



Healthy Nutrition, Healthy Liver

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Why it's called a "Liver"

- **Synthesizes**
 - Clotting factor
 - Albumin
 - Glycogen
- **Stores**
 - Glycogen
 - Albumin
 - Fat soluble Vitamins
- **Metabolizes**
 - Medications
 - Toxins
 - Amino acids



What the Liver makes

- Albumin
- Clotting factor
- Heparin
- Transferrin
- Glucose
- Cholesterol
- Uric Acid



What the Liver stores

- Glycogen
- Amino Acids
- Vitamin B1
- Vitamin B2
- Fat Soluable Vitamins (A, D, E, K)
- Cholesterol
- Fatty Acids



What the Liver releases

- Filters medications from the body
- Clears and destroys bacteria in the blood
- Bile and bilirubin (break down products of red blood cells)
- Forms ammonia from amino acid metabolism



Other duties of the Liver

- Role in blood volume regulation
- Lipid metabolism

Cannot live without the Liver



Nutrition Basics

Protein

- Made of amino acids
 - 8 essential amino acids for complete protein
- Animal protein is a complete protein
- Plant proteins need to be combined to make a complete protein
- Incorporated into muscle, blood, bone for building
- Role in oncotic pressure (fluid balance)



Nutrition Basics

Protein

- Sources:
 - Animal proteins (meat, fish, poultry, egg, dairy)
 - Plant proteins (soy, beans/legumes, lentils, nuts, grains)
- 4 calories/gram



Protein Needs

- Needs are based on lean or dry body mass.
 - .8 gm protein per kilogram wt.
 - ie. 125 lb= 56.8 kg
 $56.8 \text{ kg} \times .8 \text{ gm/kg} = 45 \text{ gm protein}$
 - ie. 195 lb= 88.6 kg
 $88.6 \text{ kg} \times .8 \text{ gm/kg} = 71 \text{ gm protein}$



Is Protein “BAD”?

- Protein is vital for growth, building and repairing the body.
 - too little can cause problems if liver function is poor (liver is not making amino acids)
 - A low protein diet compounds problems
 - too much increases work load on vital organs, particularly kidneys (urea)
- Moderate amounts of protein to meet needs.

Food	Serving	Weight in grams	Protein grams	% Daily Value
Hamburger, extra lean	6 ounces	170	48.6	97
Chicken, roasted	6 ounces	170	42.5	85
Fish	6 ounces	170	41.2	82
Cottage cheese	1 cup	225	28.1	56
Yogurt, low fat	8 ounces	227	11.9	24
Tofu	1/2 cup	126	10.1	20
Lentils, cooked	1/2 cup	99	9	18
Skim milk	1 cup	245	8.4	17
Kidney beans, cooked	1/2 cup	87	7.6	15
Cheddar cheese	1 ounce	28	7.1	14
Macaroni, cooked	1 cup	140	6.8	14
Soymilk	1 cup	245	6.7	13
Egg	1 large	50	6.3	13
Whole wheat bread	2 slices	56	5.4	11
Rice, cooked	1 cup	158	4.3	9
Broccoli, cooked	5 inch piece	140	4.2	8
		Department of Clinical Nutrition		June 11, 2006



Plant vs Animal

- Essential Amino Acids cannot be made by the human body
- Plant proteins contain *some* essential Amino Acids
 - Plant proteins must be combined to complement and provide a complete protein
- Animal proteins contain *all 8* essential Amino Acids
- Animal proteins contain more iron and saturated fats than plant proteins
- Plant proteins may be higher in fiber than animal proteins
 - Need more volume plant protein to equal animal protein content



Animal vs Plant Protein and Cancer

- There's no good evidence that eating a little protein or a lot of it influences cancer risk
- Although substances in soy could conceivably protect against endometrial, ovarian, colorectal, prostate, and other cancers, there is no good evidence for this.



Liver and Glycemic Control

- Gluconeogenesis (making glucose in the liver by non-CHO sources)
- Glycolysis (liver, kidney, and muscle converts glucose into energy)
- Glycogenesis (the liver makes glycogen from glucose)
- Glycogenolysis (release of glucose stored in the liver and muscle)



Liver and Glycemic Control

- Glucose is the end-product of digestion of carbohydrates.
- The liver stores, releases, and manufactures glucose.
- Advanced liver disease interferes with this normal function, causing poorly controlled glucose fluctuations.



