



Letter to the Editor

Putting eggs and cigarettes in the same basket; are you yolking?



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1. Overview

Dr. Spence and colleagues (2012) completed a retrospective cohort study, using patient questionnaire and total plaque area (TPA) data from a vascular disease prevention database [1]. They aimed to address whether egg yolk intake relates to vascular damage. There was no stated hypothesis. It was determined that “the effect of the upper quintile of egg consumption was equivalent in terms of atheroma development to 2/3 the effect of the upper quintile of smoking”.

2. Methods and analyses

There are concerns regarding the calculation of egg yolk-years (egg yolks per week multiplied by number of years consumed). Recall of food ingestion may only be accurate for the recent past. After a few days, episodic memory of diet diminishes and dietary recall is unlikely to be quantitatively precise [2,3]. Combined with the change in dietary habits, in particular egg consumption in Canada over the last 50 years, it is questionable whether respondent diet recall data is valid.

Spence et al. report that TPA among individuals consuming 2 or fewer eggs per week was $125 \pm 129.62 \text{ mm}^2$, whereas among individuals consuming 3 or more eggs per week, TPA was $132.25 \pm 142.48 \text{ mm}^2$ [1]. The sensitivity of the TPA measure and clinical significance of a mean difference of 7 mm^2 is unclear, considering standard deviations exceeded mean values in both groups.

In assessing the magnitude of the effect of egg yolks on TPA, including its relative effect to smoking, the authors seem to focus on bivariate relationships, “pack years of smoking” and TPA vs. “egg-yolk years” and TPA [1]. The bivariate relationship for egg yolk consumption indicates no statistically significant difference in TPA by level of consumption, as evidenced by the confidence

intervals ((Fig. 1, Panel C) [1]), except in the highest quintile (i.e., only 20% of this high risk sample). The authors proceed to state “the effect of the upper quintile of egg consumption was equivalent in terms of atheroma development to 2/3 the effect of smoking”, limiting their comparison solely to the upper quintiles in each group [1].

To highlight the danger of simply comparing bivariate relationships, one could conclude, in Dr. Spence et al.’s own terminology, that the effect of the lowest quintile of egg consumption (0 to <50 egg-yolk years) was equivalent in terms of atheroma development to $\sim 4/5$ the effect of 10–20 pack-years of smoking.

Previously, Dr. Spence et al. [4] have reported a rapid increase in plaque area between the ages of 60–75 y. Notably, patients in the ≥ 200 egg-yolk year quintile (mean age ~ 70 years) were, on average, 13 years older than patients in the bottom three quintiles (mean age ~ 57 years). Patients in the upper quintile of egg-yolk consumption, therefore, were more likely to fall within the vulnerable range of rapid plaque accumulation.

Given that age and egg yolk consumption have independent effects on TPA, we suggest exercising greater caution in interpreting the magnitude of the effect of egg yolk consumption, operationalized as “egg-yolk years,” as its measured effect is really a combination of egg yolk consumption and age.

A more appropriate interpretation would have focussed on the multiple regression analysis as it distinguishes the relative effect of each independent variable on the dependent variable. However, even there the authors encounter a specification problem. They state the effect of both smoking and egg yolk consumption on TPA is exponential, yet use a linear functional form to describe the relationship.

The regression analysis also neglected to include weekly exercise volume, total caloric intake, total fat intake, cholesterol intake, saturated fat intake, alcohol intake, vitamin intake or medication use. While the authors acknowledge the absence of theoretically important variables in the regression model, the possible implications are far from benign.

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Earlier work by Dr. Spence et al. [5,6] suggests that patients at risk for vascular events can reduce their risk of complication by 75–90% through lifestyle modification and medical therapy. Omitted variable bias would likely change the associated significance test, sign of the coefficient, as well as the magnitude of the effect of egg yolk consumption, eliminating or decreasing its importance.

The inclusion of theoretically relevant variables in models to assess relative effects cannot be underestimated. An analysis by Barraj et al. (2009), examining five modifiable risk factors for coronary heart disease, including smoking, egg yolk consumption, physical activity, BMI, and diet, demonstrated that smoking accounts for 71.6% and 59.6% of the Total Population Attributable Risk in women and men respectively, whereas the consumption of one egg/day represents only 0.247% for women and 0.99% for men.

3. Interpretation

Considering the limitations to the study design and statistical analyses, the opening statement of the discussion section “our data suggests a strong association between egg consumption and carotid plaque burden” is not supported [1].

The focus on bivariate correlation and the inadequacies associated with the full regression model, including the failure to account for theoretically relevant variables, fundamentally challenges the authors’ assertion that “In view of the almost unanimous agreement on the damage caused by smoking, we believe our study makes it imperative to reassess the role of egg yolks, and dietary cholesterol in general, as a risk factor for CHD” [1].

By comparing egg yolks with smoking, Dr. Spence et al. infer the two variables have a similar impact on vascular health [1]. However, in the two controlled egg-feeding studies they cite [8,9], egg consumption did not impact vascular reactivity in either the postprandial state or following six-weeks of elevated egg consumption in either healthy or hyperlipidemic adults. Conversely, several studies demonstrate that smoking a single cigarette and chronic smoking impairs vascular reactivity [10–12].

Controlled feeding studies also suggest eggs do not expose LDL to greater rates of oxidation in young or old participants [13,14]. Regardless, Spence et al. did not perform any postprandial measures, and fasting blood lipid values were identical between all groups. To justify their assertion that egg yolks are as damaging as smoking, a mechanism for vascular damage must be proposed [15].

Dr. Spence and colleagues use their data in conjunction with other epidemiological studies to imply a “deleterious effect of egg consumption” for those with diabetes [1]. Although several prospective studies have demonstrated a correlation between egg consumption in type II diabetes mellitus and cardiovascular disease [7,16], without experimental evidence, any “deleterious effects of egg consumption” is inconclusive. The relationship between egg consumption and diabetes is impacted by many confounding lifestyle factors and causal links at present cannot be determined. Therefore, these studies, in conjunction with their own results, cannot be used to justify their claim that egg yolks are a public health concern.

This study [1] contains numerous methodological limitations, including the absence of a hypothesis, the lack of validity to the egg yolk-years calculation, minimal control for confounding lifestyle factors, as well as inappropriate and insufficient statistical analyses. Dr. Spence and colleagues [1] argue that the negative impact of eggs is likely in the postprandial state, but do not present any data to support a deleterious effect. Their interpretations go far beyond

the scope of their data. Compared with more rigorous studies documenting little to no effect of egg consumption on vascular function [7–9,16], the opinions stated in this study were not supported.

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