DIET CONTROVERSIES IN CARDIOVASCULAR NUTRITION AND CLINICAL AND COST BENEFIT OF MNT BY RDN IN DSYLIPIDEMIA?

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Director of Nutrition
University of California Irvine Preventive Cardiology Program
Disclosures

- No financial relationships to disclose
Objectives

- Enumerate clinical and cost benefit of MNT by RDN in the management of dyslipidemia and cardiometabolic risk factors.
- Highlight recent AHA/ACC Prevention Guidelines and NLA Nutrition Recommendations for ASCVD prevention.
- Describe evidence-based cardioprotective dietary patterns.
- Explain recent controversies in CV nutrition within the context of scientific evidence.
University of California Irvine
16-Week Preventive Cardiology Program

- 8 individualized visits with each discipline followed by monthly maintenance visits
Clinical and Cost Benefits of MNT by RDN for Management of Dyslipidemia
A systematic review and meta-analysis

Authors

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  - Elvira Q. Johnson, MS, RDN
- Linda M. Arpino, MA, RDN, FAND
  - Shirley M. Ekvall, PhD, RDN

J Clin Lipidol. 2018:12, 1113-1122
Clinical and Cost benefits of MNT by RDN for Management of Dyslipidemia: A Systematic Review and Meta-analysis.

- 34 primary studies, 5704 subjects.
- Multiple individual face-to-face sessions with RDN over 3 to 21 months led to significant improvements in lipids, BMI, FBG and BP.
- Pooled analysis: MNT lowered LDL-C, TG, FBG, A1c and BMI vs. control group.
- Cost effectiveness and economic savings: MNT improved quality adjusted life years and reduced medication use.

MNT decreased LDL-C vs. Control group
Pooled meta-analysis: 10 RCT (2526 subjects)

▪ Reduction in LDL-C:
  MD= -10.3 mg/dL; 95% CI -13.9 to -6.7; I² 30%.
▪ Heterogeneity: low in short term interventions.
▪ Risk of bias: low in 9 of 10 studies.
▪ 9 observational studies also showed same findings.
▪ Confidence: evidence that MNT helps decrease LDL-C was very high.
▪ Most studies: >4 face-to-face MNT sessions (range 1–5) over 3 to 6 mos.
▪ In longer duration studies (10–18 months), most studies ≥8 face-to-face MNT sessions (range 7–21).
▪ Significant improvements in BMI, glycemic status and blood pressure.

**Pooled Meta-analysis: LDL-C change**

<table>
<thead>
<tr>
<th>Studies</th>
<th>Estimate (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adachi</td>
<td>-6.000 (-18.860, 6.860)</td>
</tr>
<tr>
<td>Al-shookri</td>
<td>-10.980 (-26.013, 4.053)</td>
</tr>
<tr>
<td>Imai</td>
<td>-11.000 (-28.706, 6.706)</td>
</tr>
<tr>
<td>Lim</td>
<td>-15.200 (-49.162, 18.762)</td>
</tr>
<tr>
<td>Morita-Suzuki</td>
<td>-12.100 (-29.154, 4.954)</td>
</tr>
<tr>
<td>Parker</td>
<td>-4.270 (-25.685, 17.145)</td>
</tr>
<tr>
<td>Vale</td>
<td>-13.000 (-18.657, -7.343)</td>
</tr>
<tr>
<td><strong>Subgroup 1 (I^2=0 %, P=0.962)</strong></td>
<td><strong>-11.485 (-15.896, -7.074)</strong></td>
</tr>
<tr>
<td>Haskell</td>
<td>-14.000 (-16.306, -11.694)</td>
</tr>
<tr>
<td>Wong</td>
<td>-4.260 (-19.327, 11.407)</td>
</tr>
<tr>
<td>Bray</td>
<td>-2.000 (-9.051, 5.051)</td>
</tr>
<tr>
<td><strong>Subgroup 2 (I^2=82.11 %, P=0.004)</strong></td>
<td><strong>-7.676 (-17.356, 2.003)</strong></td>
</tr>
<tr>
<td><strong>Overall (I^2=30.1 %, P=0.168)</strong></td>
<td><strong>-10.296 (-13.901, -6.651)</strong></td>
</tr>
</tbody>
</table>