Nutrition Basics

Carbohydrate

- Glucose is primary fuel source for muscles and brain
- Source of fiber and water soluble vitamins and minerals
- Found in starches, fruits, dairy, sugars
- Provides 4 calories/gram



Examples of 15 grams of Carbohydrate

- 1 slice of bread (wheat or white)
- ½ c. pasta (any kind)
- ½ c. beans
- 12-15 grapes
- 1 c. milk (whole, 1%, 2%, or skim)
- ½ c. orange juice
- 1 fruit leather
- 3 tsp. sugar



How much CHO do we need?

- CHO is a quick burning fuel for the muscles and brain.
- 40-50% total calories should come from CHO in the diet.
- Too little CHO forces the body to burn protein and fat for fuel.
- ie: For an 1800 calorie diet, 225 gm. of CHO/day is the goal (or 15 x 15 gm CHO foods/day)



Nutrition Basics

Fat

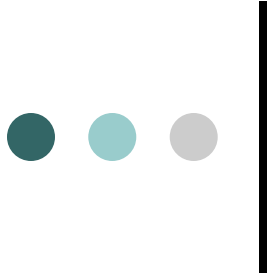
- Long-lasting, concentrated source of energy
- Form insulating layer which prevents loss of heat
- Protects organs and are part of the cell structure
- Provides essential fatty acids
- Carries fat soluble vitamins



Nutrition Basics

Fats

- 9 calories/gram
- Saturated vs Mono- and Poly-unsaturated
- Sources:
 - Animal and some plant (saturated)
 - Butter, cream, lard, fatty meats
 - Coconut and palm oils
 - Plant (mono- and poly-unsaturated)
 - Olive, canola, safflower, corn, cottonseed, peanut, avocado



What does the gallbladder do with fats?

- Gallbladder holds bile that is made in the liver
 - Bile is used to break down fats
- High volume of fats stimulate the gallbladder to release more bile
- Any type/source of fat will stimulate the gallbladder



Cholesterol: the Liver and Heart connection

- Occurs naturally in our body.
- Made by the liver from fats
- Used to make estrogen, testosterone, and bile, for digestion.
- High levels can combine with other fats and stick to the artery walls.
- Waxy and cannot dissolve in water



Cholesterol: the Liver and Heart connection

- Carried through the blood in packages called lipoproteins.
- High density lipoprotein (HDL) is a "good" package for cholesterol
- Low density lipoprotein (LDL) is a "bad" package for cholesterol.
- HDL cholesterol gathers up excess cholesterol in the blood and carries it to the liver for excretion.
- HDL may also help remove some of the cholesterol deposited on the artery walls.
- Excess LDL cholesterol builds up on artery walls.
- High total cholesterol and LDL cholesterol are risk factors for heart disease.



Cholesterol

- Sources of dietary cholesterol:
 - High saturated fat foods (butter, lard, animal fats)
 - High trans-fatty acid foods (hydrogenated fats/shortening)
 - High cholesterol foods (fatty red meat, egg yolks)

BUT...

- Hepatitis can impair the production of cholesterol.



Omega-3 Fatty Acids

- Sub-class of polyunsaturated fatty acids
- Soybean oil, canola oil and deep-sea fish, or "fatty fish" are excellent sources
- may reduce risk for cardiovascular disease, promote eye health, and *possibly*, improve immune function by reducing inflammatory response.
- prevent blood platelets from clotting and sticking to the artery walls-effects that are similar to those observed with aspirin.
 - Decreased clotting helps reduce the chances of blockages in an artery
 - decreases the risk for heart attack or stroke.



