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Nutrition Realities

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An Egg a Day is MORE Than Okay!

Even though eggs are not the major contributor of cholesterol in the American diet, over the last 35 years eggs have become the visual icon of high cholesterol, both dietary and blood cholesterol, and many consumers have responded by limiting, or eliminating eggs from their diets. U.S. Department of Agriculture data show that meat, poultry and fish together account for nearly 45% of cholesterol intake, compared to under 36% for eggs.[1] Between 1970, when the public first started hearing the diet-cholesterol message, to 1995, egg consumption decreased 24%, from 311 to 238 eggs per person per year. The message to limit dietary cholesterol had been so effective that recent surveys show that 45 to 50% of consumers considered dietary cholesterol "a serious health risk." And since everyone seemed to replay the same nutritional messages, "less than 300 mg per day of dietary cholesterol and no more than 3 to 4 whole eggs a week," consumers assumed that the recommendations must be not only science based but also proven safe and effective. Today as we are learning about many aspects of the more traditional conventional wisdom in nutrition, the proscriptions against eggs and dietary cholesterol are coming under increased scrutiny as new research not only questions the validity of old concepts but presents documented evidence that the old theories don't hold up well to rigorous scrutiny.

Today, as scientific investigation and statistical analytical methodologies have improved, research studies provide a more accurate perspective of the biological processes involved in diet-disease relationships. In fact, a 2007 observational study of 9,734 people conducted by researchers at the University of Medicine and Dentistry of New Jersey, found no increased risk for stroke, ischemic stroke or coronary heart disease when subjects ate 6 or more eggs per week. The researchers concluded that "the lack of relationship between egg consumption and cardiovascular diseases may be attributable to lack of association between serum cholesterol and egg consumption".[2]

Over the years there have been numerous reports that egg consumption is not related to either plasma cholesterol levels or coronary heart disease (CHD) incidence. Epidemiological surveys across cultures, such as the Twenty Countries Study,[3] reported that dietary cholesterol and egg consumption were related to cardiovascular disease mortality using simple correlation analyses but, when multivariate analyses were included correcting for saturated fat calories, there were no relationships between CHD and either dietary cholesterol or egg intakes. Data from the Framingham Heart Study,[4,5] the Multiple Risk Factor Intervention Trial (MRFIT)[6], the Lipid Research Clinics Prevalence Trial[7], the Alpha-Tocopheral, Beta-Carotene Cancer Prevention Study,[8] the Nurses' Health Study,[8] and the Health Professionals Follow-Up Study[8] all reported that dietary cholesterol intake was not related to either plasma cholesterol levels or CHD incidence.

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In 1999 Hu and colleagues at the Harvard School of Public Health reported in the *Journal of the American Medical Association* (JAMA) an analysis of data from the Nurses' Health Study and the Health Professionals Follow-Up Study on the relationships between weekly egg consumption and CHD and stroke incidences.[9] The Nurses' Health Study included 80,082 nurses aged 34 to 59 years at study onset followed for 14 years (1980-1994) and the Health Professionals Follow-Up Study involved 37,851 males aged 40 to 75 years in 1986 and followed for 8 years (1986-1994). The investigators determined daily egg consumption from multiple food-frequency questionnaires and measured incidences of nonfatal myocardial infarction, fatal CHD, and stroke in the two study populations.

The investigators reported that after adjustments for age, smoking, and other potential CHD risk factors, there was no evidence for a significant relationship between egg consumption and risk of CHD or stroke in either men or women. The researchers concluded "that consumption of up to one egg per day is unlikely to have substantial overall impact on the risk of CHD or stroke among healthy men and women." Using data from subgroup analyses, the authors noted an increased risk of CHD associated with higher egg consumption among study participants with diabetes (following an ad libitum diet) but not in those with hypercholesterolemia or excess body weight.

The findings by Hu et al.[9] add to an ever increasing body of evidence indicating a null relationship between egg consumption and CHD risk. The fact is that most industrialized countries have reviewed the experimental and epidemiological evidence and their nutrition experts determined that dietary cholesterol restrictions are unnecessary for a heart healthy diet.[10] In addition, studies are now showing that restricting eggs from the diet can have negative nutritional effects. The protein quality of eggs is the highest value in the supermarket, and it's available at the lowest price. Eggs have high nutrient density providing 13 different vitamins and minerals in excess of the caloric contribution. Eggs are a source of biologically available lutein and zeaxanthin which help protect eyes against age related macular degeneration, a leading cause of blindness in the elderly. In addition, eggs are an excellent source of choline, an essential nutrient needed for fetal brain and memory development and prevention of neural tube defects. And what else is there in an egg which nature has included to optimize embryonic development?: cholesterol (Should eggs be considered nature's original "functional food"?)

