Effects of egg ingestion on endothelial function in adults with coronary artery disease: A randomized, controlled, crossover trial

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Background Prevailing recommendations call for restricting intake of dietary cholesterol and eggs for those at risk of heart disease, despite accumulating evidence challenging this association. Our prior studies showed no short-term adverse effects of daily egg intake on cardiac risk factors in at-risk adults.

Objective We conducted this study to determine effects of daily egg consumption in adults with established coronary artery disease (CAD).

Methods Randomized, controlled, single-blind, crossover trial of 32 adults (mean age, 67 years; 6 women, 26 men) with CAD assigned to 1 of 6 possible sequence permutations of 3 different treatments (breakfast with 2 eggs, breakfast with ½ cup Egg Beaters, ConAgra Foods, St. Louis, MO, or a high-carbohydrate breakfast part of an ad libitum diet) for 6 weeks, with 4-week washout periods. The primary outcome measure was endothelial function measured as flow-mediated dilatation.

Results Compared with the control breakfast (ie, high-carbohydrate breakfast), daily consumption of eggs showed no adverse effects on flow-mediated dilatation (7.2% ± 2.9% vs 7.5% ± 2.9%, $P = .33$), lipids (total cholesterol: 158.3 ± 28.6 mg/dL vs 156.2 ± 27.4 mg/dL, $P = .49$), blood pressure (systolic blood pressure: 132.8 ± 14.1 mm Hg or vs 135.5 ± 14.9 mm Hg, $P = .52$; diastolic blood pressure: 77.2 ± 6.1 mm Hg vs 76.7 ± 6.9 mm Hg, $P = .86$), or body weight (90.8 ± 17.5 kg vs 91.8 ± 17.1 kg, $P = .92$). No outcomes differed ($P > .05$) between eggs and Egg Beaters.

Conclusions We found no evidence of adverse effects of daily egg ingestion on any cardiac risk factors in adults with CAD over a span of 6 weeks. (Am Heart J 2015;169:162-9.)

Background

Eggs are a concentrated source of dietary cholesterol, and it is a general belief in the medical community that egg intake is a risk factor for high serum cholesterol.[1] However, eggs are relatively low in saturated fat and thus have a small effect on total and low-density lipoprotein cholesterol (LDL-C) levels.[2] The consumption of whole eggs has been shown to lead to a significant increase in high-density lipoprotein cholesterol (HDL-C), large HDL, and large LDL compared with the consumption of egg substitutes, as well as to a greater decrease in small LDL, indicating that egg consumption can beneficially alter atherogenic lipoproteins.[3] Several studies have found no association between egg consumption and cardiovascular disease (CVD) risk in the general population.[4-6] In a trial among healthy older volunteers, egg consumption was associated with an increase in large LDL particles and HDL.[7] A lack of association between dietary cholesterol and CVD has also been established in many other epidemiologic studies such as the Framingham study,[1] the Nurses' Health Study,[4] and the National Health and Nutrition Examination Survey.[8] In a study by Houston et al,[9] dietary cholesterol and egg consumption were associated with increased CVD risk only in individuals with type 2 diabetes.

In our previous 2 studies, we found no impact of regular egg consumption on serum lipids or endothelial function in either healthy or hyperlipidemic adults, although improvements in endothelial function were noted with daily egg substitute compared with egg consumption.[10,11] In this study, we sought to assess the effects of daily consumption of eggs for 6 weeks on endothelial function, measured as flow-mediated dilatation (FMD) in participants with clinically established coronary artery disease (CAD). We hypothesized that daily egg intake, as compared with a typical high-carbohydrate American breakfast or yolk-free egg

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substitute, would have noninferior effects on endothelial function and other cardiac risk measures.

