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Saturated Fat and Heart Health: A Changing Picture?
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Nutrition topics are of interest to a large number of the US population, and reports of a current nutrition research study often spread quickly across the news media, especially when the research contradicts currently accepted advice. Such was the case with a March 2014 study published in the ***Annals of Internal Medicine*** that found no link between saturated fats and heart disease.[1] Researchers reviewed 72 previous studies that looked at the link between fatty acids and several types of coronary disease, and after pooling the results, found no evidence that saturated fat increased the risk.

Although the British Heart Foundation, one of the organizations that helped fund the research, stated that more large-scale clinical studies are needed before making a conclusive judgment,[2] media in the United States and Europe were quick to pick up on the study. Headlines about the latest research were largely black and white, and included "Saturated Fat 'Isn't Bad for Your Heart': Major Study Questions Decades of Dietary Advice," and "Now Saturated Fat Is Good for You?"[3,4]

Today's consumers are influenced by the barrage of nutrition advice provided not only by legitimate news outlets but also by doctor-hosted talk shows, food bloggers, advocates of popular fad diets, and opinions vs evidence-based commentary by noncredentialed "nutritionists." As each of these consumer-oriented sources weighs in with their takes on the research, the public is left even more confused. Thus, it is essential that RDs stay informed about the research so they can guide their clients and the public and provide practical advice. To that end, this continuing education course reviews the latest research on saturated fat and heart health and examines possible reasons for the inconsistencies in research. In addition, it presents recommendations for counseling clients and the public based on what is known about healthful eating patterns to prevent cardiovascular disease (CVD).

The Controversial Study

CVD is the leading cause of death worldwide,[5] and, according to 2015 statistics on heart disease and stroke published by the American Heart Association, it accounts for 17.3 million deaths per year, with the number expected to grow.[6] Current recommendations for heart health, including medical nutrition therapy, are based on the earliest published research of nearly 60 years ago, when Ancel Keys began the Seven Countries Study. His team examined

association between lifestyle, diet, and heart disease starting in 1958 and followed nearly 13,000 study participants over a 25-year period.[7]

In addition to identifying other correlations between lifestyle habits and heart disease, the study determined early on that countries with higher fat consumption also had more heart disease. An examination of the specific types of fat consumed was conducted in the late 1980s and revealed that saturated fat was strongly related to coronary heart disease mortality rates, as were trans fat intake and dietary cholesterol.[8,9]

As a result of these and numerous other studies,[10-13] saturated fat has been identified as a major contributing factor in increasing risk of CVD, mainly because of its effect on raising levels of LDL cholesterol. Major medical and government authorities, including the American Heart Association,[14] the British Heart Foundation,[15] the World Heart Federation,[16] the USDA,[17] and the World Health Organization,[18] all still agree, and they recommend limiting foods high in saturated fat to reduce one's risk of CVD.

The March 2014 study in the ***Annals of Internal Medicine***, conducted by Chowdhury et al,[1] along with several other well-publicized studies over the past decade have created controversy as they question the conventional wisdom and suggest that perhaps the health guidelines should be changed. However, the conflicting studies warrant a closer look at both their methods and results.

The current research in question was conducted by a team from the United Kingdom as well as the Harvard School of Public Health and was funded in part by the British Heart Foundation. Research was in the form of a systematic analysis and meta-analysis, which is an overview and mathematical synthesis of previously conducted studies.

Seventy-two studies, including a mix of cohort and randomized controlled studies, were analyzed. Researchers looked at the association between exposure to fatty acids (as estimated by diet questionnaires and records, supplementation with fatty acids, and levels of fatty acid biomarkers) and coronary disease. They defined coronary disease as either a history of a fatal or nonfatal heart attack; a diagnosis of coronary heart disease, angina, or coronary insufficiency; and sudden cardiac death.

