CHICKEN EGGSCONSUMPTION: VEHICLE TO GOOD (HDL) AND BAD (LDL) CHOLESTEROL TO THE HUMAN SYSTEM

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Abstract: *Eggs are laid by female animals of many different species, including birds, reptiles, amphibians, mammals, and fish, and have been eaten by humans for thousands of years. Bird and reptile eggs consist of a protective eggshell, albumen (egg white),vitellus (egg yolk), contained within various thin membranes. The most popular choice for egg consumption is chicken eggs. Other popular choices for egg consumption are duck, quail, roe, and caviar. As a good source of proteins and energy, it could also be harmful to the health of mankind, more especially the cardiovascular and circulatory systems. Excess consumption may lead to sedentary life style diseases like obesity, hypertension, diabetes mellitus, atherosclerosis and other coronary heart diseases.*

Key Words: *Lipo protein, lipids, fats, cholesterol, high density lipoprotein (HDL), Low density lipo protein (LDL), coronary heart disease (CHD)*

1.0 INTRODUCTION:

Eggs are among the few foods that should be classified as superfoods; they are loaded with nutrients, some of which are rare in the modern diet.Whole eggs are among the most nutritious foods on the planet, containing a little bit of almost every nutrient the human body needs. Omega-3 enriched and/or pastured eggs are even healthier.Egg yolks and whole eggs store significant amounts of protein and choline, and are widely used in cookery. Due to their protein content, the United States Department of Agriculture categorizes eggs as Meats within the Food Guide Pyramid. Despite the nutritional value of eggs, there are some potential health issues arising from egg quality, storage, and individual allergies.

2.0 METHOD:

Sample research where taken from scientific data from other works done and published in peer reviewed journals. They were analysed, criticized constructively, appraised and some which the writers deem fit was taken as a reference on this work. Stratified and probity of empirical data and cross sectional surveys done on the subject matter was also revised by the authors in bringing out the final write up.

3.0 DISCUSSION:

ANATOMY OF AN EGG

Anatomy of an Egg

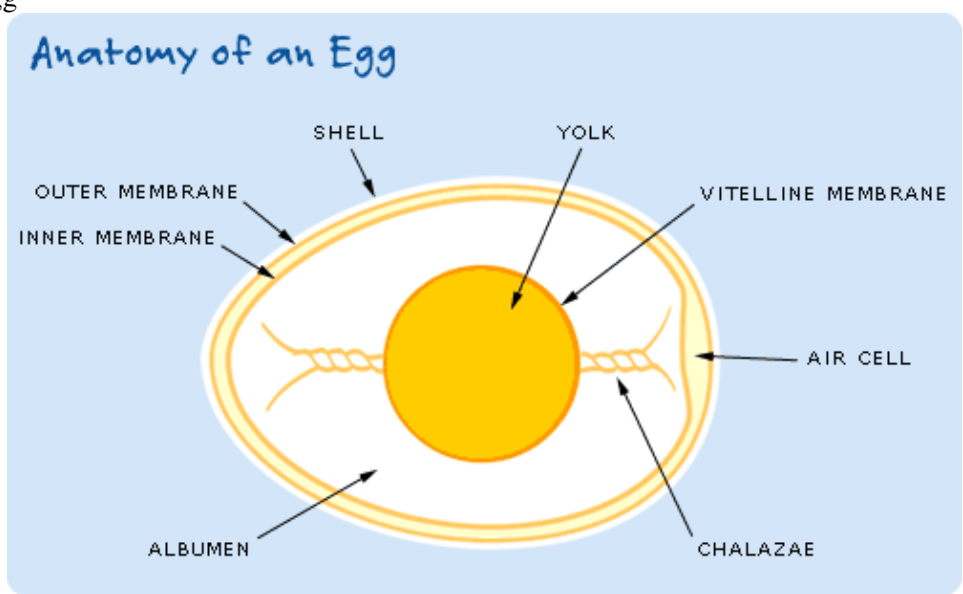

Fig.1 Anatomy of an Egg

SHELL

Bumpy and grainy in texture, an eggshell is covered with as many as 17,000 tiny pores. Eggshell is made almost entirely of calcium carbonate (CaCO3) crystals. It is a semipermeable membrane, which means that air and moisture can pass through its pores. The shell also has a thin outermost coating called the bloom or cuticle that helps keep out bacteria and dust.

