the most effective, affordable method to prevent chronic disease, the Nutrition Care Process should be used by Registered Dietitians (RDs) and dietetic technicians, registered (DTRs) for carrying out these steps (Fitzgerald et al, 2013).

Positive influence can be applied across the spectrum of engagement: at intrapersonal, interpersonal, institutional, community, and public policy levels (Slawson et al, 2013). Two of the most important aspects will be the avoidance of obesity and the consumption of an anti-inflammatory diet. These will help to protect against cancer and heart disease, as well as metabolic disorders.

TABLE 1-1 Public Health: Ten Achievements and Ten Essential Services

10 PUBLIC HEALTH ACHIEVEMENTS IN THE 20TH CENTURY
• Development of immunizations
• Increased motor vehicle safety
• Safer workplaces
• Control of infectious diseases
• Decline in deaths from heart disease and stroke
• Safer and healthier foods
• Healthier mothers and babies
• Family planning
• Fluoridation of drinking water
• Recognition of tobacco as a health hazard
10 ESSENTIAL PUBLIC HEALTH SERVICES
• Monitor health status to identify community health problems.
• Diagnose and investigate health problems and hazards in the community.
• Inform, educate, and empower people about health issues.
• Mobilize community partnerships to identify and solve health problems.
• Develop policies and plans that support individual and community health efforts.
• Enforce laws and regulations that protect health and ensure safety.
• Link people to needed personal health services and assure the provision of health care when otherwise unavailable.
• Assure competent public health and personal health care workforce.
• Evaluate effectiveness, accessibility, and quality of personal and population-based health services.
• Research for new insights and innovative solutions to health problems.

Adapted from: Centers for Disease Control and Prevention. Ten great public health achievements in the 20th century. Available at: http://www.cdc.gov/about/history/tengpha.htm. Accessed June 15, 2014; and from American Public Health Association. Available at: http://www.health.gov/phfunctions/public.htm. Accessed June 15, 2014.

HOT TOPIC

Inflammation

Obesity leads to a chronic low-grade inflammation of adipose tissue, which disrupts endocrine function and results in metabolic derangements, including type 2 diabetes (Siriwardhana et al, 2013). Dietary bioactive compounds can be eaten to suppress both systemic and adipose tissue inflammation. Curcumin, resveratrol, catechins (tea-polyphenols), quercetin, and isoflavones suppress nuclear factor-κB (NF-κB) and other inflammatory pathways (Siriwardhana et al, 2013). Dietary polyunsaturated fatty acids, such as eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), conjugated linoleic acid (CLA), and monounsaturated oleic acid have anti-inflammatory effects by down-regulating tumor necrosis factor (TNF)-alpha and other inflammation markers (Murumalla et al, 2012). Thus, eating an anti-inflammatory diet should be a major focus of public health messaging by RDs.

International and U.S. regulatory, policy, and clinical practitioners are working together on a variety of topics, including clinical guidelines (Wong et al, 2011). The field of "nutrition economics" merges nutrition, influences on health outcomes, and economics to estimate the monetary impact of health measures (Lenoir-Wijnkoop et al, 2011).

The Food and Agriculture Organization (FAO) and the World Health Organization (WHO) have frequently brought together scientists and experts in agriculture to address nutrition and malnutrition (FAO, 2013). Dietary guidelines offer dietary advice for the population to promote overall nutritional well-being. As a result, many countries have established food-based dietary guidelines. Table 1-2 highlights several key principles. The MyPlate campaign (Fig. 1-1) provides a simplified illustration of the U.S. guidelines. MyPlate is divided into sections of approximately 30% grains, 30% vegetables, 20% fruits, and 20% protein-rich foods. A smaller circle represents dairy foods like a glass of low-fat/nonfat milk or a cup of yogurt.

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TABLE 1-2 Dietary Guideline Systems

ENERGY

- Nutritional guidelines should aim to prevent the consequences of either energy deficit or excess.
- Food-based dietary guidelines should promote appropriate energy intakes by encouraging adequate food choices from a balance of foods containing carbohydrates, fats, proteins, vitamins, and minerals.
- The role of physical activity in the energy balance equation should be addressed.

PROTEIN

- For high-quality proteins, requirements for most people are met by providing 8%–10% of total energy as protein.
- For predominantly vegetable-based, mixed diets, which are common in developing country settings, 10%–12% is suggested to account for lower digestibility and increased incidence of diarrheal disease.
- In the case of the elderly, where energy intake is low, protein should represent 12%–14% of total energy.

FAT

- In general, adults should obtain at least 15% of their energy intake from dietary fats and oils.
- Women of childbearing age should obtain at least 20% to better ensure an adequate intake of essential fatty acids needed for fetal and infant brain development.
- Active individuals who are not obese may consume up to 35% fat energy as long as saturated fatty acids do not exceed 10% of energy intake.
- Sedentary individuals should limit fat to not more than 30% of energy intake.
- Saturated fatty acids should be limited to less than 10% of intake.