Omega-3 Fatty Acids

- vitamin E in a diet rich in omega-3 fatty acids may help to delay autoimmune diseases such as rheumatoid arthritis.
- AHA advises that fish oil capsules be used judiciously:
 - only by individuals with severely high triglyceride levels,
 - individuals who have not responded well to conventional treatment for heart disease, and
 - individuals who are not at risk for pancreatitis (inflammation of the pancreas)
- (Remember: impact on clotting with liver disease)



Trace Elements

- Selenium may reduce cancer risks (non specific)
- RDA = 55 to 70 $\mu\text{g}/\text{day}$
- high intake may cause vague gastrointestinal and skin symptoms (ie. upset stomach, fingernail changes, hair loss) and fatigue.



Trace Elements

- Zinc is needed for adequate wound healing, immunity, and a healthy appetite
- RDA = 12 to 15 mg/day
- may slow progression of age-related macular degeneration.
- Zinc deficiency is common among those who also have cirrhosis or diabetes mellitus or who are taking diuretics.
- May improve hepatic encephalopathy, but remains controversial.
- A high-fiber diet may interfere with zinc absorption.



Vitamins, Minerals, Trace Elements

- Selenium functions as an anti-oxidant, it is stored in the liver and kidney, high amounts can be toxic.
- Zinc is a component of enzymes, stored in the liver, muscles, bones, organs. Found in meat, fish, liver/organ meats, wheat germ, yeast.
- Use of Selenium and Zinc supplements in liver disease is not supported in studies



Vitamins, Minerals, Trace Elements

- Fat soluble vitamins
 - Vitamins A
 - Stored in liver
 - Needs bile for absorption
 - Helps keep skin and eyes healthy
 - Toxic in therapeutic or high doses
 - Found in fish oil, liver, egg yolk, dark green/yellow vegetables
 - Vitamin D
 - Stored in liver
 - Made in skin from UV light exposure



Vitamins, Minerals, Trace Elements

- Fat Soluble Vitamins, continued:
- Vitamin E
 - Not stored
 - Acts as antioxidant
 - Best sources: vegetable oils, wheat germ, green leafy vegetables, nuts, legumes
- Vitamin K
 - Helps blood to clot
 - Needs bile for absorption
 - Large amounts are toxic
 - Found in green leafy vegetables (alfalfa, spinach, cabbage, liver)



Vitamins, Minerals, Trace Elements

- Water soluble vitamins:
 - Vitamin C
 - B complex Vitamins (Thiamine/B1, Riboflavin/B2, Niacin, B6, B12), folic acid
 - Not stored



Vitamins, Minerals, Trace Elements

- Niacin thought to play a role in ridding the body of toxic and harmful chemicals.
- High doses (75 mg or more) of niacin can cause side effects; only extremely high doses of niacin (in the range of 1,500 to 3,000 mg per day in divided doses) are helpful for most medical conditions.
- very high doses used to lower cholesterol and the other conditions mentioned previously can cause liver damage.



Vitamins, Minerals, Trace Elements

- Generic multiple vitamin supplement ok
- Calcium supplementation ok
- Iron
 - **Hemochromatosis** is a disease in which large amounts of iron accumulate in the liver. Persons with this condition must avoid iron injections, all iron-containing foods, and are advised not to use iron cooking utensils.

Dietary Reference Intakes (DRIs): Estimated Average Requirements for Groups
Food and Nutrition Board, Institute of Medicine, National Academies