**Figure 1** Forest plot of LDL-C (mg/dL) comparing MNT intervention vs control (10 studies; N = 2526). Blue diamond is the total mean difference. Yellow diamonds are mean differences for subgroups. Black squares are point estimates of the individual study and also represent the size of the study. Red dotted line represents the averaged point estimate of all the studies. Subgroup 1 represents studies of short-term interventions (3–6 months), and subgroup 2 represents studies of long-term interventions (>6 months). Haskell and Vale et al reported that statin use was higher in the intervention group compared to the control group. CI, confidence interval; LDL-C, low-density lipoprotein cholesterol; MNT, medical nutrition therapy.
### Pooled Meta-analysis: TG change

<table>
<thead>
<tr>
<th>Studies</th>
<th>Estimate (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adachi</td>
<td>-8.000 (-45.349, 29.349)</td>
</tr>
<tr>
<td>Al-shookri</td>
<td>-35.400 (-65.176, -5.624)</td>
</tr>
<tr>
<td>Imal</td>
<td>-19.000 (-78.216, 42.216)</td>
</tr>
<tr>
<td>Lim</td>
<td>-55.100 (-115.238, 5.003)</td>
</tr>
<tr>
<td>Morita-Suzuki</td>
<td>26.200 (-42.791, 93.191)</td>
</tr>
<tr>
<td>Parker</td>
<td>2.030 (-46.544, 50.604)</td>
</tr>
<tr>
<td>Vale</td>
<td>-3.000 (-16.454, 10.454)</td>
</tr>
<tr>
<td><strong>Subgroup 1</strong> (I²=17.83 %, P=0.284)</td>
<td><strong>-11.515 (-26.019, 2.998)</strong></td>
</tr>
<tr>
<td>Haskell</td>
<td>-29.000 (-34.954, -23.046)</td>
</tr>
<tr>
<td>Wong</td>
<td>17.700 (-46.896, 82.296)</td>
</tr>
<tr>
<td><strong>Subgroup 2</strong> (I²=49.77 %, P=0.158)</td>
<td><strong>-17.181 (-56.976, 22.614)</strong></td>
</tr>
<tr>
<td><strong>Overall</strong> (I²=58.16 %, P=0.014)</td>
<td><strong>-15.940 (-30.755, -1.125)</strong></td>
</tr>
</tbody>
</table>

**Figure 2**  Forest plot of TG (mg/dL) comparing MNT intervention vs control (9 studies; N = 1799). Blue diamond is the total mean difference. Yellow diamonds are mean differences for subgroups. Black squares are point estimates of the individual study and also represent the size of the study. Red dotted line represents the averaged point estimate of all the studies. Subgroup 1 represents studies of short-term interventions (3–6 months), and subgroup 2 represents studies of long-term interventions (>6 months). Haskell and Vale et al reported that statin use was higher in the intervention group compared to the control group. CI, confidence interval; MNT, medical nutrition therapy; TG, triglycerides.
### Pooled Meta-analysis: HDL-C change

<table>
<thead>
<tr>
<th>Studies</th>
<th>Estimate (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adachi</td>
<td>-1.000 (-8.332, 6.332)</td>
</tr>
<tr>
<td>Al-Shokri</td>
<td>4.248 (0.127, 0.369)</td>
</tr>
<tr>
<td>Inai</td>
<td>3.000 (-12.710, 6.710)</td>
</tr>
<tr>
<td>Lim</td>
<td>2.800 (-5.559, 11.159)</td>
</tr>
<tr>
<td>Morita-Suzuki</td>
<td>0.900 (-5.532, 7.332)</td>
</tr>
<tr>
<td>Parker</td>
<td>-1.250 (-9.836, 7.336)</td>
</tr>
<tr>
<td>Vale</td>
<td>-1.000 (-2.414, 0.414)</td>
</tr>
<tr>
<td>Subgroup 1 (I^2=96 %, P=0.356)</td>
<td>-0.015 (-1.719, 1.688)</td>
</tr>
<tr>
<td>Haskell</td>
<td>4.000 (3.146, 4.854)</td>
</tr>
<tr>
<td>Wong</td>
<td>3.864 (-1.309, 9.027)</td>
</tr>
<tr>
<td>Subgroup 2 (I^2=0 %, P=0.959)</td>
<td>3.956 (3.154, 4.839)</td>
</tr>
<tr>
<td>Overall (I^2=79.65 %, P=0.000)</td>
<td>1.592 (-0.968, 4.153)</td>
</tr>
</tbody>
</table>