Methods

Study population

A study cohort of 32 adults (6 women and 26 men) with clinically established CAD were recruited from communities in the Lower Naugatuck Valley, CT (an area with a predominantly white population), through newspaper advertisements and posters at frequented sites. *Coronary artery disease* was defined by the presence of at least 1 coronary artery stenosis >50% determined angiographically or through a documented history of ischemic heart disease. The study population included men older than 35 years, postmenopausal women not on hormone replacement therapy, and nonsmokers. Exclusion criteria included the following: anticipated inability to complete the study protocol; current eating disorder; use of lipid-lowering or antihypertensive medications, unless stable on medication for at least 3 months and willing to refrain from taking medication for 12 hours prior to endothelial function scanning; regular use of high doses of vitamin C or E; use of vasoactive medications (including glucocorticoids, antineoplastic agents, psychoactive agents, bronchodilators, or nutriceuticals); regular use of fiber supplements; diabetes; sleep apnea; restricted diets by choice (eg, vegetarian, vegan, etc); coagulopathy, known bleeding diathesis, or history of clinically significant hemorrhage; and/or current use of warfarin.

Recruitment and screening

Potential participants (n= 277) were prescreened for eligibility via a structured telephone interview using established inclusion criteria. Of the 277 participants screened by telephone, 50 met our eligibility criteria. Those who met preliminary eligibility criteria were invited to undergo clinical eligibility screening and were administered informed consent. After clinical screening, 32 participants qualified for the study. All participants signed a written informed consent form before initiating the study. Participants received monetary compensation for participating in the study. Subject participation and flow through the trial are shown in Figure 1.

Study design and intervention

This study was a randomized, single-blind crossover trial with 3 dietary intervention assignments to compare their effects over a 6-week period of daily ingestion. The participants were randomly assigned to 1 of 6 sequence permutations of breakfast with eggs, breakfast with egg substitute, and a high-carbohydrate breakfast as part of an ad libitum diet (see Figure 2). Each 26-week permutation included three 6-week treatment phases interrupted by 4-week washout phases. During each treatment phase, the study participants had the liberty of preparing breakfasts with the assigned foods in any way they preferred. During each 4-week washout period, they were instructed to follow their habitual diets.

Good compliance was defined as >80% use of treatment, as documented by self-report. Participants were asked to log their daily food patterns during their treatment phase. A written side effects survey was completed once after each phase.