And surely, if eggs increased the risk of CHD then countries with higher per capita egg consumption should have high rates of CHD. In fact, it turns out to be just the opposite. The countries with the highest per capita egg intakes are Japan #1, then Spain and France, countries with very low rates of CHD mortality compared to the USA. As the articles in this issue of *Nutrition Realities* show, there are many reasons to include eggs in a healthy diet. And for segments of the population who are at nutritional risk, the elderly, growing children, low income families, and those with serious illnesses, excluding an affordable, nutrient dense source of high quality protein and a variety of essential nutrients makes very little sense and is unjust.

Our current understanding of the relationships between diet and CHD has moved beyond the simplistic view that dietary cholesterol equals blood cholesterol, and shifted towards an emphasis on saturated fats, obesity, and a sedentary lifestyle in CHD risk. Consider, that by giving the public one less ineffective dietary issue to concentrate on it may actually increase their awareness of some of their more risky behaviors. Slowly but surely, and with an ever expanding body of scientific evidence, eggs are coming back to their rightful place in the American diet. And for all those people who have been avoiding a food they enjoy, this will be a valuable shift in the conventional wisdom which will allow them to again welcome eggs back into their heart healthy diet.✤

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9 Hu FB, Stampfer MJ, Rimm EB, et al. A prospective study of egg consumption and risk of cardiovascular disease in men and women. *JAMA* 1999;281:1387-1394.

10 Klein C, The Scientific Evidence and Approach Taken to Establish Guidelines for Cholesterol Intake In Australia, Canada, The United Kingdom and the United States, Life Science Research Office, November 2006.

Eating eggs is a great opportunity for improving health.

Cholesterol

Cholesterol is not a fat, but a waxy substance (lipid) produced by all humans and animals, and is essential for bodily function. Cholesterol is found in all cells and is an important component of the central nervous system. Cholesterol is used to produce bile acids which are required for the body to absorb fats and fat-soluble vitamins from the digestive tract. The body also uses cholesterol to make steroid hormones, and as the starting material for the synthesis of vitamin D.

Dietary cholesterol is the cholesterol consumed in foods while blood cholesterol is the cholesterol that circulates in the bloodstream. Dietary cholesterol does not automatically raise blood cholesterol when a high cholesterol food is eaten. Cholesterol does not have to be supplied by the diet like vitamins since the body produces all the cholesterol it needs. The amount of cholesterol the body makes is determined by weight. People who are obese produce more cholesterol than lean people and weight loss can decrease the amount of cholesterol the body makes. In most people the body balances the amount of dietary cholesterol by changing cholesterol synthesis in body tissues. Eating excess saturated fat causes the liver to put more cholesterol into the blood circulation and slows down the removal of blood cholesterol. This is why too much saturated fat in the diet is considered to be the most important dietary factor in causing high blood cholesterol levels and increased heart disease risk. Elevated levels of cholesterol in the bloodstream carried by low density lipoproteins (LDL) are associated with an increased risk of heart disease. The LDL cholesterol ("bad cholesterol") is responsible for cholesterol entering artery walls resulting in blocked arteries. The high-density lipoprotein cholesterol, (HDL), helps move cholesterol from tissues to the liver for removal from the bloodstream. High values of HDL cholesterol ("good cholesterol") are desirable. Currently, the new perspective on heart disease risk now identifies the LDL: HDL ratio and the Total: HDL ratio (the sum of all cholesterol components to the "good cholesterol") as the best indicator of heart disease risk. A review of over 30 studies published in the Journal of the American College of Nutrition in 2008 [1] presents evidence that the LDL:HDL ratio is a better indicator of heart disease risk than either indicator alone because, according to the authors, the ratio reflects the "two-way traffic" of cholesterol entering and leaving the blood system.

1 Fernandez ML, Webb D., The LDL to HDL Cholesterol ratio as a valuable tool to evaluate coronary heart disease risk. *J Am Coll Nutr,* 27(1);1-5,2008.