INNER AND OUTER MEMBRANES

Lying between the eggshell and egg white, these two transparent protein membranes provide efficient defense against bacterial invasion. If you give these layers a tug, you'll find they're surprisingly strong. They're made partly of keratin, a protein that's also in human hair.

AIR CELL

An air space forms when the contents of the egg cool and contract after the egg is laid. The air cell usually rests between the outer and inner membranes at the egg's larger end, and it accounts for the crater you often see at the end of a hard-cooked egg. The air cell grows larger as an egg ages.

ALBUMEN

The egg white is known as the albumen, which comes from albus, the Latin word for "white." Four alternating layers of thick and thin albumen contain approximately 40 different proteins, the main components of the egg white in addition to water.

CHALAZAE

Opaque ropes of egg white, the chalazae hold the yolk in the center of the egg. Like little anchors, they attach the yolk's casing to the membrane lining the eggshell. The more prominent they are, the fresher the egg.

VITELLINE MEMBRANE

The clear casing that encloses the yolk.

YOLK

The yolk contains less water and more protein than the white, some fat, and most of the vitamins and minerals of the egg. These include iron, vitamin A, vitamin D, phosphorus, calcium, thiamine, and riboflavin. The yolk is also a source of lecithin, an effective emulsifier. Yolk color ranges from just a hint of yellow to a magnificent deep orange, according to the feed and breed of the hen.

3.1 Nutritional Value of Eggs

Chicken eggs, the most commonly eaten eggs, provide 155 calories (kcal) of food energy and 12.6 g of protein in a 100 gram serving. Eggs (boiled) supply several vitamins and minerals as significant amounts of the Daily Value (DV), including vitamin A (19% DV), riboflavin (42% DV), pantothenic acid (28% DV), vitamin B12 (46% DV), choline (60% DV), phosphorus (25% DV), zinc (11% DV) and vitamin D (15% DV) (table per 100 gram serving of a hard-boiled egg). Selenium: 22% of the RDA, Eggs also contains decent amounts of Vitamin D, Vitamin E, Vitamin K, Vitamin B6, Calcium and Zinc.

Egg yolk contains more than two-thirds of the recommended daily intake of 300 mg of cholesterol. The diet of laying hens can affect the nutritional quality of eggs. For instance, chicken eggs that are especially high in omega-3 fatty acids are produced by feeding hens a diet containing polyunsaturated fats from sources like fish oil, chia seeds or flaxseeds. Pasture-raised free-range hens, which forage for their own food, also produce eggs that are relatively enriched in omega-3 fatty acids compared to cage-raised chickens. A 2010 USDA study determined there were no significant differences of macronutrients in various chicken eggs. Cooked eggs are easier to digest, as well as having a lower risk of salmonellosis.

3.2 Health effects

Cholesterol and fat

More than half the calories found in eggs come from the fat in the yolk; 50 grams of chicken egg (the contents of an egg just large enough to be classified as "large" in the US, but "medium" in Europe) contains approximately 5 grams of fat. People on a low-cholesterol diet may need to reduce egg consumption; however, only 27% of the fat in egg is saturated fat (palmitic, stearic, and myristic acids. The egg white consists primarily of water (87%) and protein (13%) and contains no cholesterol and little, if any, fat.

There is debate over whether egg yolk presents a health risk. Some research suggests dietary cholesterol increases the ratio of total to HDL cholesterol and, therefore, adversely affects the body's cholesterol profile; whereas other studies show that moderate consumption of eggs, up to one a day, does not appear to increase heart disease risk in healthy individuals. Harold McGee argues that the cholesterol in the yolk is not what causes a problem, because fat (in particular, saturated) is much more likely to raise cholesterol levels than the actual consumption of cholesterol.