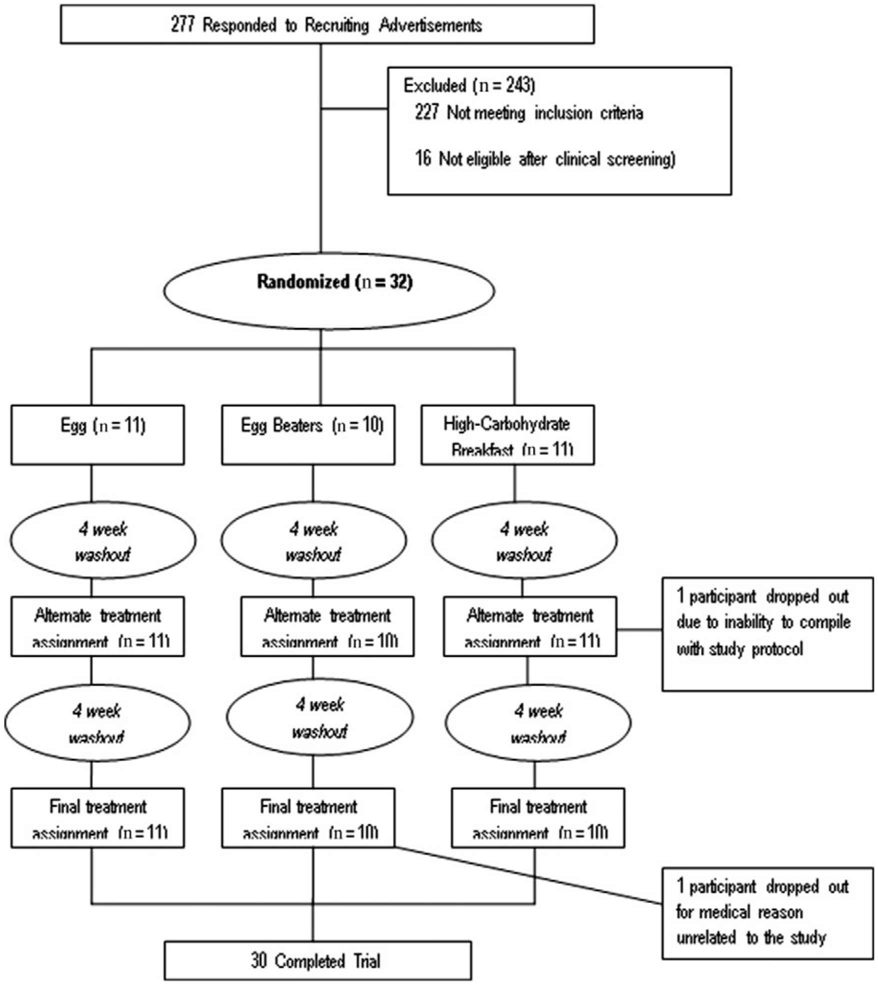
Treatment assignments

Each participant followed the assigned dietary regimen for each of the 3 treatment phases, which were to be followed in a randomly assigned sequence, with the high-carbohydrate breakfast serving as the control diet. The following are the breakfasts offered in the 3 treatment arms of the study: breakfast with 2 eggs daily for 6 weeks, breakfast with ½ cup of Egg Beaters, ConAgra Foods, St. Louis, MO, daily for 6 weeks, or a high-carbohydrate breakfast daily for 6 weeks. The high-carbohydrate breakfast consisted of any of the following choices during each day of the treatment period: bagel, waffles, pancakes, or cereal and skim milk. The brands and types of available food products provided were selected to provide a similar amount of calories, total carbohydrates, sugar, fiber, fat, and protein (see Table I).

End points

Primary outcome. Brachial artery diameter change was measured noninvasively in the right brachial artery by a high-frequency ultrasound scanning machine in accordance with published guidelines[12] and with our previous studies. In brief, the right brachial artery was imaged longitudinally, 2 to 5 cm above the antecubital fossa, by a registered vascular technologist who was blinded to the treatment assignments. A resting arterial diameter and flow velocity were measured and recorded on magnetic optical disk. An occluding cuff placed on the upper arm was inflated to a pressure of 200 mm Hg for 5 minutes and rapidly deflated to induce reactive hyperemia. Brachial artery scans were recorded on magnetic optical disk continuously between 30 and 180 seconds after cuff deflation, including a repeated flow velocity measurement during the first 15 seconds after cuff release. Diameter measurements were obtained by automatic identification using edge-detection software (Brachial Analysis Tools; Medical Imaging Applications 2004, Iowa, City, IA), which is an automated method for near and far wall detection and vessel diameter measurements in brachial ultrasound image sequences. Dilatation from baseline was measured at 50 to 80 seconds after cuff deflation to assess FMD. Flow-mediated dilatation was calculated as the percentage of change in brachial artery diameter from before cuff inflation to 60 seconds after cuff release. In addition to brachial diameter at 60 seconds after cuff release, flow after cuff deflation within the first 15 seconds was used as an indicator of stimulus strength, hyperemic flow being the

Figure 1



Flow of participants through the trial.

stimulus for endothelial reactivity. To account for potential variability in stimulus strength, FMD was divided by flow at 15 seconds after cuff deflation to create a stimulus-adjusted response measure. The resulting intraobserver reliability coefficient for the ultrasound readings was 0.94.

Secondary outcomes

Serum lipids. Fasting serum lipids were measured at the Griffin Hospital laboratory using the VITROS Chemistry Analyzer (Abbott Laboratories, Abbott Park, IL) calorimetric method.