**Figure 3**  Forest plot of HDL-C (mg/dL) comparing MNT intervention vs control (9 studies; N = 1769). Blue diamond is the total mean difference. Yellow diamonds are mean differences for subgroups. Black squares are point estimates of the individual study and also represent the size of the study. Red dotted line represents the averaged point estimate of all the studies. Subgroup 1 represents studies of short-term interventions (3–6 months), and subgroup 2 represents studies of long-term interventions (>6 months). Haskell and Vale et al reported that statin use was higher in the intervention group compared to the control group. CI, confidence interval; HDL-C, high-density lipoprotein cholesterol; MNT, medical nutrition therapy.
Pooled Meta-analysis: A1c change

<table>
<thead>
<tr>
<th>Studies</th>
<th>Estimate (95% C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adachi 2013</td>
<td>-0.600 (-1.126, -0.074)</td>
</tr>
<tr>
<td>Imai 2008</td>
<td>-0.470 (-0.677, -0.263)</td>
</tr>
<tr>
<td>Morita-Suzuki 2012</td>
<td>-0.140 (-0.457, 0.177)</td>
</tr>
<tr>
<td>Parker 2014</td>
<td>-0.260 (-0.616, 0.096)</td>
</tr>
<tr>
<td>Bray 2013</td>
<td>-0.400 (-0.822, 0.022)</td>
</tr>
<tr>
<td>Al-Shockri 2012</td>
<td>-0.400 (-1.201, 0.401)</td>
</tr>
<tr>
<td>Overall (I²=0 %, P=0.544)</td>
<td>-0.375 (-0.513, -0.236)</td>
</tr>
</tbody>
</table>

Figure 4  Forest plot of A1c (%) comparing MNT intervention vs control (6 studies; N = 1392). Blue diamond is the total mean difference. Black squares are point estimates of the individual study and also represent the size of the study. Red dotted line represents the averaged point estimate of all the studies. CI, confidence interval; MNT, medical nutrition therapy.
Pooled Meta-analysis: BMI change

![Forest plot of BMI (kg/m²) comparing MNT intervention vs control (8 studies; N = 1718). Blue diamond is the total mean difference. Black squares are point estimates of the individual study and also represent the size of the study. Red dotted line represents the averaged point estimate of all the studies. BMI, body mass index; CI, confidence interval; MNT, medical nutrition therapy.](image-url)
Summary: Clinical and cost benefits of MNT by registered dietitians for management of dyslipidemia: A systematic review and meta-analysis

**METHODS**

Face to Face Medical Nutrition Therapy (MNT) leads to Cardio-metabolic factors: $$$

34 primary studies (n=5704)
*including 10 randomized control trials (n=2526)

**RESULTS**

- Total Chol (mg/dL): -9.9
- LDL (mg/dL): -10.3
- Triglycerides (mg/dL): -15.9
- A1c (%): -0.38
- glucose (mg/dL): -0.53
- BMI (kg/m²): -0.39
- HDL (mg/dL): +1.6
- QALY (years): +0.75
- $ saved/patient year: +$638 to +$1456.00 per yr.

**CONCLUSIONS:** Evidence from this systematic review and meta-analysis demonstrates that multiple MNT sessions by an RDN are clinically effective and cost beneficial in patients with dyslipidemia and cardiometabolic risk factors.

Sikand G et al…(October 2018) 12, 1113–1122
• Dietitian intervention led to improved lipids, glucose, weight, BMI, blood pressure, quality adjusted life years and reduced need for lipid-lowering medications.
• Multiple individual sessions with a dietitian were clinically and cost beneficial.
• Benefits also reported when dietitian was part of a multidisciplinary health care team.

# NLA Recommendations for Patient-Centered Management of Dyslipidemia: Part 2—Healthy Dietary Patterns

## Recommendations

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Strength</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>The NLA Expert Panel recommends any of the following healthy dietary patterns, including an emphasis on a variety of plant foods and lean sources of protein for managing dyslipidemia: DASH, USDA (healthy US-style), AHA, Mediterranean-style, and vegetarian/vegan.</td>
<td>A</td>
<td>Moderate</td>
</tr>
<tr>
<td>Patient’s eating pattern should be individualized based on the patient’s specific dyslipidemia…Nutrition therapy by a RDN should be included.</td>
<td>A</td>
<td>Strong</td>
</tr>
</tbody>
</table>

Strength - Grade A - Strong recommendation. Net benefit is substantial.  
Quality - Moderate - Moderately certain about the effect.

Objective 2
What You Need to Know About the New 2019 AHA/ACC Prevention Guidelines
Arnett et al. Circulation 2019
Commentary by Penny Kris-Etherton, PhD, RDN, FAHA, FNLA, FAHA
Chair AHA Nutrition Committee
March 17 2019

The new guidelines strengthen the evidence base and the business case for prevention, and clearly point out where we should be investing to achieve optimal health. I hope the new guideline will spark renewed stakeholder efforts to embrace prevention. The benefits of promoting health and quality of life are worth it!

