Barnyard Brouhaha: What About Dairy and Eggs in the Diet?

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OLLI
Dairy and Eggs

Good sources of protein

Good sources of vitamin B12

Associated with controversy: risk regarding ASCVD risk
  • Saturated fat in dairy
  • Cholesterol in egg yolks

Whole-food, plant-food advocates claim animal proteins possess special risks

Vegans avoid these food sources for various perceived benefits
  • Avoiding ethical issues of using animals as food
  • Reducing environmental impact due to inefficiencies of resource utilization
  • Health risks of animal-sourced food

What do the data say about their effect on health?
Must a food be good or bad?

“You're either with us, or you're against us”

A common saying, in various forms, that implies there is no middle ground on an issue

- Jesus of Nazareth (Matthew 12:30)
- Lenin, Mussolini
- Hillary Clinton, George W. Bush, after 9/11

Can be true, or a false dichotomy, depending on the circumstances

Spoiler alert!

- Could it be that dairy and eggs are neither fair nor foul, but somewhere in between?
Dairy consumption and mortality

Netherlands Cohort Study (NLCS)
120,852 men and women
150 item food frequency questionnaire
Endpoints: Death from CVD, all causes
10 year followup
16,136 deaths
Results: NLCS

Analysis with respect to:
• All milk products
• Full fat milk, low fat milk
• Fermented milk (yogurt, processed sour milk), non-fermented milk
• Full fat cheese, low fat cheese
• Butter

No meaningful mortality differences in any category, or separately by gender, or by cause of death (CVD, all)
Dairy consumption and CVD

Sonestedt et al, Eur J Epi, 2011
Malmö Diet and Cancer Cohort (Sweden)
16,445 (38% men), recruitment 1991-96
Exclusions: Prior dx CVD, diabetes
Followup: 12 years
Endpoints: Dx cardiovascular, dx cerebrovascular
2,520 incident CVD (1,344 CHD, 1,176 CVA)
Results: Malmö

Evaluated by:
- Total dairy
- Milk: full and low fat, fermented and non-fermented
- Cheese: full and low fat
- Butter

Generally, no association between CVD and dairy consumption level, except:
- Lower CVD in women with greater cheese consumption
- Lower CVD in all with greater fermented milk consumption (yogurt, processed sour milk)
Milk Consumption and Mortality: Meta-Analysis

Larsson et al, Nutrients, 2015

367,505 subjects in 13 studies

Outcome: Mortality, all cause ± CVD, cancer

Followup: 4.1-25 years

70,743 deaths

Most adjusted for age, sex, smoking, BMI, alcohol, physical activity, socioeconomic

Few adjusted for other food items
Milk and mortality meta-analysis

Evaluated by fermented and non-fermented

No consistent association between non-fermented or fermented milk consumption and mortality, except:

- Study from Sweden (Michaelsson, 2014) showing statistically significant positive correlation between milk intake and mortality in men (HR 1.10) and women (HR 1.93)

- Study from Japan (Wang, 2015) showing inverse correlation between milk intake and mortality (HR 0.91) in both men and women

Studies were too heterogeneous to combine
Conclusions: Dairy

Evidence does not support concern that saturated fat content of dairy products is associated with excessive risk of CVD.

Evidence does not support hope that fermented dairy products are especially beneficial to health.

The neutral risk of dairy suggests that it is a reasonable replacement, providing protein and energy, for choices that have negative consequences (processed meat), but not to the extent that it eliminates choices with even lower risk (nuts, fiber).
Egg consumption and CVD

Larsson, Am J Clin Nutr 2015

37,766 men (Cohort of Swedish Men)
32,805 women (Swedish Mammography Cohort)

Followup: 13 years

Cardiovascular events: 7,331 men, 5,266 women

Outcomes: Onset of heart failure (HF), myocardial infarction (MI), ischemic stroke (ICVA), hemorrhagic stroke (HCVA)
Results: Eggs and CVD in Sweden