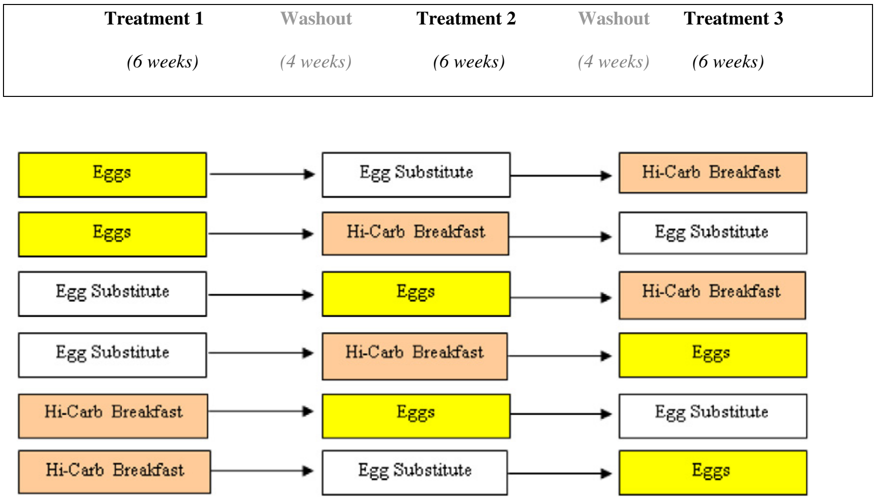
Blood pressure. Blood pressure was determined with the use of the Datascope Accutorr Plus automatic digital blood pressure device (Datascope Corp, Mahwah, NJ) with the subject supine after a 5-minute period of rest. Both systolic and diastolic pressures were calculated as the mean value of 2 readings 5 minutes apart.

Anthropometric measures. To measure weight, participants were asked to remove their heavy outer garments (jacket, coat, etc) and shoes, and stand in the center of the platform with weight distributed evenly on both feet.

Three-day food diary. A registered dietitian instructed subjects on how to complete a food diary and answered any questions posed by subjects at clinical screening. Diet records were analyzed using basic nutrition and diet analysis software (Food Processor II, version 7.0; ESHA Research, Salem, OR).

Study oversight. The study protocol was designed by the principal and co-principal investigators (D.K. and V. N.). Data were collected, maintained, and analyzed by the Yale-Griffin Prevention Research Center, Derby, CT. This study was approved by the Griffin Hospital Institutional Review Board.

Figure 2



Sequence permutations for treatment assignments. Note: "Hi-Carb Breakfast" refers to any of the following choices available to study participants during the high-carbohydrate breakfast treatment period: bagels, waffles, pancakes, or cereal and skim milk.

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Statistical analysis

An analysis of variance using linear mixed model regression with time as repeated measure were used to analyze these data. Regression models were used to adjust for potential confounding factors (ie, age, gender, race, body mass index [BMI], hypertension, dyslipidemia, and treatment sequence). All analyses of end points were based on the intention-to-treat principle. Results are expressed as means ± SD in text and tables, except otherwise stated. SAS software for Windows version 9.1 (SAS Institute, Cary, NC) was used to carry out all statistical analyses.

The sample size was estimated to allow for 20% attrition and noncompliance and to provide ≥80% power to detect a minimal difference of 3.5% in FMD between eggs and the high-carbohydrate breakfast, with maximum allowable type I error of 5% adjusted for 3 pairwise comparisons.

Results

Study participants

Of the 32 participants recruited into the study, 30 completed the trial. One participant dropped out of the study for a medical reason unrelated to the study; another dropped out due to an inability to continue complying with the study protocol. The study participants were predominantly male (81.2%) and were also mostly white (96.9%). The average age of the participants was 67.1 years. Most participants were using lipid- and blood pressure–lowering medications (ie, 90.6% and 87.5%, respectively). Other baseline data are presented in Table II, Table III.