The results of the Chowdhury study found that dietary trans fat was the only fatty acid associated with increased coronary disease risk. The researchers' review of studies that looked at both dietary intake and circulating biomarkers of saturated fatty acids showed no significant link to risk of coronary disease. The results were surprising, especially given the large size of some of the cohort studies, a total of 530,525 individuals whose dietary intake was considered, and 25,271 whose fatty acid biomarkers were assessed.[1,19]

With respect to an analysis of the study's methods and results, it should be noted that a systematic review and meta-analysis is a pooling of studies but does not prove a cause and effect. There were also several limitations to the overall study. Some of the studies included in the review and analysis involved individuals with preexisting health and cardiovascular conditions, so it's unclear if a healthy population would expect the same results. In addition, the researchers compared fat consumption between the top one-third and bottom one-third of cohorts, but the actual amounts of fat consumed between each group is unclear. Since much

of the dietary intake information was self-reported, there are also questions regarding recall bias and the length of time each diet was assessed.[19]

Commentary From Experts

After it was published, the Chowdhury study received numerous letters and responses, many of which were critical of the study's data collection methods and results. Several letters expressed concern over the author's conclusion[1] that "current evidence does not clearly support cardiovascular guidelines that encourage high consumption of PUFA and low consumption of total SAFA" and the impact this study would make on the public.

Walter Willet and other experts on diet and CVD from Harvard University called the results "seriously misleading" because of errors and omissions of important data from other studies.[20]

The Center for Science in the Public Interest questioned whether the studies selected were biased,[21] and several other researchers stressed the need for clarification on the results, since dietary saturated fat cannot be studied in isolation, and results are dependent on which nutrient is replacing it.[21] Members of the steering committee of the International Expert Movement on the Health significance of fat quality in the diet expressed concern about the public health implications of a single publication that sends mixed messages to the public, without presenting any new research or specific recommendations.[21]

Additional Conflicting Studies

Although there was significant criticism about the study, several other research studies have found similar results about the effect of saturated fat and cardiovascular risk. In January 2010, Siri-Tarino et al published a meta-analysis in the ***American Journal of Clinical Nutrition***. Their study pooled 21 prospective epidemiological studies and nearly 350,000 baseline healthy subjects who participated in The Framingham Heart Study, The Nurses Health Study, The Lipid Research Clinic Study, The Strong Heart Study, The Honolulu Heart Study, and other significant studies.

Some positive associations between saturated fat and CVD were seen in some subsets of several of the studies, but after combining of all of the data, the researchers were unable to conclude that dietary saturated fat is associated with increased risk of coronary heart disease or CVD. They did stress that a major limitation of the study was the reliance on accuracy of the dietary assessments in the component studies, as also noted in the Chowdhury study. Researchers of this study stressed that further research is needed to explore the effects and risks on heart disease of substituting other nutrients for saturated fat.[22]

Full-fat dairy products are a known source of saturated fatty acids, yet numerous studies since the 1980s have found either no association, or an inverse association, between dairy products and cardiovascular risk. However, few studies have compared the effects of full-fat dairy vs low-fat dairy. In June 2010, a 16-year prospective study of 1,500 Australian adults looked specifically at the association between various types of dairy foods and mortality due to CVD as well as cancer and all causes. The research, published by Bonthius et al in the ***European Journal of Clinical Nutrition***, showed that compared with those participants with the lowest intake of full-fat dairy products, those with the highest intake of full-fat dairy actually had decreased deaths due to CVD.[23,24]

Finally, coconut oil is a known source of saturated fat and has been shown to elevate LDL cholesterol levels and assumed to increase the risk of heart disease. Although not many epidemiological studies on groups that consume coconut oil are available, a study on Pacific Islanders, whose diet is high in coconut, showed low incidence of CVD.[25]

In addition, in a study published in 2011 in the ***Asia Pacific Journal of Clinical Nutrition***, researchers looked at the diets of Philippine women who participated in the Cebu Longitudinal Health and Nutrition Survey and determined that coconut oil may be positively associated with HDL cholesterol.[26]

Is More Research Needed?

The results of these and other studies and comments by medical professionals[27-31] have prompted researchers to examine the effects of various types of individual saturated fatty acids and how they function with the rest of the diet. The public has responded to this latest research and the possibility of revisiting the guidelines with mixed opinions and confusion. Some are wondering if this is another case of science doing an about-face on nutrition advice, as was the case with trans fat in the 1990s. Others are simply celebrating the green light to enjoy favorites such as bacon, butter, and cheese, encouraged by proponents of higher protein, lower carbohydrate diets such as Atkins, South Beach, Paleo, and ketogenic diets, and by the marketing efforts of organizations such as the Dairy Association and Dairy Council. The dairy industry has seen increased sales in the past few years, with the largest increases coming from butter and cheese.[32]