CARBOHYDRATE

- Carbohydrates are the main source of energy in the diet (>50%) for most people.
- Grain products, tubers, roots, and some fruits are rich in complex carbohydrates. Generally, they need to be cooked before they are fully digestible.
- Sugars usually increase the acceptability and energy density of the diet. Total sugar intake is often inversely related to total fat intake. Moderate intakes of sugar are compatible with a varied and nutritious diet, and no specific limit for sugar consumption is proposed in the report.

MICRONUTRIENTS

- Vitamins and minerals include compounds with widely divergent metabolic activities and are essential for normal growth and development and optimal health.
- Micronutrients may help to prevent infectious and chronic diseases. Epidemiological, clinical, and experimental studies define the role of specific foods and nutrients in disease development and prevention.

AMERICAN DIETARY GUIDELINES

An evidence-based, scientific approach is used to update the Dietary Guidelines for Americans. The latest guidelines were enhanced to describe the need for a Total Diet approach because there is no single "American" or "Western" diet. According to the National Health and Nutrition Examination Survey (NHANES), Americans eat too many calories, solid fats, added sugars, refined grains, and sodium. Americans also eat too little dietary fiber, vitamin D, calcium, potassium, omega-3 fatty acids, and other important nutrients that are mostly found in vegetables, fruits, whole grains, low-fat milk and milk products, and seafood. See http://www.health.gov/dietaryguidelines/2015.asp for the evidence-based recommendations.

Balancing Calories to Manage Weight

- Prevent and/or reduce overweight and obesity through improved eating and physical activity behaviors.
- Control total calorie intake to manage body weight. For people who are overweight or obese, this will mean consuming fewer calories from foods and beverages.
- Increase physical activity and reduce time spent in sedentary behaviors.
- Maintain appropriate calorie balance during each stage of life—childhood, adolescence, adulthood, pregnancy and breastfeeding, and older age.

Foods and Food Components to Reduce

- Reduce daily sodium intake to less than 2,300 milligrams (mg) and further reduce intake to 1,500 mg among persons who are 51 and older and those of any age who are African American or have hypertension, diabetes, or chronic kidney disease. The 1,500 mg recommendation applies to about half of the U.S. population, including children, and the majority of adults.
- Consume less than 10% of calories from saturated fatty acids by replacing them with monounsaturated and polyunsaturated fatty acids.
- Consume less than 300 mg per day of dietary cholesterol.
- Keep trans fatty acid consumption as low as possible by limiting foods that contain synthetic sources of trans fats, such as partially hydrogenated oils, and by limiting other solid fats.
- Reduce the intake of calories from solid fats and added sugars.
- Limit the consumption of foods that contain refined grains, especially refined grain foods that contain solid fats, added sugars, and sodium.
- If alcohol is consumed, it should be consumed in moderation—up to one drink per day for women and two drinks per day for men—and only by adults of legal drinking age.

(continued)

TABLE 1-2 Dietary Guideline Systems *(continued)*

Foods and Nutrients to Increase
• Individuals should meet the following recommendations as part of a healthy eating pattern while staying within their calorie needs.
• Increase vegetable and fruit intake.
• Eat a variety of vegetables, especially dark-green and red and orange vegetables and beans and peas.
• Consume at least half of all grains as whole grains. Increase whole-grain intake by replacing refined grains with whole grains.
• Increase intake of fat-free or low-fat milk and milk products, such as milk, yogurt, cheese, or fortified soy beverages.
• Choose a variety of protein foods, which include seafood, lean meat and poultry, eggs, beans and peas, soy products, and unsalted nuts and seeds.
• Increase the amount and variety of seafood consumed by choosing seafood in place of some meat and poultry.
• Replace protein foods that are higher in solid fats with choices that are lower in solid fats and calories and/or are sources of oils.
• Use oils to replace solid fats where possible.
• Choose foods that provide more potassium, dietary fiber, calcium, and vitamin D, which are nutrients of concern in American diets. These foods include vegetables, fruits, whole grains, and milk and milk products.
Building Healthy Eating Patterns
• Select an eating pattern that meets nutrient needs over time at an appropriate calorie level.
• Account for all foods and beverages consumed and assess how they fit within a total healthy eating pattern.
• Follow food safety recommendations when preparing and eating foods to reduce the risk of foodborne illnesses.
VISUAL FOOD GUIDES
• United States: USDA MyPlate (http://myplate.gov) (see Fig. 1-1)
• Canada: Health Canada—Eating Well with Canada's Food Guide (http://www.hc-sc.gc.ca/fn-an/food-guide-aliment/index-eng.php)
• People's Republic of China: Chinese Nutrition Society—Balance Dietary Pagoda (http://www.cnsoc.org/en/nutrition.asp?s=9&nid=806)
• European Food Guides (http://www.eufic.org/article/en/expid/food-based-dietary-guidelines-in-europe/)
• Mexico: Food Guide Plate (http://familyconsumersciences.com/wp-content/uploads/Mexicos-Food-Guide.jpg)

Adapted from: Dietary guidelines for Americans. Available at: http://www.health.gov/DietaryGuidelines. Accessed June 15, 2014; and Dietary Guidelines 2010. Available at: http://www.cnpp.usda.gov/DGAs2010-DGACReport.htm. Accessed June 15, 2014.