Protein

Eggs are a highly nutritious food making valuable contributions to one's diet. A large egg provides six grams of high biological value protein, 10% of the daily value based on a 2,000 calorie diet. In fact, egg protein is the standard against which other food proteins are measured. Amino acids are the building blocks of proteins which the body requires for cells and tissues, regulation of body processes, and source of energy. When proteins are broken down and used for energy they cannot be used to build and repair body tissue since there is little reserve supply of protein in the body. Everyone needs a constant supply of protein to repair body cells as they wear out and to make new body tissues especially during times of growth. The National Academy of Sciences' Institute of Medicine 2006 recommendation is to include 10-35% of daily calorie intake as protein. Recent research has indicated that muscle mass in older adults is better preserved when protein intake approaches the upper range of this recommendation.

Proteins are composed of differing combinations of 20 amino acids. The human body needs all 20 amino acids for the synthesis of its wide range of proteins. The body can synthesize 11 of these amino acids, but is unable to make 9 essential amino acids, which must be obtained from the diet. The egg contains all the essential amino acids in a proper proportion to fulfill the needs for human growth and tissue maintenance. The only food that contains a more ideal mix of essential amino acids than an egg is mother's milk.

Two eggs can be used to equal two ounces of lean meat, which is considered a serving in the Meat, Poultry, Fish, Dry Beans, Eggs, and Nuts Group of the USDA MyPyramid nutrition guidance meal plan. Eggs are lower in cost and in calories than many other animal-protein foods grouped in the same food group.

Duyff, R. The American Dietetic Association's Complete Food and Nutrition Guide. Chronimed Publishing, Minneapolis, MN. 1998.

Dietary Reference Intakes, Institute of Medicine, The National Academies Press, 2006.

www.MyPyramid.gov

Choline

Choline, is an essential nutrient needed for normal function of all cells. It is a critical component of the cell membrane and the neurotransmitter acetylcholine. The human body is dependant upon choline for normal muscle function, lipid transport, fetal development and memory center development. Eggs are an excellent source of the nutrient choline which, like folate, is essential for proper neural tube closure and nervous system function in the developing fetus. In fact, it has been found that dietary choline intakes vary enough in healthy women in the United States (from <300mg to >500mg/day) to significantly influence the risk of birth defects.[1] Choline is also needed to control the buildup of homocysteine in the blood by contributing to the production of methionine, an amino acid needed for protein synthesis. Elevated levels of homocysteine in the blood have been associated with increase risk of heart disease. A choline deficient diet has been shown to significantly increase DNA damage in humans and is the only nutrient deficiency shown to induce spontaneous carcinoma.[2]

Two eggs contain about half the recommended daily amount of choline considered an adequate intake. During pregnancy and lactation, recommendations for choline intake are increased. In fact, the placenta delivers choline to the fetus by pumping it against a concentration gradient through the umbilical blood stream, indicating how important choline is for fetal development. Sadly, a review of USDA consumption study data shows that only about 10% of the population is consuming an adequate intake of choline from their diet. Among adults; younger and older women including pregnant women, had the lowest estimated mean intakes of choline.[3] Egg intake can help close this unfortunate gap.

1 Shaw GM et al. Periconceptional dietary intake of choline and betaine and neural tube defects in offspring. *Am J Epidemiol*, 160, 102-9, 2004.
2 Sanders LM and Zeisel SH, Choline: Dietary Requirements and Role in Brain Development, *Nutr Today*, 42(4), 181-6, 2007.
3 Jensen H et al, Choline in the Diets of US Population: NHANES, 2003-2004 presented at Experimental Biology 2007.

Satiety

One of many reasons we enjoy eating is that food can quell the feeling of hunger and provide us with energy to perform our chosen activities. A food that satisfies the pangs of hunger and gives us sustained energy is one that provides satiety. A major benefit of eating eggs is not only that it satisfies hunger but, it keeps you from needing snacks before the next meal which has been demonstrated to be a valuable asset in any weight reduction and weight maintenance strategy. Researchers at Wayne State University compared the reported feeling of satiety and weight loss of overweight and obese men and women who consumed either an isocaloric egg or bagel-based breakfast while following a weight loss diet. They found that compared to an isocaloric, equal weight bagel-based breakfast, the egg-breakfast induced greater satiety and enhanced weight loss by 65% and a 34% greater reduction in waist circumference without a significant difference in blood lipid levels between groups.[1]

1 Vander Wal JS et al. Egg breakfast enhances weight loss. *Int J Obes* advance online pub, 5 August 2008; dol:10.1038/ijo.2008.130

Eye Health

Age related macular degeneration (ARMD) occurs when the macula of the retina deteriorates and central vision becomes affected. ARMD occurs mostly in people over 50 years of age, and is the leading cause of irreversible blindness in the elderly. There presently is no cure for ARMD but laser therapy can be an effective treatment.