**Related Resources:**

- [Full Guideline: 2019 ACC/AHA Guideline on the Primary Prevention of Cardiovascular Disease](#)
- [Highlights from the 2019 CVD Primary Prevention Guideline (PDF)](#)
- [Slide Set (PDF)](#)
Eat a heart-healthy **dietary pattern**:

- Emphasize **plant-based foods** such as vegetables, fruits, legumes, nuts, whole grains, lean protein and fish.
- Limit foods high in **saturated fats and dietary cholesterol** (for example, meat and organ meats, full-fat dairy products, eggs and tropical oils such as coconut and palm oil).
- Minimize trans fat, sodium (salt), processed meats, refined carbs and sweetened beverages.

Be **physically active** most days of the week, 150 min/wk moderate-intensity e.g. brisk walking or 75 min/wk vigorous physical activity e.g. jogging.
Encourage overweight or obese adults to seek comprehensive counseling and advise them to restrict calories and be more physically active.

Encourage adults with type 2 DM or high blood pressure to be counseled by health care providers about lifestyle changes as a key part of their treatment plan. Treatment plans may also include medication.
Highlights of the 2019 AHA/ACC Prevention Guidelines

- Health care providers should **consider the “whole person”** by:
  - Focusing on shared decision-making – understanding patients’ concerns and helping them make informed decisions;
  - Using team-based care e.g. referring patients to registered dietitians, psychologists and physical therapists when practical.
  - Understanding social determinants of health, such as a patient’s willingness and ability to make lifestyle changes, health literacy, socioeconomic status, neighborhood settings, social support, socioeconomic factors and others.
Objective 3: Examine Recent CV Nutrition Controversies

• Dietary cholesterol: Are eggs back?
• Is butter back? Are saturated fats back?
• Are keto diets good or bad for weight loss?
• Does increasing intake of omega-6 polyunsaturated fatty acids (PUFAs) e.g. linoleic acid lead to increased pro-inflammatory cytokines in humans?
• Is coconut oil good for my health?
Diet Controversy 1: Patient Scenario

- I heard dietary cholesterol does not matter.
- Then I heard dietary cholesterol does matter.
- How many eggs can I have per week?
- Can I eat as many eggs as I want?
National Lipid Association Recommendations for Patient-Centered Management of Dyslipidemia: Part 2

Terry A. Jacobson, MD*, Kevin C. Maki, PhD, Carl E. Orringer, MD, Peter H. Jones, MD, Penny Kris-Etherton, PhD, Geeta Sikand, MA, Ralph La Forge, MSc, Stephen R. Daniels, MD, PhD, Don P. Wilson, MD, Pamela B. Morris, MD, Robert A. Wild, MD, PhD, MPH, Scott M. Grundy, MD, PhD, Martha Daviglus, MD, PhD, Keith C. Ferdinand, MD, Krishnaswami Vijayaraghavan, MD, Prakash C. Deedwania, MD, Judith A. Aberg, MD, Katherine P. Liao, MD, MPH, James M. McKenney, PharmD, Joyce L. Ross, MSN, CRNP, Lynne T. Braun, PhD, CNP, Matthew K. Ito, PharmD, Harold E. Bays, MD, W. Virgil Brown, MD,

On behalf of the NLA Expert Panel

Chart 1 Nutrition recommendations

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Strength</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>The NLA Expert Panel supports a cardioprotective eating pattern for the management of dyslipidemia and overall cardiovascular health that includes &lt;7% of energy from saturated fat, with minimal intake of trans fatty acids to lower levels of atherogenic cholesterol (LDL-C and non-HDL-C).</td>
<td>A</td>
<td>Moderate</td>
</tr>
<tr>
<td>The cardioprotective eating pattern should limit cholesterol intake to &lt;200 mg/day to lower levels of atherogenic cholesterol (LDL-C and non-HDL-C).</td>
<td>B</td>
<td>Moderate</td>
</tr>
<tr>
<td>There are individuals who are hyper-responders to dietary cholesterol because of genetic or other reasons. For known or suspected hyper-responders, further reduction in dietary cholesterol beyond the &lt;200 mg/day that is recommended as part of the cardioprotective eating pattern for the management of dyslipidemia may be considered. Consumption of very low intakes of dietary cholesterol (near 0 mg/day) may be helpful for such individuals.</td>
<td>B</td>
<td>Low</td>
</tr>
</tbody>
</table>
Dietary Cholesterol and ASCVD

- Modest Increase: **100 mg/day of dietary cholesterol raises LDL-C about 2 mg/dL:** (systematic reviews and meta-analyses).
- Variability in response—hyper and hypo-responders (ABCG5 and ABCG8).
- Egg consumption: not associated with CVD risk and cardiac mortality in general, healthy population (Epi studies).
- However, egg consumption (dietary cholesterol) significantly increased CVD risk in people with diabetes.
- Limit to <200 mg/day to lower levels of atherogenic cholesterol (LDL-C and non-HDL-C): NLA 2015.