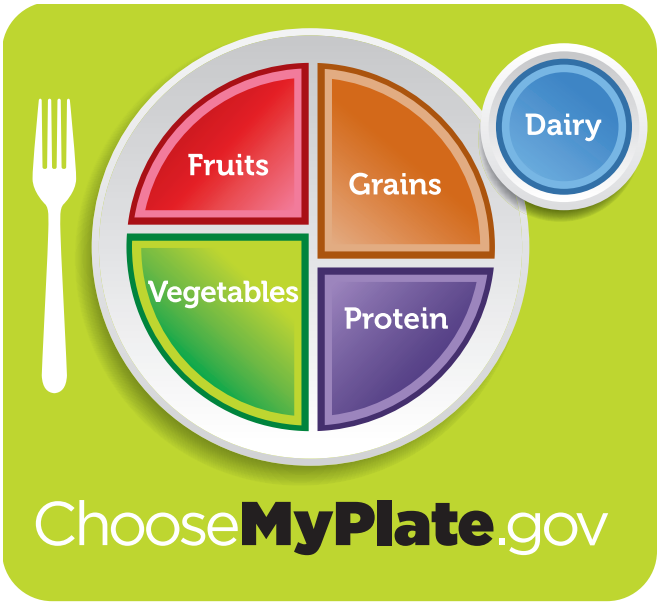

Figure 1-1. MyPlate. (Reprinted from USDA. Available at: http://www.choosemyplate.gov/print-materials-ordering/graphic-resources.html. Accessed June 15, 2014.)

Functional Genomics: From Genome to Phenome . . . the "Physiome"

The human body has about 25,000 genes, representing the human **genome**. The **transcriptome** contains over 100,000 RNA molecules, with gene expression profiling the multiple copy variants in an individual. The transcriptome is the precursor of the **proteome**, the complete set of proteins found in an organism; humans have over 1 million proteins. **Metabolome** describes the low molecular weight biochemical compounds (metabolites) that have led to most biomarker discoveries. The **phenome** represents what is visible (eye and skin color, height, body shape or size) and is affected by environmental influences, mutations, and genetic single nucleotide polymorphisms (SNPs.)

Genes are inert when inherited; they are turned on by diet and environmental factors. **Nuclear receptors (NRs)** regulate the expression of target genes in response to activation by steroid hormones and other signaling pathways. They are central regulators of pathophysiologic processes (Bolt et al, 2013).

Coactivators are cellular factors recruited by activated NRs that complement their function as mediators of the cellular response to endocrine signals; they induce structural changes in agonist-bound NRs that are essential for NR-mediated transcriptional activation (Johnson and O'Malley, 2012). The best known coactivators are the steroid receptor

coactivators (SRCs) 1, 2, and 3. SRCs are widely implicated in NR-mediated diseases, especially in cancers (Johnson and O'Malley, 2012). The **SRC genes** have the following essential functions:

- SRC-1: For gluconeogenesis, sugar metabolism, and weight (Zhu et al, 2013)
- SRC-2: For fat absorption, energy accretion, fertility, circadian rhythm management (SRC-2 is a master regulator; disruption can lead to changes in physiology, behavior, performance, metabolic disease, cancer, heart disease)
- SRC-3: For proper cell signaling and functioning; increased levels may lead to cancer (Long et al, 2012)

The identification of these genetic, molecular, and cellular mechanisms provides a new level of management for health as well as for cancer and other chronic disorders.

For More Information

- Academy of Nutrition and Dietetics
  http://www.eatright.org/Public/landing.aspx?TaxID=6442451979
- Academy of Nutrition and Dietetics – Evidence Analysis Library
  http://andevidencelibrary.com/category.cfm?cid=27&cat=0
- Food and Nutrition Information Center (FNIC) – Dietary Guidance
  http://fnic.nal.usda.gov/dietary-guidance

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PREGNANCY AND LACTATION

PREGNANCY

NUTRITIONAL ACUITY RANKING: LEVEL 1 (UNCOMPLICATED); LEVEL 3 (HIGH RISK)

DEFINITIONS AND BACKGROUND

Women should have a "preconception risk assessment" from 3 to 6 months before conception if desired (March of Dimes, 2013). They should be aware of their personal genetic biomarkers that could cause problems with infertility, pregnancy, childbirth, or chronic diseases. They should also consider other risks that work against a healthy pregnancy outcome (WebMD, 2013).