Type 2 diabetes

Studies have shown conflicting results about a possible connection between egg consumption and type 2 diabetes. A 1999 prospective study of over 117,000 people by the Harvard School of Public Health concluded, in part, that "The apparent increased risk of CHD associated with higher egg consumption among diabetic participants warrants further research. A 2008 study by the Physicians' Health Study I (1982–2007) and the Women's Health Study (1992–2007) determined the "data suggest that high levels of egg consumption (daily) are associated with an increased risk of type 2 diabetes. However, a study published in 2010 found no link between egg consumption and type 2 diabetes.

A meta-analysis from 2013 found that eating 4 eggs per week increased the risk of diabetes by 29%. Another meta-analysis from 2013 also supported the idea that egg consumption may lead to an increased incidence of type two diabetes.

Cardiovascular risk

Eggs are one of the largest sources of phosphatidylcholine (lecithin) in the human diet. A study published in the scientific journal Nature showed that dietary phosphatidylcholine is digested by bacteria in the gut and eventually converted into the compound TMAO, a compound linked with increased heart disease.

The 1999 Harvard School of Public Health study of 37,851 men and 80,082 women concluded that its findings suggest that consumption of up to 1 egg per day is unlikely to have substantial overall impact on the risk of CHD or stroke among healthy men and women. In a study of 4,000 people, scientists found that eating eggs increased blood levels of a metabolite promoting atherosclerosis, TMAO, and that this in turn caused significantly higher risk of heart attack and stroke after three years of follow-up.

A 2007 study of nearly 10,000 adults demonstrated no correlation between moderate (six per week) egg consumption and cardiovascular disease or strokes, except in the subpopulation of diabetic patients who presented an increased risk of coronary artery disease. One potential alternative explanation for the null finding is that background dietary cholesterol may be so high in the usual Western diet that adding somewhat more has little further effect on blood cholesterol. Other research supports the idea that a high egg intake increases cardiovascular risk in diabetic patients.

A 2009 prospective cohort study of over 21,000 individuals suggests that egg consumption up to 6 week has no major effect on the risk of cardiovascular disease and mortality and that consumption of 7 week is associated with a modest increased risk of total mortality in males, whereas among males with diabetes, any egg consumption is associated with an increased risk of all-cause mortality and there was suggestive evidence for an increased risk of myocardial infarction and stroke. A 2013 meta-analysis found no association between egg consumption and heart disease or stroke. A 2013 systematic review and meta-analysis found no association between egg consumption and cardiovascular disease or cardiovascular disease mortality, but did find egg consumption more than once daily increased cardiovascular disease risk 1.69-fold in those with type 2 diabetes mellitus compared to type 2 diabetics who ate less than 1 egg per week. Another 2013 meta-analysis found that eating 4 eggs per week increased the risk of cardiovascular disease by 6%.

3.3 Contamination in causing diseases

Egg cleaning on a farm in Norway

A health issue associated with eggs is contamination by pathogenic bacteria, such as Salmonella enteritidis. Contamination of eggs exiting a female bird via the cloaca may also occur with other members of the Salmonella genus, so care must be taken to prevent the egg shell from becoming contaminated with faecal matter. In commercial practice in the US, eggs are quickly washed with a sanitizing solution within minutes of being laid. The risk of infection from raw or undercooked eggs is dependent in part upon the sanitary conditions under which the hens are kept. Health experts advise people to refrigerate washed eggs, use them within two weeks, cook them thoroughly, and never consume raw eggs. As with meat, containers and surfaces that have been used to process raw eggs should not come in contact with ready-to-eat food.

A study by the U.S. Department of Agriculture in 2002 (Risk Analysis April 2002 22(2):203-18) suggests the problem is not as prevalent as once thought. It showed that of the 69 billion eggs produced annually; only 2.3 million are contaminated with Salmonella, equivalent to just one in every 30,000 eggs, thus showing Salmonella infection is quite rarely induced by eggs. However, this has not been the case in other countries, where Salmonella enteritidis and Salmonella typhimurium infections due to egg consumptions are major concerns. Egg shells act as hermetic seals that guard against bacteria entering, but this seal can be broken through improper handling or if laid by unhealthy chickens. Most forms of contamination enter through such weaknesses in the shell. In the UK, the British Egg Industry Council awards the lions stamp to eggs that, among other things, comes from hens that have been vaccinated against Salmonella.