The coconut industry has also had a boost in sales from highly saturated coconut oil, fueled in large part by the "Dr Oz Effect" after the television doctor touted its health benefits in a series of segments in 2011.[33] The saturated tropical oil, which has long been shunned by RDs and the health community, received wide media coverage for its possible benefits for weight loss, diabetes, and Alzheimer's disease,[34] as well as for the suggestion that it may be heart healthy after all; sales have increased ever since.[35] However, many RDs and medical experts in CVD are not convinced that the research is as black and white as this latest research and the media suggests.[31,36-39]

Fatty Acid Functions and Effects

Dietary fat provides a concentrated source of energy as well as essential fatty acids. In addition, fat is required for absorption of fat-soluble vitamins into the body. While fat-containing foods are often considered to be either saturated or unsaturated, all dietary fat is actually composed of various types of fatty acids. Olive oil, for example, is considered a monounsaturated fat, but it contains nearly 14% saturated fatty acids from palmitic and stearic acid, as well as 10% polyunsaturated fatty acids. Beef tallow, a saturated fat, actually contains approximately 47% saturated fatty acids, as well as 39% monounsaturated fatty acids, and 4% polyunsaturated fatty acids. The various functions and effects fats have on the body are due to the specific types of fatty acids a food contains, as well as the structural differences of the fats.[40]

Fatty acids are classified as saturated, polyunsaturated, monounsaturated, or trans fats based on the number of double bonds in their carbon chain. Saturated fatty acids have no double bonds. Monounsaturated fatty acids have only one double bond, and polyunsaturated fatty acids contain two or more double bonds. In addition, configuration of the double bonds is

important in the structure of the fat and its effect on health. In the molecular structure of natural unsaturated fatty acids, the hydrogen atoms are in the cis-configuration, or on the same side of the double bond. Unsaturated fats, which have been partially hydrogenated, have their hydrogen atoms in the trans-configuration, on opposite sides of the double bond.[40]

In addition to their number of double bonds, fatty acids are also classified by their hydrocarbon chain length. Those that contain up to six carbons are considered short chain fatty acids. Those that contain eight to 12 carbons are medium length, and those with twelve or more carbons are long-chain fatty acids. Like all fats, saturated fats as a group include fatty acids of varying chain length, and the length accounts for their variations in cooking performance as well as their effect on health and heart disease.

Although they are often associated with negative health consequences, saturated fats do indeed have many important roles in the body. Some of these include regulating hormones and the expression of genes, acting as cell messengers, and providing immune functions. Other research[27,41] suggests that some saturated fats may regulate the availability of polyunsaturated fatty acids such as DHA and possibly serve as the raw material for producing omega-3 fats that are unavailable through the diet. However, because the saturated fatty acids needed for any of these functions can be synthesized within the body, there is no Recommended Dietary Allowance for saturated fat.

The current recommendation, based on evidence dating back to the Seven Countries Study and endorsed by the American Heart Association,[14] the National Cholesterol Education Program,[42] and other national organizations specializing in evidence-based dietary recommendations, is to limit saturated fat intake to no more than 5% to 6% of total calories because it has been shown to negatively affect LDL cholesterol. However, since saturated fats may be beneficial to the body in some ways, and as some of the research suggests, not all increase heart disease risk, more thorough research that takes a closer look at how individual saturated fatty acids function in the body seems to be warranted.

Until recently, saturated fats have been treated as one blanket group to avoid, and little attention has been given to the effects that individual fatty acids have on health and heart disease. These more recent studies have suggested that not all saturated fats have the same health effects. In its most recent position statement on dietary fatty acids, the Academy of Nutrition and Dietetics stressed that “fatty acids can no longer be viewed in general categories such as saturated or unsaturated, because the individual fatty acids in each group appear to influence health differently.”[40]

Long-Chain Saturated Fats

The varying effects of saturated fatty acids appear to be due to chain length and the location of the first double bond on the fatty acid chain. The most commonly consumed saturated fats in the American diet consist of long-chain fatty acids with between 12 and 18 carbons. These fatty acids include lauric acid (12:0), found in palm kernel and coconut oil; myristic acid (14:0), found in beef tallow and cocoa butter; and palmitic acid (16:0), found in most oils and fats, dairy products, butter, and red meats. All have a similar effect on serum lipoprotein in that they increase LDL cholesterol. However, the longer chain stearic acid (18:0) found in meats, high fat dairy foods, chocolate, beef tallow, lard, and fully hydrogenated vegetable oils such as cocoa butter, has been shown to have a neutral effect on LDL cholesterol.[40,43]