Life Stage Group	CHO (g/d)	Protein (g/d) ^a	Vit A (μg/d) ^b	Vit C (mg/d)	Vit E (mg/d) ^c	Thiamin (mg/d)	Ribo-flavin (mg/d)	Niacin (mg/d) ^d	Vit B ₆ (mg/d)	Folate (μg/d) ^e	Vit B ₁₂ (μg/d)	Copper (μg/d)	Iodine (μg/d)	Iron (mg/d)	Magnesium (mg/d)	Molybdenum (μg/d)	Phosphorus (mg/d)	Selenium (μg/d)	Zinc (mg/d)	
Infants																				
7-12 mo		9*												6.9						2.5
Children																				
1-3 y	100	11	210	13	5	0.4	0.4	5	0.4	120	0.7	260	65	3.0	65	13	380	17	2.5	
4-8 y	100	15	275	22	6	0.5	0.5	6	0.5	160	1.0	340	65	4.1	110	17	405	23	4.0	
Males																				
9-13 y	100	27	445	39	9	0.7	0.8	9	0.8	250	1.5	540	73	5.9	200	26	1,055	35	7.0	
14-18 y	100	44	630	63	12	1.0	1.1	12	1.1	330	2.0	685	95	7.7	340	33	1,055	45	8.5	
19-30 y	100	46	625	75	12	1.0	1.1	12	1.1	320	2.0	700	95	6	330	34	580	45	9.4	
31-50 y	100	46	625	75	12	1.0	1.1	12	1.1	320	2.0	700	95	6	350	34	580	45	9.4	
51-70 y	100	46	625	75	12	1.0	1.1	12	1.4	320	2.0	700	95	6	350	34	580	45	9.4	
> 70 y	100	46	625	75	12	1.0	1.1	12	1.4	320	2.0	700	95	6	350	34	580	45	9.4	
Females																				
9-13 y	100	28	420	39	9	0.7	0.8	9	0.8	250	1.5	540	73	5.7	200	26	1,055	35	7.0	
14-18 y	100	38	485	56	12	0.9	0.9	11	1.0	330	2.0	685	95	7.9	300	33	1,055	45	7.3	
19-30 y	100	38	500	60	12	0.9	0.9	11	1.1	320	2.0	700	95	8.1	255	34	580	45	6.8	
31-50 y	100	38	500	60	12	0.9	0.9	11	1.1	320	2.0	700	95	8.1	265	34	580	45	6.8	
51-70 y	100	38	500	60	12	0.9	0.9	11	1.3	320	2.0	700	95	5	265	34	580	45	6.8	
> 70 y	100	38	500	60	12	0.9	0.9	11	1.3	320	2.0	700	95	5	265	34	580	45	6.8	
Pregnancy																				
14-18 y	135	50	530	66	12	1.2	1.2	14	1.6	520	2.2	785	160	23	335	40	1,055	49	10.5	
19-30 y	135	50	550	70	12	1.2	1.2	14	1.6	520	2.2	800	160	22	290	40	580	49	9.5	
31-50 y	135	50	550	70	12	1.2	1.2	14	1.6	520	2.2	800	160	22	300	40	580	49	9.5	
Lactation																				
14-18 y	160	60	885	96	16	1.2	1.3	13	1.7	450	2.4	985	209	7	300	35	1,055	59	10.9	
19-30 y	160	60	900	100	16	1.2	1.3	13	1.7	450	2.4	1,000	209	6.5	255	36	580	59	10.4	
31-50 y	160	60	900	100	16	1.2	1.3	13	1.7	450	2.4	1,000	209	6.5	265	36	580	59	10.4	

NOTE: This table presents Estimated Average Requirements (EARs), which serve two purposes: for assessing adequacy of population intakes, and as the basis for calculating Recommended Dietary Allowances (RDAs) for individuals for those nutrients. EARs have not been established for vitamin D, vitamin K, pantothenic acid, biotin, choline, calcium, chromium, fluoride, manganese, or other nutrients not yet evaluated via the DRI process.

^aFor individual at reference weight (Table I-1). *Indicates change from prepublication copy due to calculation error.

^bAs retinol activity equivalents (RAEs). 1 RAE = 1 μg retinol, 12 μg β-carotene, 24 μg α-carotene, or 24 μg β-cryptoxanthin. The RAE for dietary provitamin A carotenoids is two-fold greater than retinol equivalents (RE), whereas the RAE for preformed vitamin A is the same as RE.

^cAs α-tocopherol. α-Tocopherol includes *RRR*-α-tocopherol, the only form of α-tocopherol that occurs naturally in foods, and the *2R*-stereoisomeric forms of α-tocopherol (*RRR*-, *RSR*-, *RRS*-, and *RSS*-α-tocopherol) that occur in fortified foods and supplements. It does not include the *2S*-stereoisomeric forms of α-tocopherol (*SRR*-, *SSR*-, *SRS*-, and *SSS*-α-tocopherol), also found in fortified foods and supplements.

^dAs niacin equivalents (NE). 1 mg of niacin = 60 mg of tryptophan.