Food allergy

Egg allergy

One of the most common food allergies in infants is eggs. Infants usually have the opportunity to grow out of this allergy during childhood, if exposure is minimized. Allergic reactions against egg white are more common than

reactions against egg yolks. In addition to true allergic reactions, some people experience a food intolerance to egg whites. Food labeling practices in most developed countries now include eggs, egg products and the processing of foods on equipment that also process foods containing eggs in a special allergen alert section of the ingredients on the labels.

4.0 ANALYSIS:

Healthy nature of Eggs to the human system

a. Eggs are high in cholesterol but they do not adversely affect blood cholesterol

It is true that eggs are high in cholesterol, a single egg contains 212 mg, which is over half of the recommended daily intake of 300 mg. However, it's important to keep in mind that cholesterol in the diet doesn't necessarily raise cholesterol in the blood if not in excess or dense.
The liver actually produces large amounts of cholesterol every single day. When we eat more eggs, the liver just produces less cholesterol instead, so it evens out. The response to egg consumption varies between individual: In 70% of people, eggs don't raise cholesterol at all. In the other 30% (termed hyper responders), eggs can mildly raise Total and LDL cholesterol.

b. Eggs Raise HDL (The Good) Cholesterol

HDL stands for High Density Lipoprotein. It is often known as the "good" cholesterol. People who have higher levels of HDL usually have a lower risk of heart disease, stroke and various health problems.
Eating eggs is a great way to increase HDL. In one study, 2 eggs per day for 6 weeks increased HDL levels by 10%.

c. Eggs Contain Choline – an Important Nutrient.

Most people don't get enough of choline but is a nutrient that most people don't even know exists. Yet, it is an incredibly important substance and is often grouped with the B vitamins. Choline is used to build cell membranes and has a role in producing signalling molecules in the brain, along with various other functions. Dietary surveys have shown that about 90% of people in the U.S. are getting less than the recommended amount of choline. Whole eggs are an excellent source of choline. A single egg contains more than 100 mg of this very important nutrient.

d. Eggs turn LDL Cholesterol from Small, Dense to Large, Linked to a Reduced Risk of Heart Disease

LDL cholesterol is generally known as the "bad" cholesterol, it is well known that having high levels of LDL is linked to an increased risk of heart disease.But what many people don't realize is that there are subtypes of LDL that have to do with the size of the particles. There are small, dense LDL particles and then there are large LDL particles. Many studies have shown that people who have predominantly small, dense LDL particles have a higher risk of heart disease than people who have mostly large LDL particles.
Even if eggs tend to mildly raise LDL cholesterol in some people, some studies show that the particles change from small, dense to large LDL which is a good thing although more research needs to be done.

e. Eggs Contain Lutein and Zeaxanthin, antioxidants that have major benefits for eye health

One of the consequences of aging is that eyesight tends to get worse. There are several nutrients that help counteract some of the degenerative processes that can affect our eyes. Two of these are called Lutein and Zeaxanthin, powerful antioxidants that tend to build up in the retina of the eye. Studies show that consuming adequate amounts of these nutrients can significantly reduce the risk of cataracts and macular degeneration, two very common eye disorders. Egg yolks actually contain large amounts of both Lutein and Zeaxanthin. In one controlled trial, eating just 1.3 egg yolks per day for 4.5 weeks increased blood levels of Lutein by 28-50% and Zeaxanthin by 114- 142%.

f. Eggs are also high in Vitamin A, which deserves another mention here. Vitamin A deficiency is the most common cause of blindness in the world.

g. In the case of Omega-3 or pastured eggs,

They lower triglycerides as well of course, it doesn't just matter what we eat, it also matters what the foods that we eat, ate.In this regard, not all eggs are created equal. Their nutrient composition varies depending on how the hens were fed and raised. Eggs from hens that are raised on pasture and/or fed Omega-3 enriched feeds tend to be much higher in Omega-3 fatty acids. Omega-3 fatty acids are known to reduce blood levels of triglycerides, a well-known

risk factor for heart disease. Studies show that consuming Omega-3 enriched eggs is a very effective way to reduce triglycerides in the blood. In one of the studies, just 5 omega-3 enriched eggs per week for 3 weeks reduced triglycerides by 16- 18%.