Pregnancy is an anabolic state that affects maternal tissues, using hormones synthesized to support successful pregnancy. Progesterone induces fat deposition to insulate the baby, supports energy reserves, and relaxes smooth muscle, which will cause a decrease in intestinal motility for greater nutrient absorption. Estrogen increases tremendously during pregnancy for growth promotion, uterine function, and water retention. Progesterone and estrogen secreted during pregnancy in combination also help prepare for successful lactation.

Adequate weight gain is needed to ensure optimal fetal outcome (Figs. 1-2 and 1-3). The energy costs of pregnancy vary by the BMI of the mother (Thomas et al, 2012). Tissue growth in pregnancy is approximately: breast, 0.5 kg; placenta, 0.6 kg; fetus, 3 to 3.5 kg; amniotic fluid, 1 kg; uterus, 1 kg; increase in blood volume, 1.5 kg; and extracellular fluid, 1.5 kg. Rapid weight losses or gains are not desirable.

Brain development starts during pregnancy and continues into adulthood. Deficiency of various micronutrients has long-term implication for cognitive development. Because pre- and postnatal brain growth correlates specifically with duration of gestation and lactation, the rate of fetal brain growth is related to the mother's energy turnover and sufficiency (Barton and Cappellini, 2011).

Nutritional deficits are serious (Procter and Campbell, 2014). During pregnancy, food insecurity has been found to correlate with greater weight gain, more complications, and gestational diabetes (Laraia et al, 2010). Maternal underweight is associated with small-for-gestational-age (SGA) or preterm deliveries. Energy restriction during gestation or lactation impacts the developmental programming of energy balance in the infant. Susceptibility to obesity, incapacity to regulate energy balance, altered leptin and insulin sensitivity, and changes in body composition may result (Pico et al, 2012).

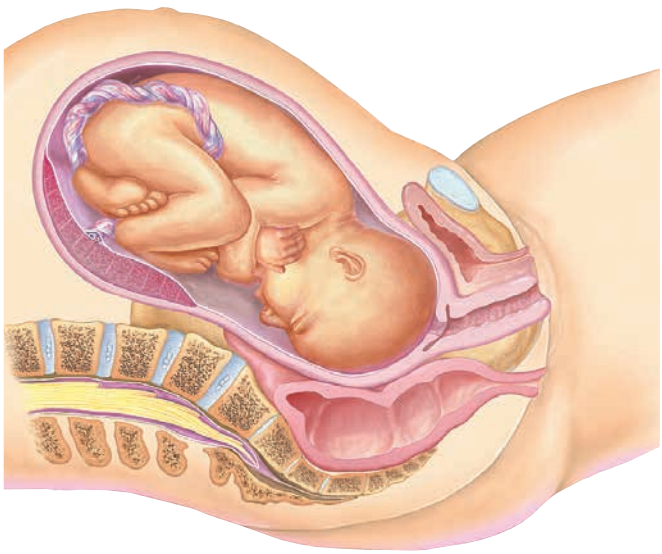

Figure 1-2. The fetus shortly before birth. (Reprinted with permission from Anatomical Chart Company.)

Figure 1-3. A mother and her healthy newborn.

A short span between pregnancies or an early pregnancy within 2 years of menarche increases the risk for stunting or preterm infants. Maternal nutrient depletion of energy and protein leads to poor nutritional status at conception and may alter pregnancy outcomes. Stunting (low height-for-age) and major diseases including heart disease, hypertension, and type 2 diabetes originate from impaired intrauterine growth and development. Environmental insults (poor diet, chemicals, infections) during pregnancy can adversely affect the long-term health of the offspring. This result is called the **Developmental Origins of Health and Disease (DOHaD)** paradigm (Fig. 1-4) (Uuay et al, 2011).

Poor maternal iron and folate intakes have been associated with preterm births and intrauterine growth retardation, common in early or closely spaced pregnancies. Use of prenatal folic acid supplements around the time of conception has been associated with a lower risk of autistic disorder; thus, prenatal folic acid supplementation is important for many reasons (Suren et al, 2013).

Higher maternal weight before pregnancy increases the risk of late fetal death, although it protects against the delivery of an SGA infant. Obesity increases the risk for first trimester or recurrent miscarriages and the need for caesarean delivery; thus, obesity should be corrected before pregnancy when possible (Mamun et al, 2011). Bariatric surgery can improve fertility. Pregnancy after bariatric surgery reduces complications such as gestational diabetes mellitus, hypertensive disorders, and fetal macrosomia but may increase risk for an SGA birth (Willis and Sheiner, 2012).