New research suggests that ARMD may result from lack of certain nutrients in the diet. Vitamins and minerals, mainly antioxidants found abundantly in fruits and vegetables may reduce the risk of ARMD. One group of vegetable chemicals, carotenoids seem to have a protective effect against ARMD. Carotenoids exist in high concentrations in eye tissues and function as antioxidants to neutralize damage to cells caused by free radicals from sunlight. Carotenoids act as filters and form a pigment that protects the eye tissue from blue wavelength light, a potentially destructive band of radiation present in ordinary sunlight.

Lutein and zeaxanthin are two xanthophyll antioxidants making up the macular pigment of the eye and recent research has shown they reduce a person's risk and slow the progression of ARMD. The chicken egg yolk contains lutein and zeaxanthin within its fat-soluble matrix dispersed with other fat-soluble micronutrients such as vitamin A, vitamin D, and vitamin E. The yolk of the chicken egg provides a readily bioavailable source of lutein and zeaxanthin which has been shown to have greater bioavailablity than lutein from supplements and spinach. Researchers at the University of Massachusetts reported that the addition of one egg to the diet of subjects with an average age of 79 years significantly increases both their serum lutein and zeaxanthin concentrations without elevating serum total cholesterol or the serum concentration of the LDL fraction.[1] Similarly, women between the ages of 24 and 59 years were found to have increased serum zeaxanthin and macular pigment optical

egg Q

Q: Are brown eggs more nutritious than white eggs?

A: The color of the egg's shell is determined by the breed of the hen. Since many consumers prefer white eggs producers most often raise White Leghorn hens, which produce eggs with white shells. Consumers who live in the New England area often prefer brown shelled eggs, so egg producers there raise breeds such as the Rhode Island Red which produces brown shell eggs. The color of the shell has nothing to do with egg quality, flavor, or nutritional value, only the breed of hen laying the eggs. However, brown shell eggs are usually slightly higher in price than white eggs because the brown shell producing hens are larger birds and require more feed for the eggs produced.

Q: Is it safe to eat raw eggs?

A: Public health authorities and the egg industry continue to warn against consuming raw eggs or lightly cooked eggs. The egg might be contaminated with *Salmonella Enteritidis* (SE) a bacterium that can cause food borne illness. Eggs and some other animal products have a small possibility of containing SE. The risk of food borne illness is greatest for those who are pregnant, elderly, very young, or who have medical problems resulting in an impaired immune system. These individuals should avoid any raw and undercooked animal foods. Everyone needs to remember that while there is a small risk of contacting SE, consumers need to treat eggs and other raw animal foods safely. It is not recommended that anyone eat raw eggs. SE is killed by proper cooking temperatures and it is recommended that eggs be cooked until both the yolk and the whites are firm, not runny.

Q: Where are the vitamins and minerals located in the egg?

A: The yolk or yellow portion of the egg contains a higher proportion of the egg's vitamins and minerals than the white. Please refer to the chart (right) for the list of nutrients contained in one egg.

Q: What are organic and free-range eggs and do they differ nutritionally?

A: Organic eggs are eggs produced by hens fed "organic" feeds grown without pesticides, chemical or commercial fertilizers. In addition, there are no pesticides, herbicides, or fungicides added to the feed. There are no known nutritional differences between organic eggs and regular eggs. Free-range eggs are produced by hens raised outdoors or with daily access to the outdoors. The hens are free to run around, but in the event of bad weather the hens are kept inside. True free-range eggs are only available on a seasonal basis in the United States. The term free-range can also refer to eggs produced by hens raised inside on an open floor rather than in cages. Free range eggs do not differ from regular eggs in terms of nutritional value or cholesterol level; however, they are more expensive due to production costs.