h. Eggs are high in quality protein, with all the essential amino acids in the right ratios

Proteins are the main building blocks of the human body. They're used to make all sorts of tissues and molecules that serve both structural and functional purposes. Getting enough protein in the diet is very important and studies show that currently recommended amounts may be too low. Eggs are an excellent source of protein, with a single large egg containing 6 grams. Eggs contain all the essential amino acids in the right ratios, so our bodies are well equipped to make full use of the protein in them. Eating adequate protein can help with weight loss, increase muscle mass, lower blood pressure and optimize bone health.

i. Moderate Eggs do not raise your risk of heart diseases and may reduce the risk of Stroke

For many decades, eggs have been unfairly demonized. It has been claimed that because of the cholesterol in them, they must be bad for the heart. Many studies published in recent years have examined the relationship between moderate egg consumption and the risk of heart disease. In one review of 17 studies with a total of 263,938 participants, no association was found between moderate egg consumption and heart disease or stroke. Many other studies have led to the same conclusion. However, some studies have found that people with diabetes who eat many eggs have an increased risk of heart disease. Whether the eggs are actually causing the increased risk isn't known, because these types of studies can only show statistical association. They cannot prove that eggs caused anything.
It is possible that diabetics who eat eggs are less health conscious, on average. On a low-carb diet, which is by far the best diet for diabetics, moderate eating of eggs leads to improvements in risk factors for heart disease.

j. Eggs are highly fulfilling and tend to make you eat fewer calories, helping you to lose weight

They are a high protein food but protein is by far the most fulfilling macronutrient. Eggs score high on a scale called the Satiety Index, which measures the ability of foods to induce feelings of fullness and reduce subsequent calorie intake. In one study of 30 overweight women, eating eggs instead of bagels for breakfast increased feelings of fullness and made them automatically eat fewer calories for the next 36 hours. In another study, replacing a bagel breakfast with an egg breakfast caused significant weight loss over a period of 8 weeks.

5.0 FINDINGS

5.1The Relationship between Dietary and Circulating Cholesterol; Case of Nicholas R. Fuller, Amanda Sainsbury, Ian D. Caterson, and Tania P. Markovic " Egg Consumption and Human Cardio-Metabolic Health in People with and without Diabetes"*

The effect of dietary cholesterol intake on circulating cholesterol level is small. A meta-analysis of cholesterol feeding studies including both healthy populations and populations with cardio-metabolic disease, using a variety of sources of dietary cholesterol (including eggs) showed that for every 100 mg per day increase in dietary cholesterol intake, circulating total cholesterol increased by 0.06 mmol/L, high-density lipoprotein (HDL) increased by 0.008 mmol/L, and the ratio of total to HDL cholesterol increased by 0.020.

One large egg contains approximately 200 mg of dietary cholesterol, so consuming an egg a day would be expected to increase total circulating cholesterol levelsby approximately 0.12 mmol/L.While mean changes in lipoproteins in response to dietary cholesterol are small, considerable heterogeneity has been observed in circulating cholesterol responses to dietary cholesterol.For example, there appears to be less efficient absorption of dietary cholesterol in those who have obesity and insulin resistance, when compared to those who are lean and insulin sensitive.

However, meta-analyses comparing the effects of dietary cholesterol and fat on circulating lipid and lipoprotein levels reveal that dietary saturated and trans-fat elicit much stronger effects, and taking into consideration their higher percentage energy contribution in the diet relative to dietary cholesterol, saturated and trans-fat are the major contributors to circulating total and low-density lipoprotein (LDL) cholesterol levels.

For every 2.8-gram per day reduction in saturated fat intake, total cholesterol reduces by approximately 0.08 mmol/L. Therefore, while increasing egg intake by one egg per day would be expected to increase total cholesterol by approximately 0.12 mmol/L, a concomitant reduction in saturated fat intake by 6 g per day (the amount of saturated fat in a tablespoon of butter, for example) would be expected to reduce circulating cholesterol levels by a similar amount.

