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# Nutrition Research Update

Issue 5 - Special Cholesterol Edition



*This special edition of Nutrition Research Update focuses on recent publications and controversy over dietary cholesterol. We hope you find this topic thought–provoking and relevant to your professional work. If you have any questions about the studies or concepts presented, don't hesitate to contact us at info@eggnutrition.org.*

*Regards,*

*Mitchell Kanter, PhD*
*Executive Director, The Egg Nutrition Center*

## SPECIAL FEATURE

### Deconstructing the Study Behind the Sensational Headlines

By: Mitch Kanter, PhD, Executive Director of the Egg Nutrition Center

An observational study published in the journal *Atherosclerosis* in August suggested that eating eggs can be almost as damaging to you heart as smoking cigarettes. The study assessed plaque build-up in the arteries of older men and women who visited cardiovascular clinics in Canada. Read full article.

## CHOLESTEROL

### Is Dietary Cholesterol as Bad for You as History Leads Us to Believe?

*Advances in Nutrition* recently published a summary of the proceedings from a late-breaking session at the 2011 Experimental Biology conference on the topic of dietary cholesterol. Read full article.

### Effects of Whole Egg Consumption in Individuals with Metabolic Syndrome

A recent study in *Metabolism* investigated possible effects of egg consumption on markers of metabolic syndrome. For many years, Americans have been told that a high carbohydrate, moderate protein and low–fat diet was the best way to minimize disease risk. Read full article.

### Impact of Dietary Cholesterol on Lipoprotein Metabolism

The journal *Nutrients* recently featured a review on the physiological impact of dietary cholesterol on lipoprotein metabolism and heart disease risk. Read full article.

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SPECIAL FEATURE

## Deconstructing the Study Behind the Sensational Headlines

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An observational study published in the journal *Atherosclerosis* in August suggested that eating eggs can be almost as damaging to you heart as smoking cigarettes. The study assessed plaque build-up in the arteries of older men and women who visited cardiovascular clinics in Canada. The researchers used medical records to analyze the number of egg yolks consumed per week as well as smoking history and compared the effects of the two on CVD risk. Unfortunately many important factors were not taken into account including saturated fat intake, alcohol consumption, exercise habits, HDL:LDL cholesterol, serum triglycerides or waist circumference.

The Egg Nutrition Center's initial response to this study was to contact seven researchers including experts in cardiovascular disease and epidemiology for their perspectives. All pointed out a number of limitations in the study design, one being that it is a cross sectional study, in which it is impossible to reach a cause-and-effect conclusion. Additionally, the experts were concerned that there is no reported control for other dietary components besides eggs and that the study authors failed to adjust for age in their analysis. Another important limitation they highlighted was the sampling bias introduced by the fact that the subjects in the study already had heart disease, and that those who were the in the poorest health reported the highest egg consumption levels. Most of the experts we contacted wondered how a study of this nature, with all of its flaws, was accepted for publication in a peer reviewed journal.

It is unfortunate when studies like this one attract a large amount of media attention. It would have been beneficial for reporters to have investigated the data and uncovered some of the flaws and biases associated with this study before publishing their remarks.

At the Egg Nutrition Center we continue to study the effects of eggs on human health as we have always done, and we'll let the chips fall where they may regarding the results of the projects we fund. We adhere to the Guidelines for Industry Funded Research and request that all investigators who work with us do the same. We realize that not every study will yield a positive result; that's the nature of science. The key is to support well-designed, well-controlled studies so that the public can feel good about the results, whatever they happen to be. In the case of the recent *Atherosclerosis* paper, I'm not so sure that's what we received.

LEARN MORE

The Egg Nutrition Center's response statement to this study can be found online here.

Source:
Spence D, Jenkins D, Davignon J. Egg Yolk Consumption and Carotid Plaque. *Atherosclerosis* 2012; 224(2):469-473.

Next Article >> Cholesterol Review

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## Is Dietary Cholesterol as Bad for You as History Leads Us to Believe?

*Advances in Nutrition* recently published a summary of the proceedings from a late-breaking session at the 2011 Experimental Biology conference on the topic of dietary cholesterol. The article, authored by the session speakers, highlights scientific evidence contradicting the role of dietary cholesterol in heart disease and explores cholesterol intake in the context of paleoanthropology and the native human diet.