Planned pregnancies usually have the most favorable outcomes. Continuous dietary monitoring of pregnant women and pregnant teens is essential, especially for calcium, iron, folate, vitamins A, C, B_6, and B_{12} (American College of Obstetricians and Gynecologists [ACOG], 2013). Other nutrients of importance include magnesium, fiber, zinc, vitamin D, and biotin. Table 1-3 lists risk assessments and indicators of potentially poor maternal or fetal outcomes.

Many birth defects may be prevented by maternal use of multivitamins during the periconceptual period. To prevent SGA births, a mother is encouraged not to smoke, to manage cardiac disease or hypertension, and to gain sufficient weight. If HIV-positive pregnant women experience weight loss, energy intake recommendations should be based on direct measurements of total daily energy expenditure (TDEE,) especially with concurrent malnutrition and coinfection (Kosmiski, 2011). A multidisciplinary approach is recommended.

Eating disorders such as anorexia or bulimia nervosa must be managed carefully during pregnancy to avoid complications such as weight loss, miscarriage, and poor infant feeding practices. Women with unmanaged phenylketonuria (PKU) may also have poor reproductive outcomes. Prevention requires initiation of the low-phenylalanine (Phe) diet before conception or early in pregnancy, with metabolic control and sufficient intake of energy and proteins.

Certain complications are more likely to occur during a twin gestation, including preeclampsia and other hypertensive disorders, antepartum hospitalization for preterm labor or abnormal bleeding, nutritional deficiencies, cesarean delivery, and postpartum hemorrhage (Young and Wylie, 2012). For twin and multiple pregnancies, close monitoring, sufficient energy intake, multimineral supplementation, and early patient education may reduce complication risk.

Each individual has a unique genetic profile and phenotype. Because both parents contribute genes and chromosomes to the fetus, a genetic family history may be beneficial. **Epigenetics** involves inherited changes in chromatin and DNA that affect human pathologies, including inflammatory disorders and

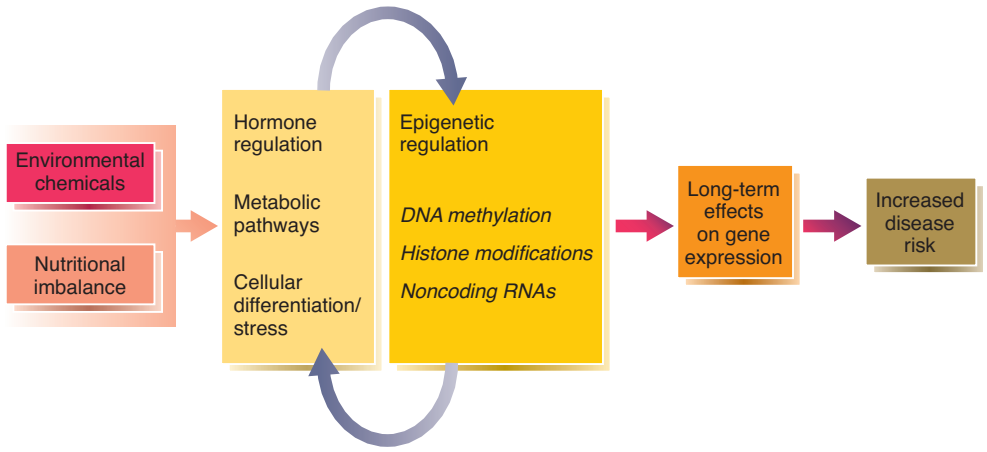

Figure 1-4. Developmental Origins of Health and Disease (DOHaD) paradigm. (Adapted with permission from Barouki R, Gluckman PD, Grandjean P, et al. Developmental origins of non-communicable disease: implications for research and public health. *Environ Health*. 2012;11:42.)

TABLE 1-3 Prenatal Risk Assessment

PRE-PREGNANCY	
❑ Poor eating habits	❑ Hx eating disorder (anorexia or bulimia)
❑ Hx 3 or more pregnancies in past 2 years	❑ Hx multiple abortions
❑ Obesity (>120% desirable BMI for age)	❑ Weight of <85% desirable BMI for height and age

PAST PREGNANCY	
❑ Anomalies (Congenital)	❑ Preterm Labor
❑ Birthweight, Low (<2500 gms)	❑ Pre-eclampsia / Eclampsia
❑ Miscarriages	❑ Prematurity or SGA
❑ Death (Infant or stillbirth >20 wks)	❑ Other: Indicate_____