Medium-Chain Saturated Fats

Saturated fats that are classified as medium-length or medium-chain triglycerides (MCTs) contain fewer carbons in their chain structure and are metabolized differently than the longer chain fats. Although not a major source of energy for most individuals, MCTs have been more closely examined lately because of these differences. Medium-chain fatty acids are mainly used as a medical supplement for patients with malabsorption issues, and as an energy and fat source in total parenteral nutrition. Human breast milk is rich in MCTs, but the most commonly consumed source of MCT in adults is coconut oil, which contains the medium-chain fatty acids capric acid (10:0) and carprylic acid (8:0).[40]

Some research[44-46] has found that although they are saturated in their chemical structure, medium-chain fatty acids may have some potential health benefits rather than detriments, including their role in assisting with weight loss and metabolic disease, which are risk factors for CVD.

Once consumed, MCTs are transported via the portal system and quickly oxidized, rather than stored as triglycerides. They have also been shown to have a positive effect on thermogenesis, which can increase energy expenditure, and are proposed to be beneficial for weight loss. In a 2003 study published in ***Obesity Research*** by St-Onge et al, researchers determined that overweight or obese men whose diets were supplemented with a specially designed MCT oil had increased energy expenditure and decreased abdominal adipose tissue as compared with men whose diets were rich in olive oil, a long-chain fatty acid.[44]

It's important to note that although rich in MCTs, coconut oil also contains approximately 40% long-chain fatty acids from lauric acid, which has been shown to be hypercholesterolemic. With regard to CVD, few studies are available on the effects of either pure MCT oil or coconut oil on lipoproteins, and those that have been conducted have mixed results.[47-49]

Some studies have found that coconut oil increases LDL but it also elevates HDL cholesterol, while other studies have found a neutral effect on lipids.[36,46,48]

Focusing on the Bigger Picture

The difficulty in classifying various high-fat foods, as opposed to individual fatty acids, as helpful or harmful, is due to the fact that there is so much overlap of the types of fatty acids in these foods. With regard to dairy foods, for example, while whole milk is generally thought of as a source of saturated fat, it contains more than 400 different fatty acids of varying degrees of saturation and chain length.[50] Short-term intervention studies suggest that although increased dietary intake of whole milk will raise LDL cholesterol, other fatty acids or components in milk will cause an increase in HDL too, which results in no change to the total cholesterol-HDL ratio[51] This may account for some of the conflicting results of research[24,51] on high-fat dairy foods and CVD risk.

Additional support for the need to consider the range of fatty acids and possibly other components in foods rich in saturated fat comes from a 2012 study published in the ***American Journal of Clinical Nutrition***. In a 10-year investigation of the effects of various foods on the incidence of CVD, de Oliveria Otto et al found total intake of saturated fat from dairy foods was inversely associated with CVD risk, while saturated fat intake from meat did show a positive

association with risk.[52] Researchers suggested that the effects of dairy foods vs meats might be due to the fact that dairy foods contain larger amounts of medium-chain fatty acids, which may raise HDL levels, whereas meat contains a greater amount of the hypercholesterolemic long-chain palmitic acid.

In that same study, butter and plant foods that contain saturated fat, such as nuts, avocados, margarine, and salads, as well as mixed plant and animal foods containing saturated fats, including donuts and fried chicken and fish, showed no associated risk of CVD. Researchers did state, however, that the study participants had a low intake of saturated fat from these foods, which presented a limitation of the study.

In their discussion of the study, de Oliveria Otto et al raised an important concept—that of food synergy. They suggest the differences in cardiovascular risk are influenced by more than just saturated fat content of various foods.[52] Perhaps sodium, other fatty acids, or other nutrients may modify or exacerbate the effect of saturated fatty acids, and they may affect disease risk through nonlipid pathways.