Currently, many Western countries do not have dietary recommendations to limit cholesterol consumption; however, dietary guidelines in the US recommend cholesterol intakes ranging from less than 200 mg per day for individuals at high risk for cardiovascular disease (CVD) to less than 300 mg per day for healthy individuals. However, several recent studies have indicated that the relationship between dietary cholesterol intake, serum lipid levels, and coronary heart disease (CHD) risk is not nearly as strong as previously reported

Often using eggs as a vehicle for dietary cholesterol, studies have demonstrated that cholesterol intake maintains or improves the LDL-C:HDL cholesterol ratio and results in the formation of larger LDL and HDL particles, suggesting decreased atherogenicity. Moreover, cholesterol intake has been shown to have no negative impact on endothelial function, and has led to increased HDL-C levels. Since recent study findings have suggested novel functions of HDL, such as in pathways that improve glucose metabolism, this may be of particular benefit. In addition to experimental research, a growing body of epidemiological research questions the association between dietary cholesterol and serum lipids, when other dietary factors are taken into account.

The article also explores the theoretical challenge that arises when considering dietary cholesterol in the context of human history. Paleoanthropologists believe that dietary cholesterol has existed in the human diet for millions of years in the form of eggs, bone marrow and organ meats, potentially exceeding current dietary recommendations. In light of this as well as the important physiological need for cholesterol in cell membranes and bile production, the authors suggest that humans were specifically adapted to cholesterol consumption as a component of our native diet.

The authors conclude that elimination of dietary cholesterol from current diets would require significant changes in patterns of dietary intake. Since foods containing cholesterol, like eggs, are also nutrient-rich, efforts to eliminate dietary cholesterol from the diet may have undesirable effects, such as inadequate intake of protein or certain micronutrients like choline. The authors also point out that other diet and lifestyle changes are more likely to impact heart disease risk. While decreases in dietary cholesterol to less than 200 mg per day may have the potential to decrease LDL-C by only 3-5%, strategies such as decreasing saturated fat intake to less than 7% of energy intake and losing 10 pounds of body weight have proven more effective.

### KEY MESSAGES

- Although current dietary cholesterol recommendations in the US range from 200 – 300 mg per day, many Western countries do not have existing guidelines pertaining to cholesterol intake.
- Recent studies indicate that dietary cholesterol maintains or improves the LDL:HDL cholesterol ratio and positively impacts lipoprotein particle size; both of these factors are beneficial in the reduction of heart disease risk.
- The field of paleoanthropology suggests that humans may have adapted to dietary cholesterol by consuming foods that contained cholesterol but did not contain significant amounts of saturated fats; in the modern context, these nutrients often coexist in foods, making it difficult to distinguish risk factors.

Source:
Kanter MM, Kris-Etherton PM, Fernandez ML, Vickers KC, Katz DL. Exploring the Factors That Affect Blood Cholesterol and Heart Disease Risk: Is Dietary Cholesterol as Bad for You as History Leads Us to Believe? *Advances in Nutrition* 2012; 3:711-717.

Next Article >> Metabolic Syndrome

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## Effects of Whole Egg Consumption in Individuals with Metabolic Syndrome

A recent study in *Metabolism* investigated possible effects of egg consumption on markers of metabolic syndrome. For many years, Americans have been told that a high carbohydrate, moderate protein and low-fat diet was the best way to minimize disease risk. However, many researchers are taking a new look at this advice and finding that not all dietary fats and cholesterol are as detrimental to health as was previously believed. This was the rationale for research conducted by Blesso and others who proposed that daily egg consumption, along with carbohydrate restriction, would alter lipoprotein metabolism and influence atherogenic lipoprotein profiles and insulin resistance.

In this study, researchers fed a carbohydrate-restricted diet (25-30% of calories) plus three eggs per day for 12 weeks to 37 middle–aged men and women with metabolic syndrome. Some of the subjects (n=20) received three whole eggs (EGG group), while the other participants (n=17) received an equivalent amount of yolk-free egg substitute (SUB group). Metabolic syndrome is partially characterized by an atherogenic dyslipidemic pattern that includes low plasma HDL-cholesterol (HDL-C), elevated fasting triglycerides, and a predominance of small dense LDL particles that are particularly susceptible to oxidation and subendothelial retention, as well as small HDL particles.

During the study, all subjects' diets had 24% fewer calories than their baseline diet, and those in the EGG group were consuming twice as much cholesterol (360 mg/d vs 740 mg/d) than they did at the beginning of the study. The SUB group decreased cholesterol intake by 38% compared to baseline (345 mg/d vs 214 mg/d); total fat and protein intake did not change for either group.

After 12 weeks, there was a 4% weight loss across study groups and no effects on total cholesterol or LDL cholesterol levels were observed in either group. All participants had improved lipid profiles with decreases in plasma triglycerides, apoC-III, apoE, oxLDL, VLDL particle diameter, large VDL, small LDL and medium LDL particles. Additionally, all individuals had increases in HDL cholesterol and number of large LDL and HDL particles.