Efficacy outcome

Endothelial function was unaffected by intake of 2 eggs daily for 6 weeks and showed no difference when compared with a high-carbohydrate breakfast (FMD: 7.25 ± 2.9% vs 7.5% ± 2.9%, $P = .33$). Total cholesterol, triglycerides, and HDL-C and LDL-C were also unaffected by egg intake and not adversely affected as compared with daily consumption of a high-carbohydrate breakfast (total cholesterol: 158.3 ± 28.6 mg/dL vs 156.2 ± 27.4 mg/dL, $P = .49$; triglycerides: 110.2 ± 37.7 mg/dL vs 106.2 ± 29.2 mg/dL, $P = .73$; HDL: 56.5 ± 18.1 mg/dL vs 54.5 ± 16.6 mg/dL, $P = .73$; LDL: 80.1 ± 26.6 mg/dL vs 80.9 ± 25.6 mg/dL, $P = .87$).

Consumption of 2 eggs daily for 6 weeks compared with a high-carbohydrate breakfast did not adversely affect blood pressure (systolic blood pressure: 132.8 ± 14.1 mm Hg vs 135.5 ± 14.9 mm Hg, $P = .52$; diastolic blood pressure: 77.2 ± 6.1 mm Hg vs 76.7 ± 6.9 mm Hg, $P = .86$). Neither body weight nor BMI was affected by egg intake and did not differ from the high-carbohydrate breakfast (weight: 90.8 ± 17.5 kg vs 91.8 ± 17.1 kg, $P = .92$; BMI: 28.9 ± 8.9 kg/m^2 vs 31.0 ± 4.3 kg/m^2, $P = .16$).

There were no differences in effects on endothelial function, lipid profile, blood pressure, or anthropometric measures ($P > .05$) between eggs and egg substitute (Egg Beaters) (see Table III).

Table I. Nutrient profile of the selected options for a high-carbohydrate breakfast

Food product	Serving size	kcal	Total Carbohydrates (g)	Sugars (g)	Fiber (g)	Fat (g)	Protein (g)
Bagel, Lender's original style, plain, frozen	1 bagel (57 g)	140	29	2	1	0.5	5
Waffles, Kellogg's Special K, original	2 waffles (70 g)	160	29	2	< 1	2.5	5
Pancakes, Aunt Jemima, low-fat buttermilk	2 pancakes (69 g)	135	26	6	< 1	2	3
Cereal and skim milk (Chex)	1 C cereal + ½ C milk	156	32	9	1	1	6
Chex, General Mills, cereal only	1 cup (31 g)	(114)	(26)	(3)	(1)	(1)	(2)
Milk, skim, ½ cup	½ cup (122 g)	(42)	(6)	(6)	(0)	(0)	(4)
Cereal and skim milk (Corn Flakes)	1 C cereal + ½ C milk	143	30	9	1	0	6
Corn Flakes, Kellogg, cereal only	1 cup (28 g)	25	(24)	(3)	(1)	(0)	(2)
Milk, skim, ½ cup	½ cup (122 g)	(42)	(6)	(6)	(0)	(0)	(4)

Our findings persist controlling for age, gender, race, BMI, hypertension, dyslipidemia, and treatment sequence in regression models.

Dietary intake

The percent of caloric intake from fat was significantly (P = .005) higher during the egg phase compared with the high-carbohydrate breakfast phase. The percent of caloric intake from saturated fat was significantly higher in the egg phase compared with the high-carbohydrate phase (P = .002) and also compared with the Egg Beaters phase (P = .02). The percent of caloric intake from carbohydrate was significantly lower (P = .0235) in the egg phase compared with the high-carbohydrate breakfast phase. Cholesterol intake was higher in the egg phase compared with the high-carbohydrate breakfast phase (P < .0001) and also compared with the Egg Beaters phase (P < .0001). Table IV provides complete results of the selected nutrients analyzed.