Dietary Cholesterol and ASCVD

• Scientific evidence supports NLA recommendation for <200 mg/day of dietary cholesterol.

• Not able to identify hyper and hypo responders in a clinical setting.

• Even small reductions in LDL-C have CVD benefits

• The growing prevalence of diabetes is a further justification for restriction of dietary cholesterol

Penny Kris-Etherton, PhD, RD, FNLA
NLA Annual Meeting 2015

Zhong VW, Van Horn L et al.
Is consuming dietary cholesterol or eggs associated with incident CVD and all-cause mortality?

- N= 29615 adults, 6 prospective US cohorts
- Median follow-up: 17.5 years.
- Findings: each additional 300 mg of dietary cholesterol/per day was significantly associated with higher risk of incident CVD (adjusted hazard ratio [HR], 1.17; adjusted absolute risk difference [ARD], 3.24%) and all-cause mortality (adjusted HR, 1.18; adjusted ARD, 4.43%)
- Each additional half an egg consumed per day was significantly associated with higher risk of incident CVD (adjusted HR, 1.06; adjusted ARD, 1.11%) and all-cause mortality (adjusted HR, 1.08; adjusted ARD, 1.93%).

Zhong et al. study JAMA 2019.
Study Findings

- For every additional 300 mg of dietary cholesterol eaten per day, the risk of CVD and all-cause mortality was higher by 17% and 18%, respectively.

- Conclusion: Higher consumption of dietary cholesterol or eggs was significantly associated with higher risk of incident CVD and all-cause mortality in a dose-response manner especially stroke. Assoc. became non-significant after adjustment for consumption of eggs and red meat.

- US: Eggs and meats contribute 25% and 42% of total dietary cholesterol, respectively.

Zhong et al. study JAMA 2019
Study Findings

- US: Average dietary cholesterol intake = 295 mg/day, equals 3 to 4 eggs per week. Adjusted HR for incident CVD 1.06 (95% CI, 1.03-1.10) and all-cause mortality 1.08 (95% CI, 1.04-1.11).

- For each additional half of an egg consumed daily, the risk of CVD and all-cause mortality was higher by 6% and 8%, respectively.

- Closer look: dietary cholesterol was more strongly associated with risk of stroke than heart disease, and it was associated with both CVD and non-CVD deaths.

Zhong et al. JAMA 2019
Important reminder from Zhong et al. “Our data is observational, reflects associations only and not cause and effect.”

- Concern: greater for those who consumed 2 eggs daily vs. 3-4 eggs weekly. HR for incident CVD 1.27 (95% CI, 1.10-1.45) and for all-cause mortality 1.34 (95% CI, 1.15-1.52).

- Concern: increased with consumption of 600 mg cholesterol/day, HR for CVD 1.37 (95% CI, 1.19-1.59) and for all-cause mortality 1.38 (95% CI, 1.22-1.58).
Strengths and Limitations

- **Strengths**: Large sample size and a long duration of follow-up. Median follow up 17.5 yrs.
- **Major limitation**: Use of a single measure of dietary intake to look at outcomes up to 30 years later.
- **Some people may have changed their diet after developing high cholesterol or other conditions, which may influence the results of the study.**
- **Findings should be interpreted in the context of several previous studies, which showed low to moderate egg intake is not associated with a higher risk of CVD in generally healthy people.**
Study Implications

- Considering the negative consequences of egg consumption and dietary cholesterol in the setting of heart-healthy dietary patterns, the importance of following evidence based dietary recommendations, such as limiting intake of cholesterol-rich foods, should not be dismissed.

- Mechanism of the observed association with non-CVD mortality remains to be defined.
Study Implications

- “Among US adults, higher consumption of dietary cholesterol or eggs was significantly associated with higher risk of incident CVD and all-cause mortality in a dose-response manner.”
- Overall, strength was modest, but higher consumption of cholesterol or eggs substantially above the median was associated with a monotonic increase in CVD incidence and all-cause mortality. At the population level, this is an important finding.
- Assoc. between egg consumption and dietary cholesterol with CVD events and mortality may be mediated by higher levels of LDL-C or another mechanism along with residual confounders.”
Zhong et al study may re-kindle debate on role of dietary cholesterol and egg consumption in CVD.