However, the EGG group had greater increases in HDL cholesterol and experienced significant reductions in the LDL/HDL cholesterol ratio over time, while the SUB group did not. Furthermore, the EGG group exhibited greater increases in large HDL particles and showed increased diameter of LDL and HDL particles over time. Reductions in total and medium VLDL particles were also greater in the EGG group compared with those consuming the substitute. There were no effects on fasting glucose, but insulin and insulin resistance (HOMA-IR) were both significantly decreased for those in the EGG group.

The authors concluded that daily consumption of whole eggs further enhances the benefits of a moderately carbohydrate-restricted diet in improving the atherogenic lipoprotein profiles of patients with metabolic syndrome.

### KEY MESSAGES

- Despite consuming twice as much dietary cholesterol as at baseline, participants consuming three whole eggs per day for 12 weeks did not exhibit an increase in total cholesterol or LDL cholesterol levels.
- While all study participants had improved lipoprotein panels, subjects consuming three whole eggs per day had greater increases in HDL cholesterol and greater increases in lipoprotein particle size compared with those consuming an egg substitute.
- Study subjects consuming three whole eggs per day experienced significant decreases in insulin and insulin resistance, while those consuming the egg substitute did not.

Source:
Blesso CN, Andersen CJ, Barona J, Volek JS, Fernandez ML. Whole egg consumption improves lipoprotein profiles and insulin sensitivity to a greater extent than yolk-free egg substitute in individuals with metabolic syndrome. *Metabolism*. 2012 Sep [Epub ahead of print]

Next Article >> Lipoprotein Metabolim

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## Impact of Dietary Cholesterol on Lipoprotein Metabolism

The journal *Nutrients* recently featured a review on the physiological impact of dietary cholesterol on lipoprotein metabolism and heart disease risk. While epidemiological studies have shown the lack of correlation between cholesterol intake and cardiovascular disease (CVD) risk, the effects of dietary cholesterol intake on lipoprotein levels remain a concern among consumers and health professionals alike.

Both elevated levels of plasma LDL and low levels of HDL cholesterol are associated with increased risk of CVD. Additionally, the ratio between LDL and HDL is a key marker of CVD risk, making it a valuable tool for heart disease assessment. However, dietary cholesterol intake and plasma lipoprotein levels do not always correlate. In response to cholesterol intake, the majority of individuals maintain homeostasis by decreasing absorption or suppressing synthesis of cholesterol. Only about 25% of individuals known as "hyper-responders" experience an increase in plasma cholesterol levels in response to dietary cholesterol intake.

Even though a fraction of the population responds to dietary cholesterol with increases in plasma cholesterol, studies show that these individuals have increases in both HDL and LDL cholesterol, therein maintaining the LDL-C/HDL cholesterol ratio. Furthermore, when dietary cholesterol is consumed as part of a weight loss diet, studies show increases in HDL levels while LDL remains at the same level, thus improving lipoprotein profiles overall.

Particle size is another key factor in the role that lipoproteins play in CVD risk. Smaller LDL particles are more readily oxidized and susceptible to foam cell formation, making individuals with this pattern of LDL size three times more likely to develop CVD. Conversely, those with larger LDL particles have lower risk for CVD. Numerous studies have demonstrated an association between dietary cholesterol intake and increased LDL size as well as increased number of large LDL particles and decreased small LDL subfractions.

Intake of cholesterol has also been linked with larger HDL particle size and greater amount of HDL, which are associated with lower CVD risk as well. These changes appear to enhance reverse cholesterol transport, the process by which cholesterol is removed from the peripheral tissues and returned to the liver for processing. While studies continue to elucidate the pathways by which dietary cholesterol is metabolized, existing evidence suggests neutral impact on lipoprotein levels as well as positive outcomes related to particle size and functionality.

## KEY MESSAGES

- The majority of individuals compensate for dietary cholesterol intake by decreasing endogenous synthesis and/or absorption rates of cholesterol; about 25% of the population are categorized as hyper-responders.
- Dietary intake of cholesterol during weight loss has been shown to increase HDL levels while LDL levels remain constant.
- Dietary cholesterol promotes the formation of larger LDL and HDL particles, which are less atherogenic than smaller particles and may enhance reverse cholesterol transport, respectively.

Source:
Barona J, Fernandez ML. Dietary cholesterol affects plasma lipid levels, the intravascular processing of lipoproteins and reverse cholesterol transport without increasing the risk for heart disease. *Nutrients* 2012; 4:1015-1025.

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