Adverse events

No adverse events were reported.

Discussion

To the best of our knowledge, this is the first randomized controlled trial of egg ingestion on endothelial function in patients with CAD. Our findings provide evidence that short-term (6 weeks) consumption of eggs does not adversely affect endothelial function in patients with coronary heart disease. Moreover, consuming 2 eggs daily did not alter serum cholesterol or other measures of the lipid profile.

These results on endothelial function are consistent with our previous studies in other populations. We initially found no adverse effects of daily egg consumption in a cohort of healthy adults[10] and in a subsequent cohort of hyperlipidemic adults.[11] However, lipid profile results were different in these previous studies, for example, in hyperlipidemic patients, an improvement in LDL-C was seen after egg substitute and not after egg consumption, and in healthy subjects increases in LDL-C were seen after oatmeal compared with egg consumption. In a dose-response meta-analysis of prospective studies by Rong et al,[13] high egg consumption was not associated with increased risk of coronary heart disease or stroke. The lack of change in endothelial function observed in our study is likely due to the fact that serum total cholesterol and LDL-C did not increase.[14]

Our study is consistent with earlier studies showing no adverse effects on the lipid profile with egg consumption.[15,16] In a recent study by Klangjareonchai et al,[17] daily consumption of 3 eggs per day for 12 weeks led to an increase in HDL-C as well as a decrease in LDL-C to HDL-C ratio in participants with CVD.

A recent observational study by Spence et al[18] showed a strong association between egg yolk consumption and increased carotid plaque burden. The authors concluded that egg intake was as harmful as smoking. The study was limited, however, by its lack of data on other sources of saturated fat and cholesterol. There was no control for other dietary variables, and eggs may have been a marker for other important differences in dietary patterns. Some other studies[19] have suggested that in animal models, the intestinal metabolism of dietary choline (also present in egg) may result in the production of deleterious compound for cardiovascular health.

Our findings on blood pressure are similar to what we observed in our previous 2 trials.[10,11] However, Qureshi et al[20] reported a reduction in blood pressure among participants consuming an average of 1 egg per day. A prior study by Majumder and Wu[21]suggests that the digestion of eggs produces a number of potent angiotensin-converting enzyme inhibitor peptides which may help to lower blood pressure.

In our study, weight and BMI declined slightly with egg intake, although changes were not statistically significant. This occurred despite higher total calorie intake during the egg assignment (Table IV). Despite their high cholesterol content, eggs are a source of monounsaturated fatty acids, polyunsaturated fatty acids, and micronutrients. Eggs, in contrast to other sources of animal protein, provide relatively little total fat and proportionately little saturated fat.[22] The protein content of eggs is associated with a high

Table II. Demographic characteristics (n = 32)

Variable	Value
Gender	
Female	6 (18.8%)
Male	26 (81.2%)
Race	
White	31 (96.9%)
Nonwhite	1 (3.1%)
Medication	
Lipid-lowering medication use	90.6%
Blood pressure–lowering medication use	87.5%
Aspirin use	78.1%
Age (y)	67.1 ± 7.3

Values are mean ± SD, except otherwise stated.