^eAs dietary folate equivalents (DFE). 1 DFE = 1 μg food folate = 0.6 μg of folic acid from fortified food or as a supplement consumed with food = 0.5 μg of a supplement taken on an empty stomach.

SOURCE: Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride (1997); Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B₆, Folate, Vitamin B₁₂, Pantothenic Acid



Water and Fluid Needs

- Water is part of every cell in the body, all bodily fluids (digestive juices, lymph, blood, urine, perspiration,..); carries nutrients, wastes through the body; regulates body temperature; lubricates (saliva, mucous,..)
- Needs based on use and losses through kidneys, lungs, skin, bowel.



Water and Fluid Needs

- Needs about 1 ml water/1 calorie
 - ie. 2000 calories=2000 ml water =66 oz
= 8 cups
- Any liquid at room temperature provides fluids.
- Water is 100% liquid for hydration.
- Other liquids (juice, milk, jello, soups...) provide nutrients in addition to fluids.



Coffee

- No randomized controlled studies
- Some population studies
 - Higher coffee/tea consumption lowers risk of liver damage in high risk for liver disease individuals, observational study cannot prove causality or identify the active ingredient in coffee.
- No indication to increase coffee/tea consumption.



How to evaluate a research article

- Randomized, double-blind controlled studies
- Human versus animal models
- Size and duration of study
- Specific conditions or applications
- Reputation and source of research
- Source of funding
- Within 5 years



Supplements

- Herbals, foods, spices, teas
 - The liver processes almost everything ingested.
 - Herbs should be taken with extreme care and only under the supervision of a practitioner knowledgeable in the field of herbal medicine.



Supplements

Herbals

- Alpha lipoic acid
 - Animal study: some protection against chloroquine-induced hepatotoxicity
 - Protects against ethanol-induced gastric ulcers
- SAmE
 - Animal study: alcohol-induced liver injury
 - Human study: liver disease
 - Adverse reactions include diarrhea, GI distress, headache, nausea



Supplements

- Green tea extract
 - Animal study: protects against alcohol damage in liver of rats
 - More studies needed
- Other herbals as celery seed, tumeric (need human studies), dandelion (diuretic), licorice root (reduce risk of cirrhosis with hepatitis C) more studies needed



Supplements

- Milk thistle
 - Human studies, used in alcoholic liver disease/cirrhosis, mushroom poisoning, cirrhosis, liver disease, viral hepatitis
 - May cause significant herb-drug interactions in certain drug classes and not others



How much do I need to keep my liver healthy?

- Calories: 25-35 calories/kg lean body mass
- Protein: 1.2-1.5 gm protein/kg lean body mass
- Carbohydrate: 45-50% total calories
- Fat: 30% total calories



How much do I need to keep my liver healthy?

- Water-soluble vitamins
 - and fat-soluble vitamins in water-soluble form IF DEFICIENCY is suspected
- Minerals
 - Trace elements IF DEFICIENCY is recognized
 - No Iron therapy with hemochromatosis or hemosiderosis
 - May be needed with esophageal or GI bleeding



How much do I need to keep my liver healthy?

- 30-45 minutes physical activity most days (for maintenance)
- 60-90 minutes physical activity most days (for wt. loss)
- 8 cups liquid (1 ml liquid/calorie) or to equal losses



Examples

- 125#=56.8 kg
 - Calories: 1400-2000 calories
 - Protein: 68-85 gm
 - CHO: 175-250 gm
 - Fat: 50-70 gm
 - Fluid: 1400-2000 ml (6-8 cups)
- 195#=88.6 kg
 - Calories: 2200-3100 calories
 - Protein: 67-130 gm
 - CHO: 275-385 gm
 - Fat: 73-100 gm
 - Fluid: 2200-3100 ml (9-13 cups)



Resources

- American Liver Foundation
 - www.liverfoundation.org
- American Cancer Society
 - www.cancer.org
- American Dietetic Association
 - www.eatright.org
- Food and Nutrition Information Center
 - www.nal.usda.gov/fnic/etext/000031.html
- National Institute of Diabetes & Digestive & Kidney Diseases
 - www.niddk.nih.gov/