Just as researchers are learning more about the different health effects of various saturated fatty acids, they have also learned that with regard to measuring heart disease risk, there is more to the picture than simply LDL, HDL, and total cholesterol. The LDL particle number, measured as apoprotein B, and size of LDLs is important as well.[53-55]

Apolipoprotein B particles carry and deposit cholesterol on the blood vessel walls, and small, dense LDL particles are more likely to enter artery walls to form the damaging plaque that leads to atherosclerosis than are larger fluffy LDL particles. Some research studies have shown that increasing dietary saturated fat tends to increase the number of large LDL particles, but not necessarily the small ones. On the other hand, refined carbohydrates, more than any type of fatty acids, tend to increase the small LDL particles.[56-58]

Replacing Saturated Fat

One of the key concerns about reducing saturated fat in the diet is which nutrient(s) should replace it. A major limitation of the controversial studies on saturated fat and CVD is that there were no controls or information about what the replacement nutrients were. In comparison, several studies that did control for diet composition[59-61] found that when carbohydrates—especially higher glycemic, refined carbohydrates—were substituted for dietary saturated fat, heart disease risk increased.

In a review of research on CVD, saturated fat, and modulation by replacement nutrients, Siri-Tarino et al looked at numerous epidemiologic and clinical studies and determined that replacing saturated fat with carbohydrates, especially refined carbohydrates and added sugars, as is typical of the American diet, did not reduce risk of heart disease. In fact, it was associated with dyslipidemia, and in some cases, an even greater risk of CVD. Conversely, reducing carbohydrate intake has been shown to improve atherogenic dyslipidemia. Researchers suggest that carbohydrates and insulin control the disposition of excess dietary nutrients, and modulate lipoprotein processes.[59,61]

To find out more about the metabolic changes that occur when dietary fat is replaced by carbohydrate, while keeping total calories consistent, Volk et al conducted a controlled feeding

study to examine the stepwise effect of dietary carbohydrates on circulating saturated fatty acids and plasma palmitoleic acid.[62]

Palmitoleic acid in blood or adipose tissue is associated with adverse health conditions and cardiovascular risks such as obesity, insulin resistance, hypertriglyceridemia, and inflammation, and it is a predictor of metabolic syndrome and type 2 diabetes.[62]

Research determined that the levels of circulating saturated fatty acids remained fairly stable in the study subjects, as dietary saturated fat and total fat and carbohydrate was manipulated. However, as carbohydrate intake was increased, while saturated and total fat decreased, the proportion of plasma palmitoleic acid increased. Interestingly, the increases in plasma palmitoleic acid with increased carbohydrate intake was consistent with all 16 test subjects, who consumed between 50 g and 350 g of carbohydrate from whole-grain and mainly lower-glycemic index foods. Researchers noted that the highest carbohydrate level was designed to model the dietary guidelines.

Replacing saturated fat with unsaturated fats has also been shown to reduce CVD risk. Although the controversial Chowdhury study did not support these findings, numerous other studies[63,64] and a major review of randomized controlled studies that replaced saturated fats with polyunsaturated fats have found a reduction in heart disease events. In a major systematic review conducted to update the most recent Nordic Nutrition Guidelines, a total of 607 articles were reviewed to update evidence on the effect of amount and type of dietary fat on cardiometabolic risk factors. Researchers found convincing evidence that reducing dietary saturated fat and replacing it with polyunsaturated fat improves both total and LDL cholesterol levels and results in reduced CVD risk, especially in men.[65]

The beneficial effects of increasing dietary sources of monounsaturated fats on CVD risk has also been shown, most recently in a study on the effects of Hass avocados[66] a rich source of monounsaturated fat, on LDL cholesterol levels, LDL particle size, and CVD risk factors. After consuming a moderate-fat diet, with 6% to 7% of the saturated fat replaced by one Hass avocado each day, researchers noted a reduction in LDL cholesterol, LDL particle number, and small, dense LDL, as compared to low-fat diet alone and, even as compared to moderate-fat diet with fat coming primarily from monounsaturated oils. Research speculated that other nutrients or compounds such as plant sterols found in avocados might be especially beneficial for reducing cardiovascular risk.

Other dietary sources of monounsaturated fat were examined in the PREDIMED study in Spain.[67] Investigators noted a reduction in major cardiovascular events, especially stroke, from diets higher in monounsaturated fats. PREDIMED was a large randomized trial with nearly 7,500 individuals who were assigned to two variations of a Mediterranean diet, supplemented with either nuts or olive oil, or a reduced fat control diet. The results of the PREDIMED study were not included in the controversial Chowdhury study, due to the study cutoff date.