Table III. Outcome measures after 6 weeks of treatment

Variable	Egg	Egg Beaters	High-carbohydrate breakfast
FMD (%)			
Baseline	6.3 ± 2.9	6.3 ± 2.9	6.3 ± 2.9
6 wk	7.2 ± 2.9	7.3 ± 2.2*	7.5 ± 2.9*
Change	0.6 ± 1.2	0.9 ± 2.2*	1.1 ± 2.2*
Stimulus-adjusted response measure			
Baseline	0.08 ± 0.06	0.08 ± 0.06	0.08 ± 0.06
6 wk	0.1 ± 0.0	0.1 ± 0.1*	0.1 ± 0.0
Change	0.0 ± 0.1	0.0 ± 0.0*	0.0 ± 0.1
Total cholesterol (mg/dL)			
Baseline	153.0 ± 27.8	153.0 ± 27.8	153.0 ± 27.8
6 wk	158.3 ± 28.6	153.4 ± 16.3	156.2 ± 27.4
Change	6.3 ± 22.1	2.3 ± 14.2	3.2 ± 15.8
Triglyceride (mg/dL)			
Baseline	118.0 ± 43.2	118.0 ± 43.2	118.0 ± 43.2
6 wk	110.2 ± 37.7	109.5 ± 44.3	106.2 ± 29.2
Change	−8.8 ± 31.7	−9.3 ± 35.6	−11.8 ± 34.8
HDL-C (mg/dL)			
Baseline	54.5 ± 17.5	54.5 ± 17.5	54.5 ± 17.5
6 wk	56.5 ± 18.1	54.3 ± 16.2	54.5 ± 16.6
Change	1.7 ± 6.7	0.1 ± 6.0	−0.03 ± 8.2
LDL-C (mg/dL)			
Baseline	75.3 ± 24.2	75.3 ± 24.2	75.3 ± 24.2
6 wk	80.1 ± 26.6	77.5 ± 27.8	80.9 ± 25.6*
Change	6.3 ± 18.9	4.0 ± 13.6	5.7 ± 13.9*
Total cholesterol/HDL-C			
Baseline	3.0 ± 0.9	3.0 ± 0.9	3.0 ± 0.9
6 wk	3.0 ± 0.9	3.1 ± 1.0	3.1 ± 0.9
Change	−0.04 ± 0.6	0.1 ± 0.5	0.05 ± 0.5
Systolic blood pressure (mm Hg)			
Baseline	136.1 ± 15.5	136.1 ± 15.5	136.1 ± 15.5
6 wk	132.8 ± 14.1	135.4 ± 16.3	135.5 ± 14.9
Change	−3.4 ± 13.6	−0.7 ± 12.7	−1.2 ± 13.3
Diastolic blood pressure (mm Hg)			
Baseline	76.7 ± 7.9	76.7 ± 7.9	76.7 ± 7.9
6 wk	77.2 ± 6.1	76.8 ± 8.5	76.7 ± 6.9
Change	0.3 ± 7.6	0.1 ± 8.7	−0.1 ± 9.1
Weight (kg)			
Baseline	92.8 ± 19.0	92.8 ± 19.0	92.8 ± 19.0
6 wk	90.8 ± 17.5	91.8 ± 18.5	91.8 ± 17.1
Change	−1.1 ± 6.2	−0.7 ± 2.9	−0.9 ± 4.9
BMI (kg/m^2)			
Baseline	31.2 ± 4.8	31.2 ± 4.8	31.2 ± 4.8
6 wk	28.9 ± 8.9	30.1 ± 7.2	31.0 ± 4.3
Change	−2.4 ± 8.1	−1.2 ± 5.7	−0.3 ± 1.6

Values are mean ± SD. [†]Significant compared with high carbohydrate breakfast ($P < .05$). [‡]Significant compared with Egg Beaters ($P < .05$). *P* values are obtained from Generalized Linear Model (GLM).

* Significant change from baseline ($P < .05$).

satiety index, and thus, eggs may be of benefit in weight control. Excluding eggs from the diets of patients with CVD as per the current American Heart Association dietary recommendations could potentially lead to alternate choices high in starch and sugar, potentially associated with increased CVD morbidity and mortality. Consuming a nutrient-dense breakfast has been associated with weight loss and weight loss maintenance.[23]

This study highlights an important consideration, seemingly often overlooked when dietary recommendations are being promulgated: when the public is advised to avoid or limit a food or food category, what do people eat instead? Although coronary care units may scrupulously avoid eggs, we are aware of no systematic guidance regarding the breakfast foods served in their place. Although some foods, such as oatmeal, might offer benefits, others are far more suspect. Many of the popular breakfast choices in the United States are starchy and or sugary. There is, to our knowledge, no published population-level data to indicate that the substitution of such foods for eggs confers net benefit, or avoids net harm. Such unintended and insalubrious effects are all the more likely if egg intake is innocuous, or beneficial. Further research regarding prevailing food substitutions is much needed.