6.0 RESULTS:

6.1 Case review on Nicholas R. Fuller et. al work by the writers

The work done by Nicholas r. Fuller et.al clearly shows minimal increment in blood cholesterol as compared to circulating lipid and lipo proteins. With this, one can consume as many as 10 eggs per day since additional egg has cholesterol value of 0.12mmol/L according to their research work done.

10 eggs giving 1.2mmol/L, which the writers still see as insignificant to cause any coronary heart disease, when all these eggs are eaten once per day occasionally or periodically. But Nicholas r. Fuller et. al failed to relate it to the lipid profile before and after one has consumed these eggs for a time frame.The lipid profile is used as part of a cardiac risk assessment to help determine an individual's risk of heart disease and to help make decisions about what treatment may be best if there is borderline or high risk.

Lipids are a group of fats and fat-like substances that are important constituents of cells and sources of energy. Monitoring and maintaining healthy levels of these lipids is important in staying healthy. The results of the lipid profile are considered along with other known risk factors of heart disease to develop a plan of treatment and follow-up. Depending on the results and other risk factors, treatment options may involve lifestyle changes such as diet and exercise or lipid-lowering medications such as statins.

A lipid profile typically includes:

- Total cholesterol - this test measures all of the cholesterol in all the lipoprotein particles.
- High-density lipoprotein cholesterol (HDL-C) - measures the cholesterol in HDL particles; often called "good cholesterol" because it removes excess cholesterol and carries it to the liver for removal.
- Low-density lipoprotein cholesterol (LDL-C) - calculates the cholesterol in LDL particles; often called "bad cholesterol" because it deposits excess cholesterol in walls of blood vessels, which can contribute to atherosclerosis. Usually, the amount of LDL-C is calculated using the results of total cholesterol, HDL-C, and triglycerides.
- Triglycerides - measures all the triglycerides in all the lipoprotein particles; most is in the very low-density lipoproteins (VLDL).
- Some other information may be reported as part of the lipid profile. These parameters are calculated from the results of the tests identified above.
- Very low-density lipoprotein cholesterol (VLDL-C) - calculated from triglycerides/5; this formula is based on the typical composition of VLDL particles.
- Non-HDL-C - calculated from total cholesterol minus HDL-C.
- Cholesterol/HDL ratio - calculated ratio of total cholesterol to HDL-C.

An extended profile (or advanced lipid testing) may also include low-density lipoprotein particle number/concentration (LDL-P). This test measures the number of LDL particles, rather than measuring the amount of LDL-cholesterol. It is thought that this value may more accurately reflect heart disease risk in certain people Also further investigations like the heart beats before eating these eggs and after eating could be assessed to see the fluctuations and whether there may be a link to cardiac arrhythmias whether with tachycardia or bradycardia.

7.0 RECOMMENDATION:

With exceptions, people with genetic disorders like familial hypercholesterolemia or a gene type called ApoE4 should minimise or avoid eggs in order not to make it a precursor to coronary heart diseases.

Eggs are high in cholesterol, but eating eggs in moderation does not have adverse effects on cholesterol in the blood for the majority of people.

Egg consumption moderately leads to elevated levels of HDL (the “good”) cholesterol, which is linked to a reduced risk of many diseases

Moderate egg consumption appears to change the pattern of LDL particles from small, dense LDL (bad) to large LDL, which is linked to a reduced heart disease risk

Omega-3 enriched and pastured eggs contain significant amounts of Omega-3 fatty acids. Eating these types of eggs is an effective way to reduce blood triglycerides.

Eggs are fairly high in quality animal protein and contain all the essential amino acids that humans need.

8.0 CONCLUSION:

Moderate addition of eggs to our daily diets can help prevent malnutrition and many deficiencies to help the proper functioning of the human system. This becomes very necessary to men and women from the ages of 30 - 45 years since eating red meats like beef, mutton, chevon, beacon, pork predisposes them of getting prostate cancers, gastric cancers, breast/ cervical cancers and coronary heart diseases.

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