Nutrient Content of One Large Egg
Whole, Raw, Fresh

Nutrient	Whole Egg	White	Yolk
Calories	72	16	54
Total Fat (g)	5	0.06	4.5
Saturated Fat (g)	1.5	0	1.6
Trans Fat (g)	0.05*	0	0.05*
Cholesterol (mg)	212	0	210
Sodium (mg)	70	55	8
Carbohydrate (g)	0.4	0.2	0.6
Protein (g)	6.3	3.6	2.7
Vitamin A (IU)	244	0	245
Vitamin D (mg)	18	0	18
Calcium (mg)	27	2	22
Thiamine	0.03	0	0.03
Vitamin B6 (mg)	0.07	0	0.06
Vitamin C (mg)	0	0	0
Iron (mg)	0.09	0.03	0.46
Riboflavin (mg)	0.24	0.15	0.09
Folate (mcg)	24	1	25
Vitamin B12 (mcg)	0.65	0.03	0.33
Zinc (mg)	0.56	0.01	0.39
Phosphorus (mg)	96	5	66
Lutein & Zeaxanthin (mcg)	166	0	186
Choline (mg)	125	1.1	113.3

U.S. Department of Agriculture, Agricultural Research Service. 2007. USDA National Nutrient Database for Standard Reference Release #20. Nutrient Data Laboratory (www.nal.usda.gov/fnic/foodcomp)
USDA Database for the Choline Content of Common Foods
Differences in nutrient levels between egg white, egg yolk and whole egg are due to sampling procedure
*Sadler, Strain and Caballero (1999) *Encyclopedia of Human Nutrition*. San Diego, Academic Press

density after 12 weeks of eating an egg daily with no increase in their serum cholesterol concentrations.[2]

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Nutrient Density

Eggs were designed by nature to be a complete nutrient reserve for the developing chick. Eggs are an important food for humans because of their high nutrition value at a comparably affordable price. A major concern however is that many Americans are sedentary and need to watch their caloric intake to maintain a healthy weight. Yet within their allowable caloric intake they must obtain all of the essential nutrients needed for health. In order to achieve this goal they need to consume foods that are nutrient dense and keep them from feeling hungry. Nutrient density refers to the quantity of one or more nutrients supplied by a food in relation to its caloric content. Nutrient-dense foods provide a high proportion of a person's daily diet needs of essential nutrients while supplying a small proportion of the daily need for calories. Eggs are a nutrient dense food because they are an excellent source of high quality protein, provide a wide range of vitamins and minerals, and are relatively low in calories.

One large egg has 72 calories with 13 vitamins and minerals. The amounts of various nutrients supplied in two large eggs are shown in the chart (right). As the nutrient daily values show, eggs provide a wide variety of nutrients for relatively few calories. One large egg offers only 7% of the total daily calorie intake of a person on a 2,000 calorie diet and provides 12.5% DV for protein, and 14% for riboflavin, and 8% or more of the daily value for several other nutrients including vitamins A, D, E, B-6, B-12, folate, iron, phosphorus, and zinc. And, it is important to realize that the egg is one of the few natural sources of vitamin D in the diet. With all of these nutritional benefits it is not difficult to see why eggs are considered a nutrient dense food.

Nutrition Facts
Daily Values (DV): 2 Large Eggs
Calories 144

Amount/Serving	% DV*	Amount/Serving	% DV*
Protein	25%	Folate	12%
Vitamin A	10%	Thiamin	5%
Vitamin B12	22%	Riboflavin	28%
Vitamin B6	7%	Phosphorus	20%
Vitamin D	9%	Zinc	8%
Vitamin E	4%	Iron	10%

One large egg contains 5 gm fat (7.7% DV), 0 trans fat, 1.5 gm saturated fat (8% DV*), and 212 mg cholesterol (71% DV) 37.0 mg omega -3 fatty acids, 514 mg omega-6 fatty acids.

*DV = Daily Value based on a 2,000 calorie diet.

Conclusion

Limiting egg intake would be a missed opportunity to benefit from the many naturally occurring nutritional benefits found in an egg such as:

- High quality protein
- Excellent source of choline
- Balanced assortment of essential vitamins and minerals
- Highly bioavailable antioxidants lutein and zeaxanthin
- Individual portion sized packaging, only 72 calories per egg offering satiety
- A moderate fat content
- A healthy ratio of mono-unsaturated and polyunsaturated fats to saturated fats
- Easily chewed food
- Easily prepared
- Abundantly available
- Culturally familiar
- Affordable low cost protein
- Extensive storage capacity: 4-5 week shelf life when refrigerated

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