This study will not change general healthy eating guidelines that emphasize increasing consumption of fruits, vegetables, whole grains, nuts, and legumes and lowering consumption of red and processed meats and sugar.

For generally healthy persons, low to moderate eggs intake can be included as part of a healthy eating pattern, but they are not essential.

Frank Hu, MD  
Chair, Department of Nutrition at Harvard

“Nutrition research, in contrast with RCTs that compare a drug with placebo, is more difficult for many reasons, including complexities in data gathering and changes in human behavior over time.”

Statement by Robert H. Eckel, MD in the accompanying JAMA Editorial to Zhong et al study.
Objective 3

- Describe evidence-based cardioprotective dietary patterns.
AARP Study: Which Dietary Patterns are Effective for lowering CVD Risk & LDL-C?

1. DASH (Dietary Approaches to Stop Hypertension)
2. Healthy Eating Index (HEI) (USDA diet)
3. Alternative Healthy Eating Index (AHEI) (AHA diet)
4. Mediterranean style dietary pattern

Conclusion: All whole foods dietary patterns are effective.

Evidence among men (n=242,321) and women (n=182,342)

Effects of Dietary Patterns on CVD risk factors in RCTs

Evidence-Based Cardioprotective Dietary Patterns

High intake of

- Plants sources: fruits, vegetables, whole grain; legumes, nuts, and seeds
- Fish or seafood, lean meats, and non-fat or low-fat (1%) dairy products
- Plant-based oils in place of animal fats

Limit intake of

- High-fat red meat and high-fat dairy products
- Sweets, sugar-sweetened beverages

DASH and Mediterranean-style, HEI and AHEI dietary patterns


Controversy 2: Patient Scenario

On which dietary pattern will I lose weight?

- DASH diet
- Mediterranean diet
- Vegetarian diet
- Vegan diet
- Pescatarian diet
- Keto diet
Eat a heart-healthy **dietary pattern**: 

- Emphasize **plant-based foods** such as vegetables, fruits, legumes, nuts, whole grains, lean protein and fish.

- Limit foods high in **saturated fats and dietary cholesterol** (for example, meat and organ meats, full-fat dairy products, eggs and tropical oils such as coconut and palm oil).

- Minimize trans fat, sodium (salt), processed meats, refined carbs and sweetened beverages.
“A variety of dietary approaches can produce weight loss in overweight and obese adults...if reduction in energy intake is achieved.”

Low fat

Higher protein

Low carbohydrate (30 g to 130 g)

Adopting new dietary patterns such as DASH, Mediterranean or Vegetarian.

At least 14 visits over 6 months with an interventionalist e.g. RDN for behavior modification and personalized meal planning.
Weight loss of 5-10% body weight is generally recommended for overweight/obese individuals to lower atherogenic lipoproteins and improve ASCVD risk factors.

Any dietary approach will result in weight loss if energy intake is reduced. Several healthy patterns e.g. Mediterranean-style, DASH, USDA, and vegetarian diets, can be tailored to personal and cultural food preferences and appropriate calorie needs to lose weight.

Strength of Evidence A
The Saturated Fat Controversy

Ancel Keys on the cover of Time Magazine in 1961. He claimed that saturated fats in the diet clogged arteries and caused heart disease.

Time Magazine cover story in 2014. Scientists were wrong about saturated fats. They don’t cause heart disease after all.
Diet Controversy 2: Patient Scenario

- Is butter back? Are saturated fats back?
Clearing up the Controversy from flawed studies

Saturated fatty acids (SFA) are not back!

- Some early epi studies (e.g., Siri-Tarino et al., 2010): “no association with SFA and CAD.”
- These studies were flawed. They did not consider the nutrient substituted for SFA, which was refined carb and added sugars.
- Their correct conclusion should have been “SFA, refined carbs & added sugars are equally bad for CHD risk.”
## Saturated Fat Intake and CHD Events