While research that focuses on the effects of individual nutrients can be helpful in answering questions of science, more and more respected medical experts on CVD are focusing on the importance of looking at a whole diet approach to reducing risk vs focusing on specific types of fats, individual fatty acids, and other nutrients. It's possible to manipulate lipoprotein and other risk markers with specific nutrients, but the human body and each individual's diet are far more

complex. Most experts are in agreement that foods such as whole fruits, vegetables, high-fiber complex carbohydrates, nuts, seeds, fish, and other sources of unsaturated fats are beneficial for good health. Those foods that are highly processed and high in added salt, sugar, and fats put individuals at increased risk for not only CVD but also other chronic diseases such as diabetes and cancer.[68-71]

Putting It Into Practice

Research on the issue of saturated fat's impact on the risk of CVD is clearly a complex subject, which no doubt requires further study. Heart disease remains the leading cause of death in developed countries, and RDs are in a unique position to be able to interpret and relay the research to the public to avoid confusion and provide practical advice on dietary changes individuals can make to reduce their risk.

The most recent controversial findings on the subject should not be taken as a green light or recommendation to eat foods that are high in saturated fat ad libitum. Although the research examined does suggest that not all saturated fatty acids act the same way with regard to increasing risk of CVD, it's not always possible to translate lab research to the human diet. There is far too much overlap of the types of fats in foods, and it's impossible to eat only one type of fatty acid, because one's diet is composed of foods, not individual fatty acids.

Just as there are a variety of lifestyle factors that influence heart health, the dietary risk for CVD is dependent on much more than just saturated fat. Several of the studies presented have identified the roles that refined carbohydrates and unsaturated fats play as well, and other factors such as pro- and anti-inflammatory foods, antioxidants in foods, plant sterols, and fiber content likely interact and play an important role in either increasing the risk or prevention of heart disease. Many scientists and nutrition experts are in agreement that the focus should be on the diet as a whole, rather than on individual nutrients.[52]

As food and nutrition experts, RDs should provide advice that centers on improving the whole diet vs focusing on individual nutrients. RDs should be able to make recommendations for ways to increase consumption of fruits, vegetables, unsaturated fats from nuts, seeds, avocados, plant oils, and fish, as well as high-fiber unrefined whole grains and legumes. In addition to saturated fats, it appears that refined carbohydrates play an important role in risk for CVD, so RDs should be diligent about assessing intake of carbohydrates in general, and specifically refined carbohydrates, and providing recommendations for appropriate substitutes for excess carbohydrates. All types of fatty acids and foods have a place in a healthy diet, and the focus should be on balance, variety, and overall quality of diet from nutrient dense whole foods.

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Examination

1. According to 2015 statistics published by the American Heart Association, cardiovascular disease (CVD) accounts for approximately how many deaths annually?
A. 5 million
B. 9 million
C. 17 million
D. 20 million

2. According to 2015 statistics, deaths from CVD have leveled off and appear to be dropping.
A. True
B. False

3. Saturated fatty acids contain how many double bonds in their structure?
A. One
B. Two or more
C. None
D. Three

4. The most commonly consumed dietary saturated fats in the American diet are primarily what chain length?
A. Short-chain fatty acids
B. Medium-chain fatty acids
C. Long-chain fatty acids
D. They are of mixed lengths

5. A research study on medium-chain fatty acids found that subjects supplemented with medium-chain triglyceride oil had which of the following?
A. Lower LDL cholesterol
B. Increased energy expenditure
C. Improved satiety
D. Reversed atherosclerosis

6. Whole milk contains fatty acids of varying degrees of saturation and chain length.
A. True
B. False

7. High-fat dairy products have not been associated with increased risk of CVD. In the case of whole milk, this may be because of which of the following?
A. Some of its fatty acids or components also raise HDL cholesterol
B. It usually reduces LDL cholesterol
C. It is high in antioxidants
D. It helps reduce platelet aggregation

8. Which type of LDL particles are most likely to contribute to atherosclerosis?
A. Large, dense LDL particles
B. Small, dense LDL particles
C. Large, fluffy LDL particles
D. All types of LDL particles contribute equally to atherosclerosis.

9. Foods that are high in which of the following produce the most damaging type of LDL particles?
A. Saturated fat
B. Refined carbohydrates
C. Animal protein
D. Cholesterol

10. Participants in the PREDIMED Study whose diets were supplemented with which of the following were noted to have a reduction in CVD?
A. Avocados
B. Nuts or olive oil
C. Whole grains
D. Salmon