CURRENT PREGNANCY	CURRENT/CHRONIC MEDICAL CONDITIONS	
❑ Age, Maternal (≥35 years)	❑ Asthma	❑ Hypertension, Chronic
❑ Age, Maternal (≤15 years)	❑ Cardiac Disease	❑ Pyelonephritis
❑ Bleeding, >12 wks gestation	❑ Diabetes Mellitus	❑ Seizure Disorder
❑ Cervix, Incompetent	❑ Disability, Physical	❑ Sickle Cell Disease
❑ Gestational Diabetes	❑ Dysplasia, Cervical	❑ Tuberculosis, Active
❑ Hyperemesis Gravidarum (after 12 wks)	❑ HIV positive	❑ Other: _____
❑ Intrauterine Growth Retardation		
❑ Multiple Pregnancy (twins, triplets, etc)		
❑ Placenta Previa, Degree of: _____		
❑ Preterm Labor		
❑ Short Pregnancy Interval		
❑ Risk for anemia — Hgb (<11 g) or Hct (<33%)		
❑ Risk of toxemia (2-lb+ weight gain per wk)		
❑ Weight loss during PG or gain <2 lb/month in the last two trimesters		
❑ Other: Indicate _____		

NUTRITIONAL OR SOCIO-ECONOMIC CONCERNS	
❑ Financial or food insecurity	❑ Smoker (_____ /day)
❑ Food faddism or pica	❑ Modified diet for diabetes ___ celiac ___ PKU___
❑ Drug or alcohol use	❑ Poorly managed vegan diet
❑ Poor nutrient intake	❑ Inadequate energy intake
❑ Homeless	❑ Inability to shop/prepare meals

Adapted from: Neighborhood Health Plan of Rhode Island. Available at: http://www.nhpri.org/matriarch/default.asp. Accessed June 15, 2014.

cancers, and nutritional factors have a profound effect on gene expression. Disruption of epigenetic programs in response to environmental stimuli during prenatal exposure disturbs the fetal epigenome, potentially impacting susceptibility to disease later in life (Kaur et al, 2013).

The Academy of Nutrition and Dietetics suggests at least three visits for medical nutrition therapy in high-risk pregnancies. More visits will be needed for individuals who have multiple risk factors, such as diabetes with celiac disease.

ASSESSMENT, MONITORING, AND EVALUATION

Genetic Markers

- Carrier screening for inherited genetic disorders (Tay-Sachs, PKU, cystic fibrosis [CF], sickle cell, thalassemia)

Clinical/History

- Previous fertility problems?
- Gravida (number of pregnancies)
- Para (number of births)
- Abortus (number of abortions)
- Height
- Prepregnancy weight (% standard)
- Obesity?
- Weight grid or prenatal BMI
- Present weight for gestational age
- Desired weight at term
- Blood pressure (BP)
- Multiple gestation?
- Diabetes, hepatitis B, HIV-AIDS, hypothyroidism, or other chronic disease?
- History of births with neural tube defects
- History of preterm delivery or multiple births
- Family history of PKU or CF
- Uterine or cervical abnormalities

- Diet history including folate, fish (mercury risk), alcohol
- Smoking habits, herbs, botanicals, illicit drug use
- Exposure to isotretinoin (Accutane), diethylstilbestrol (DES), anticoagulants, anticonvulsants
- Nausea or vomiting (frequency, duration, impact on intake)
- Pica or harmful beliefs
- Vegan or disordered eating pattern
- Rubella immunity?
- Ultrasound, chorionic villous sampling, or amniocentesis

Lab Work

- Hemoglobin and hematocrit (H&H)
- Serum iron (Fe)
- Urea nitrogen (N)
- Glucose (by 24 to 28 wk)
- Calcium (Ca^{++}), magnesium (Mg^{++})
- Albumin (Alb)
- Transferrin
- Ceruloplasmin
- T3, T4, thyroid-stimulating hormone (TSH)
- Blood urea nitrogen (BUN)
- Creatinine
- Homocysteine
- Cholesterol (may be increased)
- Alkaline phosphatase (ALP) (may be increased)
- Total iron-binding capacity (TIBC) (often increased in late pregnancy)
- Alpha fetoprotein (for open neural tube defects)