### No Significant Relationship

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Risk Ratio IV, Random, 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coronary Heart Disease</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shekelle et al(17)</td>
<td>1.11 [0.91, 1.36]</td>
<td>1981</td>
</tr>
<tr>
<td>McGee et al(9)†</td>
<td>0.86 [0.67, 1.12]</td>
<td>1984</td>
</tr>
<tr>
<td>Kushi et al(13)</td>
<td>1.33 [0.95, 1.87]</td>
<td>1985</td>
</tr>
<tr>
<td>Posner et al(16)</td>
<td>0.92 [0.68, 1.24]</td>
<td>1991</td>
</tr>
<tr>
<td>Goldbourt et al(35)†</td>
<td>0.86 [0.56, 1.35]</td>
<td>1993</td>
</tr>
<tr>
<td>Fehily et al(28)</td>
<td>1.57 [0.56, 4.42]</td>
<td>1994</td>
</tr>
<tr>
<td>Ascherio et al(4)†</td>
<td>1.11 [0.87, 1.42]</td>
<td>1996</td>
</tr>
<tr>
<td>Esrey et al(8)</td>
<td>0.97 [0.80, 1.18]</td>
<td>1996</td>
</tr>
<tr>
<td>Pietinen et al(15)</td>
<td>0.93 [0.60, 1.44]</td>
<td>1997</td>
</tr>
<tr>
<td>Boniface et al(5)†</td>
<td>1.37 [1.17, 1.60]</td>
<td>2002</td>
</tr>
<tr>
<td>Jakobsen et al(8)†</td>
<td>1.03 [0.66, 1.60]</td>
<td>2004</td>
</tr>
<tr>
<td>Oh et al(33)</td>
<td>0.97 [0.74, 1.27]</td>
<td>2005</td>
</tr>
<tr>
<td>Tucker et al(18)†</td>
<td>1.22 [0.31, 4.77]</td>
<td>2005</td>
</tr>
<tr>
<td>Xu et al(10)</td>
<td>1.91 [0.31, 11.84]</td>
<td>2006</td>
</tr>
<tr>
<td>Leosdottir et al(14)</td>
<td>0.95 [0.74, 1.21]</td>
<td>2007</td>
</tr>
</tbody>
</table>

**Subtotal (95% CI)**

1.07 [0.96, 1.19]

Heterogeneity: \( \tau^2 = 0.02; \chi^2 = 25.54, df = 15 (P = 0.04); I^2 = 41\% \)

Test for overall effect: \( Z = 1.22 (P = 0.22) \)

---


Slide courtesy of D. Mozaffarian
Replacement of Saturated Fat with other Types of Fat or Carbohydrates and CVD Risk

Isocaloric substitution of SFA by equivalent energy from

- **Trans fat (2%)**: 5%
- **MUFA (5%)**: -15%
- **PUFA (5%)**: -25%
- **Carbohydrates from refined starches/sugars (5%)**: 1%
- **Carbohydrates from whole grains (5%)**: -9%

Changes in Risk (%)

Types of Fats and Mortality

- MV-adjusted results, isocaloric comparison is CHO

Saturated Fatty Acids (SFA) and CV Health

- SFA negative impact on CV health: strong evidence.

- Increase: LDL-C, coagulation, inflammation, insulin resistance, risk of CVD and T2D.

- All saturated fatty acids are not created equal: Its all about the chain length.

Arnett et al. 2019 AHA/ACC Prevention Guidelines.
Jacobson et al. 2015 NLA Nutrition Recommendations
Saturated Fatty Acids and CV Health

Long-chain SFAs—14 – 20 carbons

- Myristic (14:0) and palmitic (16:0)
  - Strong evidence: increase LDL-C
  - May increase coagulation, inflammation, and insulin resistance.
- Epi studies—associated with higher risk of CHD, CVD, and T2D.
- May improve insulin sensitivity when SFA is replaced with unsaturated fatty acids.

- Stearic (18:0): associated with increased incident T2D, but not increase in LDL-C.

Maki K et al. J Nutr. 2017
2017 AHA Advisory: Core RCT on Replacement of Dietary Saturated Fat With PUFA

- Four core RCT replacing SFA with PUFA had at least 2 years’ duration, good adherence proven by blood or tissue levels of cholesterol and/or PUFA, and standard outcome ascertainment. Meta-analysis showed a 29% reduction in CHD events.

- Six additional trials: not considered core trials due to short duration, low adherence, or nonstandard outcome ascertainment. However, meta-analyses that included several of these trials along with some or all of the core trials also found a significant reduction in CHD events on the PUFA diet.

Evidence has accumulated during the past several years that strengthens long-standing AHA recommendations to replace saturated fat with polyunsaturated and monounsaturated fat to lower the incidence of CVD. Reduction in total dietary fat or a goal for total fat intake is not recommended. This shift from saturated to unsaturated fats should occur simultaneously in an overall healthful dietary pattern such as the DASH or Mediterranean diet as emphasized by the 2013 AHA/American College of Cardiology lifestyle guidelines and the 2015 to 2020 Dietary Guidelines for Americans.”