No association between level of egg consumption and rate of MI, HF, or CVA, except:

- Men consuming 1 or more eggs per day had increased risk of HF (RR 1.30, CI 1.01-1.67)
Egg consumption and coronary artery calcification

Choi et al, Atherosclerosis, 2015

23,417 asymptomatic w/o CVD or elevated cholesterol undergoing health screening

Coronary artery calcifications (CAC) are associated with risk for subsequent MI

CAC present in 11% of screened subjects

Asked about # eggs consumed / day
Egg intake and CAC

7+ eggs / week vs. < 1 egg / week

• RR CAC 1.80 (CI 1.14-2.83)

Increase in RR per egg / day:

• 1.54

CAC - egg association enhanced by low vegetable intake, higher BMI
CVD & diabetes risk in relation to egg consumption


22 cohorts in 15 studies

Considerable heterogeneity among studies

Outcomes: Dx of CVD, dx of diabetes, death
Egg consumption & mortality

11,845 deaths in 103,202 subjects followed for average 15.3 years

No association between level of egg consumption and all-cause mortality

No association between level of egg consumption and cardiovascular deaths
Egg consumption & diabetes

Diabetes diagnosed in 4,889 of 69,297 subjects over 14.8 years followup

Diabetes risk for highest vs. lowest quantile of egg consumption: RR 1.42 (CI 1.09, 1.86)
### CVD risk vs. egg consumption

<table>
<thead>
<tr>
<th>Author</th>
<th>HR (95% CI)</th>
<th>Weight, %</th>
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<tbody>
<tr>
<td><strong>IHD</strong></td>
<td></td>
<td></td>
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<tr>
<td>Hu, 1999 (30)</td>
<td>1.06 (0.79, 1.48)</td>
<td>7.67</td>
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<tr>
<td>Hu, 1999 (30)</td>
<td>0.82 (0.60, 1.13)</td>
<td>7.54</td>
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<tr>
<td>Nakamura, 2006 (32)</td>
<td>0.84 (0.61, 1.16)</td>
<td>7.26</td>
</tr>
<tr>
<td>Oureshi, 2007 (33)</td>
<td>1.10 (0.92, 1.32)</td>
<td>22.36</td>
</tr>
<tr>
<td>Djousse, 2008 (34)</td>
<td>0.90 (0.73, 1.12)</td>
<td>16.39</td>
</tr>
<tr>
<td>Subtotal (I² = 12.3%, p = 0.34)</td>
<td>0.97 (0.86, 1.09)</td>
<td>61.23</td>
</tr>
<tr>
<td><strong>Stroke</strong></td>
<td></td>
<td></td>
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<tr>
<td>Hu, 1999 (30)</td>
<td>0.89 (0.60, 1.32)</td>
<td>4.96</td>
</tr>
<tr>
<td>He, 2003 (31)</td>
<td>0.73 (0.24, 2.25)</td>
<td>0.60</td>
</tr>
<tr>
<td>Oureshi, 2007 (33)</td>
<td>0.90 (0.72, 1.13)</td>
<td>14.80</td>
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<tr>
<td>Djousse, 2008 (34)</td>
<td>0.99 (0.80, 1.23)</td>
<td>16.34</td>
</tr>
<tr>
<td>Yaemsiri, 2012 (44)</td>
<td>0.62 (0.20, 1.93)</td>
<td>0.59</td>
</tr>
<tr>
<td>Subtotal (I² = 0.0%, p = 0.89)</td>
<td>0.93 (0.81, 1.07)</td>
<td>37.29</td>
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<tr>
<td><strong>CVD</strong></td>
<td></td>
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<tr>
<td>Houston, 2011 (35)</td>
<td>2.36 (0.68, 8.23)</td>
<td>0.49</td>
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<tr>
<td>Zazpe, 2011 (36)</td>
<td>1.10 (0.46, 2.63)</td>
<td>0.99</td>
</tr>
<tr>
<td>Subtotal (I² = 0.0%, p = 0.33)</td>
<td>1.41 (0.69, 2.89)</td>
<td>1.48</td>
</tr>
<tr>
<td>Overall (I² = 0.0%, p = 0.71)</td>
<td>0.96 (0.88, 1.05)</td>
<td>100.00</td>
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</table>
CVD risk in diabetics vs. egg consumption