INTERVENTION

Objectives

- Maintain adequate gestational duration; prevent preterm delivery.
- Provide additional nutrients and energy (net cost of pregnancy varies from 20,000 to 80,000 kcal total). Women carrying more than one fetus must add extra kilocalories to support multiple births.
- Achieve adequate weight gain during pregnancy; avoid delivery of low-birth-weight (LBW) infants. The Institute of Medicine (IOM) **gestational weight gain (GWG)** guidelines suggest the following (Fig. 1-5) (IOM, 2013):
  1. Underweight women (BMI <18.5) should gain 28 to 40 lb.
  2. Normal weight women (BMI = 19 to 24.9) should gain 25 to 35 lb total; 46 lb with twins.
  3. Overweight women (BMI = 25 to 29.9) should gain 15 to 25 lb; 42 lb with twins.
  4. Obese women (BMI >30) should gain 11 to 20 lb; 35 lb with twins.
- Encourage proper gestational weight gain, such as 2 to 4 lb first trimester, 10 to 11 lb second trimester, and 12 to 13 lb third trimester. More weight should be gained if preconceptual weight was low, especially in younger women. Adolescents risk gaining an excessive amount of weight during pregnancy and should be closely monitored.
- Prevent or correct hypoglycemia, ketosis, and hyperglycemia.
- Provide adequate amino acids to meet fetal and placental growth. Approximately 950 g of protein are synthesized for the fetus and placenta. Low protein intake may lead to a smaller infant head circumference.
- Promote development of an adequate fetal immune system.
- Prevent or correct iron deficiency, which occurs in over half of pregnancies. Iron deficiency is correlated with low birth weight (Pena-Rosas et al, 2012). Low neonatal iron status negatively affects cognitive and neurobehavioral development (Cao and O'Brien, 2013).
- Folate deficiency and elevated homocysteine levels may lead to miscarriage, cleft lip and palate, club foot, structural heart disease, anencephaly, and neural tube defects. A woman with a history of spontaneous abortion in her immediate prior pregnancy and short interpregnancy interval is especially vulnerable. L-Methylfolate is the active form of folate used for DNA reproduction and regulation of homocysteine levels. Women with altered genetic alleles may not have sufficient methyl-tetrahydrofolate (MTHFR) to metabolize folic acid properly; these women may need special prenatal supplements, such as Neevo. Vitamins B_6 and B_{12} are also needed for hyperhomocysteinemia.
- Vitamin A deficiency (VAD) is strongly associated with depressed immune system and higher morbidity and mortality due to blindness, measles, diarrhea, and respiratory infections. On the other hand, doses of 10,000 to 30,000 IU vitamin A may cause birth defects, such as cleft palate.
- Avoid zinc and calcium deficiencies. Poor maternal zinc status may be associated with fetal loss, congenital malformations, intrauterine growth restriction, reduced birth weight, prolonged labor, and preterm or postterm deliveries (Chaffee and King, 2012).
- Inadequate and deficient vitamin D status in pregnant women ranges from 5% to 84% globally (Brannon, 2012). Low maternal vitamin D status increases maternal risk for preeclampsia, gestational diabetes, obstructed labor, and infectious disease; infants have greater risk for SGA birth and for developmental programming of type 1 diabetes, inflammatory and atopic disorders, even schizophrenia (Brannon, 2012).
- Systematic provision of iodine supplementation is recommended to prevent cretinism (Stagnaro-Green et al, 2012). Use of iodized salt may be encouraged.
- Limit caffeinated beverage intake.
- Avoid alcohol, which increases the risk for orofacial clefts and spina bifida.

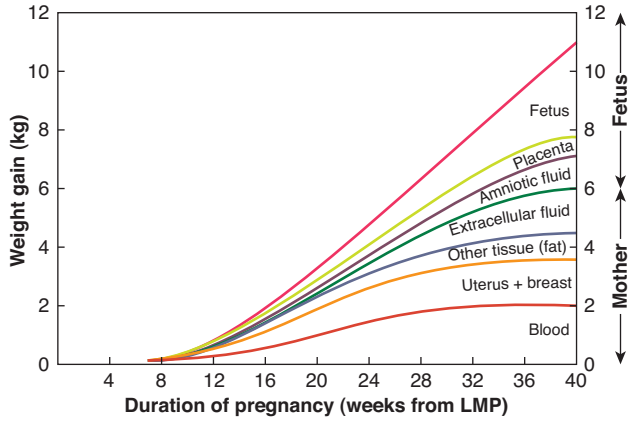

Figure 1-5. Gestational weight gain. (Adapted with permission from Pitkin RM. Nutritional support in obstetrics and gynecology. *Clin Obstet Gyn*. 1976 Sep;19(3):489-513).

- Support the individual patient. Pregnant women who are fatigued, stressed, and anxious tend to consume more energy but fewer micronutrients.
- Develop or improve good eating habits to prevent chronic health problems postnatally. The interaction between genes, nutrition, and environmental stimuli has been found to cause permanent changes in metabolism.
- Discuss the importance of a high-quality prenatal diet. Fetal undernutrition can predispose to hypercholesterolemia and other health concerns.
- Women should drink plenty of fluids to remain adequately hydrated.
- Multiple gestation creates nutritional challenges. There are more risks for adverse outcomes, including diabetes, hypertension, eclampsia, and delivery of a premature or LBW infant. For twins, weight gain should reflect the period of gestation and prepartum BMI; 35 to 45 lb is often recommended with twins, and 50 lb overall is recommended for triplets.
- Monitor BP and blood glucose regularly to prevent or to identify complications such as preeclampsia or gestational diabetes.
- Monitor or treat other complications, such as nausea and vomiting of pregnancy (NVP) and hyperemesis gravidarum. Table 1-4 discusses special problems in pregnancy; see also appropriate disorder entries.