The study is limited by the fact that the study population was predominantly white and male; therefore, this limits the generalizability of our findings. Study participants were a small subset of the sampling frame. Because previous studies have shown that CVD mortality increase in diabetic patients with long-term intake of eggs,[24] noninclusion of diabetic patients with CVD is another limitation of our study. The limitation of small study size was overcome by crossing over the population to all 3 different treatment assignments, thereby improving the power of the study. As shown in Table IV, total cholesterol intake went up considerably with the egg assignment, as expected. Less expected were the apparent increases in total calorie and fat ingestion, suggesting that eggs may have been added to diets without displacing calories from other sources. To the extent this did occur, it would tend to bias results against the a priori hypothesis. The lack of any apparent adverse effects of egg ingestion was in spite of these trends. This study relied on self-report by the participants, which can introduce measurement and recall biases. The use of food diaries and recall often has significant variability. The

Table IV. Selected nutrient intake

Variable	Eggs	Egg Beaters	High-carbohydrate breakfast
Energy (kcal)	2664.4 ± 2271.0	2333.0 ± 1359.1	2705.5 ± 2119.3
Fat (kcal)	1098.9 ± 1628.7	757.3 ± 508.5	792.4 ± 549.3
Fat (g)	122.1 ± 181.0	84.2 ± 56.5	88.1 ± 61.1
% Kcal from fat	36.6 ± 10.6*	32.2 ± 7.4	29.6 ± 9.4
Saturated fatty acids (kcal)	341.3 ± 488.2	224.1 ± 153.2	225.9 ± 125.9
% Kcal from saturated fatty acids	11.9 ± 3.9*,†	9.7 ± 3.5	9.0 ± 3.1
Protein (g/d)	116.6 ± 120.9	97.3 ± 44.4	92.7 ± 36.6
% Kcal from protein	17.9 ± 4.0	18.6 ± 6.5	15.8 ± 5.1†
Carbohydrates (g)	247.7 ± 121.2	253.4 ± 128.6	288.7 ± 110.1
% Kcal from carbohydrates	42.3 ± 12.6*	45.0 ± 10.8	49.7 ± 13.2
Fiber (g/d)	19.3 ± 10.4	20.8 ± 12.4	21.9 ± 10.6
% Kcal from fiber	3.4 ± 1.5	3.8 ± 1.6	3.8 ± 1.5
Cholesterol (mg/d)	742.0 ± 619.9*,†	203.9 ± 144.7	209.9 ± 108.4
Sugar (g)	80.7 ± 54.5	80.7 ± 45.4	96.0 ± 63.1
% Kcal from sugar	13.7 ± 8.9	15.1 ± 7.3	16.7 ± 9.2

Values are mean ± SD; *P* values are obtained from Generalized Linear Model (GLM).
* Significant compared with high-carbohydrate breakfast ($P < .05$).
† Significant compared with Egg Beaters ($P < .05$).

study participants may not be honest in reporting what they have been eating or they may choose a day to report their food intake that may not necessarily be representative of the types of foods that they typically consume. Another limitation of the study was that participants were not monitored on a daily basis and were not administered a supervised diet. However, this can also be viewed as a strength of the study because it provides a more realistic scenario and potentially increases external validity.

Conclusion

Daily egg intake for 6 weeks in adults with established CAD was associated with no discernible adverse effects. In the larger context of relevant epidemiologic findings, our study argues against the exclusion of eggs from the diet for the sake of cardiac health promotion. Data from longer-term intervention studies are warranted to inform public health nutrition policy.

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