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<th>HR (95% CI)</th>
<th>Weight, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hu, 1999 (30)</td>
<td>2.02 (1.05, 3.88)</td>
<td>21.20</td>
</tr>
<tr>
<td>Tanasescu, 2004 (48)</td>
<td>1.44 (1.05, 1.98)</td>
<td>32.91</td>
</tr>
<tr>
<td>Qureshi, 2007 (33)</td>
<td>1.90 (1.02, 3.55)</td>
<td>22.00</td>
</tr>
<tr>
<td>Qureshi, 2007 (33)</td>
<td>0.60 (0.22, 1.64)</td>
<td>12.88</td>
</tr>
<tr>
<td>Houston, 2011 (35)</td>
<td>5.02 (1.63, 15.49)</td>
<td>11.01</td>
</tr>
<tr>
<td>Overall ($\hat{r}^2 = 54.5%, p = 0.07$)</td>
<td>1.69 (1.09, 2.62)</td>
<td>100.00</td>
</tr>
</tbody>
</table>
Conclusions: Eggs, CVD & diabetes

Egg consumption not associated with increased risk of diagnosed CVD, IHD, CVA, stroke

Egg consumption not associated with increased risk of mortality (overall or CVD-specific)

Eating 1+ / day on average associated with 42% increase in risk of diabetes

Diabetics eating 1+ / day on average had 69% increase in CVD
TMAO and egg consumption

Effect of egg ingestion on trimethylamine-N-oxide production in humans: a randomized, controlled, dose-response study

Carolyn A Miller, Karen D Corbin, Kerry-Ann da Costa, Shucha Zhang, Xueqing Zhao, Joseph A Galanko, Tondra Blevins, Brian J Bennett, Annalouise O’Connor, and Steven H Zeisel

TMAO and egg consumption

Dose (no. of eggs): Zero One Two Four Six

#1 #2

TMAO (μmol/L)

#3 #4

0 20

#5 #6

0 20

Time (h)
TMAO and egg consumption

Area under plasma TMAO curve (μmol/L·24 h)

Dose (no. of egg yolks)
TMAO and egg consumption

Six subjects had a baseline level of TMAO corresponding to a steady level of about 1 umol.

One egg increased that, but not statistically significantly, to 2 umol.

Two eggs increased the average level to 3, with considerable inter-subject variation, significantly different from baseline.

Four eggs increased the level to 5, above the cut point associated with increased risk of CHD (Cleveland Clinic).
TMAO and egg consumption

Response was highly variable among the six subjects; three with little response, three with rather dramatic responses (>10 with 4 or more eggs)

The TMAO response is due to choline in the yolk; eating egg whites should not be a concern

On the other hand, these responses give me concern about habitual consumption of two or more whole eggs daily, and the risk it could entail of promoting atherosclerosis
Conclusions: Eggs & health

Highest levels of egg consumption may be associated with:

- Increased risk of diabetes
- Increased rate of coronary artery atherosclerosis
- Increased risk of CVD is diabetics
- However, no increased mortality or clinically diagnosed CVD have been observed thus far
Recommendations: Eggs & health

Egg yolks are rich in choline

- Gut microbiome converts choline to TMA, and TMA becomes TMAO, which promotes ASCVD
- A feeding study confirmed the appearance of significantly increased amount of blood TMAO after two eggs

Modest egg intake (up to a couple per week) is probably beneficial, at worst neutral

Regular consumption of eggs (more than one daily on average) should be viewed with concern