Food and Nutrition

- Desired pattern of food intake: Two to three servings of milk–yogurt–cheese group (for calcium, protein); 6 oz of meat or protein substitute (protein, iron, zinc); three fruits and four vegetables, including citrus (vitamin C) and rich sources of vitamin A and folacin; nine servings of grains and breads, three of which are whole grain or enriched breads/substitutes (iron, energy); three servings of fat.
- Include in diet: 1 g protein/kg body weight daily (or 10 to 15 g above recommended dietary allowances for age). Young teens: 11 to 14 years (1.7 g/kg); 15 to 18 years (1.5 g/kg); over 19 years of age (1.7 g/kg); high risk (2 g/kg).
- Energy: In women of normal weight, energy requirements increase minimally in the first trimester, by 350 kcal/d in the second trimester, and by 500 kcal/d in the third trimester (Table 1-5) (IOM, 2013). Increase for high levels of physical

TABLE 1-4 Special Issues in Pregnancy

ISSUE	CONSIDERATIONS
Allergies, personal or family history	Nutritional strategies to program the microbiota composition to favor a more beneficial bacterial population and to support the development of the metabolic and immune systems may provide a good opportunity to prevent later health problems such as obesity, diabetes, and allergy (Nauta et al, 2013). Women may wish to take a prescribed probiotic to stimulate health-producing microbes in their fetus for greater gut immunity.
Hyperemesis (intractable, dehydrating vomiting)	This affects 20% of pregnancies in the first trimester. Half of these patients have some liver dysfunction. Check also for *Helicobacter pylori* infection. Early hospitalization with tube feeding may be needed. Metoclopramide (Reglan) may help. When eating orally, liquids taken between meals, extra B-complex vitamins and vitamin C, and limited fat may be beneficial. Low birth weight and greater length of hospital stay are common. Avoid electrolyte imbalances.
Liver dysfunction such as viral hepatitis, gallstones, or intrahepatic cholestasis in pregnancy	With pruritus, elevated bile acids in the second half of pregnancy, high levels of aminotransferases and mild jaundice, immediate delivery may be needed.
Multiple gestation	Energy regimen of 20% protein, 40% carbohydrate, and 40% fat is useful. Supplement with calcium, magnesium, zinc, multivitamins, and essential fatty acids.
Nausea and vomiting of pregnancy (NVP)	Initial treatment of nausea and vomiting should be conservative with dietary changes, emotional support, and perhaps use of ginger. NVP affects 80% of pregnancies. Evaluate for *H. pylori*. Frequent, small meals should be consumed separately from fluids. Offer high-protein snacks, such as cheese or lean meat. Avoid lying down immediately after meals and suggest not skipping meals. Do not force eating; suck on ice chips or other frozen items and make up lost calories later. Eat meals and snacks in a well-ventilated area, free of odors; avoid strong spices and aromas. Eat and drink slowly and rest after meals. Try lemonade and potato chips or saltines. Avoid large meals, very sweet, spicy, or high-fat foods if not tolerated. Eat dry crackers before rising in the morning. Multivitamin–mineral supplements may also trigger NVP; it may be helpful to try a different brand. Minimize offensive odors. Rehydration may be essential. NVP often abates by 17 weeks of pregnancy. Ondansetron and metoclopramide may be safely used.
Preeclampsia	Calcium supplementation appears to approximately halve the risk of preeclampsia, to reduce the risk of preterm birth, and to reduce the rare occurrence of morbidity (Hofmeyr et al, 2010).
Pica (intake of nonnutritive substances)	Chronic intake of ice, freezer frost, baking soda, baking powder, cornstarch, laundry starch, baby powder, clay, or dirt may significantly lower hemoglobin levels. WIC and prenatal counselors must be aware. Discussion of practices should be nonjudgmental; pica may have strong cultural history. Food cravings and aversions often subside after pregnancy.
Severe gastrointestinal problems	Consider total parenteral nutrition with adequate lipids (10%–20% of energy) for the fetus, as well as protein and carbohydrate. Check blood sugar regularly. Use adequate fluid according to estimated needs. Complications may include bacteremia, decreased renal function with preexisting disease, neonatal hypoglycemia, or subclavian vein thrombosis.
Vegans or vegetarians	Vitamin B_{12}, zinc, calcium, and vitamin D supplements may be needed.
Women with high levels of inflammatory cytokines	Reduced placental perfusion and a tendency toward preeclampsia may occur. An anti-inflammatory diet may be used.
Women who have previously given birth to an infant with neural tube defect or anencephaly	Test for folic acid alleles; consider use of Neevo or 600 μg folate daily throughout PG.

References: Hofmeyr GJ, Lawrie TA, Atallah AN, et al. Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. *Cochrane Database Syst Rev.* 2010 Aug 4;(8):CD001059; Nauta AJ, Ben Amor K, Knol J, et al. Relevance of pre- and postnatal nutrition to development and interplay between the microbiota and metabolic and immune systems. *Am J Clin Nutr.* 2013;98:586S.