A healthful dietary pattern can include

- Lean protein to replace SFA
- Carbohydrate from whole grains, nuts, seeds, and legumes

Taking into consideration the totality of the scientific evidence, satisfying rigorous criteria for causality, we conclude strongly that lowering intake of saturated fat and replacing it with unsaturated fats, especially polyunsaturated fats, will lower the incidence of CVD.
## NLA Recommendations for Patient-Centered Management of Dyslipidemia: Part 2—Saturated Fat

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Strength</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommends a cardioprotective eating pattern that includes &lt;7% of energy from saturated fat and minimal intake of <em>trans</em> fat to lower atherogenic LDL-C and non-HDL-C.</td>
<td>A</td>
<td>Moderate</td>
</tr>
<tr>
<td>Dietary saturated fat may be partially replaced with unsaturated fats, as well as proteins to &lt;7% of energy. Incorporate foods high in unsaturated fats (liquid vegetable oils, spreads, nuts &amp; seeds) and lean protein foods (legumes, seafood, lean meats, and non-fat or low-fat dairy products) as replacements for foods high in saturated fat.</td>
<td>A</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

Strength - Grade A - Strong recommendation. Net benefit is substantial. Quality - Moderate - Moderately certain about the effect.

Diet Controversy 3

Does increasing intake of omega-6 polyunsaturated fats (PUFA) lead to increased pro-inflammatory cytokines in humans? e.g. Corn oil, safflower oil, soy bean oil, sunflower oil
How to Address the PUFA Controversy in Practice

A Food-Based Approach

PUFA Oil? OR MUFA Oil?
Unsaturated Fatty Acids and CV Health

Polyunsaturated fatty acids (PUFA)

- Linoleic acid (replacing SFA): lowers LDL-C and CVD risk
- PUFA intakes: not associated with increased inflammatory markers (CRP, IL-6)
- ALA: high intakes lower lipids, vascular inflammation and BP.
- EPA and DHA: reduce TG, blood pressure, susceptibility to ventricular arrhythmia, platelet activation and inflammation.

Arnett et al. Circulation 2019 AHA/ACC Prevention Guidelines
“There is no clinical evidence that increasing intake of n-6 PUFA leads to increased pro-inflammatory cytokines in humans. Higher intake of n-6 PUFA was not associated with inflammatory biomarkers such as C-reactive protein, interleukin-6, and soluble TNF receptors 1 and 2 in our previous study, whereas plasma n-6 PUFA concentration was inversely associated with the level of pro-inflammatory interleukin-1Ra and positively associated with the level of anti-inflammatory transforming growth factor-β.”
There Is Coconut Everywhere
Consumers lap up the tropical plant in water, milk, flour, oil and snacks

The world is going coconuts. Following the popularity of coconut water, a broad spectrum of foods now add coconut oil and coconut flour. WSJ’s Anne-Marie Chaker and Tanya Rivero discuss the popularity of coconut as well as its actual and perceived health benefits. Photo Illustration: Greg Clarke

By ANNE MARIE CHAKER
March 27, 2017 10:57 a.m. ET
Controversy 4: Coconut Oil & CV Health

- False health claims: based on reported benefits that MCTs bypass portal circulation.
- However, coconut oil contains primarily lauric acid.
  - Only 58% of the fatty acids in coconut oil are MCTs—caprylic (7.4%), capric (5.9%) and lauric acid (44%).
- Lauric acid: behaves like a SFA in terms of digestion and metabolism.
- 70%–75% of lauric acid is absorbed via chylomicrons in the liver, whereas MCTs bypass portal circulation.

Saturated Fatty Acids and CV Health

Short-chain SFAs—6 carbons in length
- Acetate (2:0), propionate (3:0), and butyrate (4:0)
- Produced by bacteria in the gut via fermentation of soluble and insoluble fiber

Medium-chain SFAs—8 – 12 carbons in length
- Caproic (6:0), caprylic (8:0), capric (10:0), and lauric (12:0)
- Caprylic and capric acids: true MCTs
- Lauric acid: similar to long-chain SFA: Raises LDL-C, coagulation, inflammation, and insulin resistance.

<table>
<thead>
<tr>
<th>Lipid</th>
<th>Amount</th>
<th>SFA</th>
<th>8:0</th>
<th>10:0</th>
<th>12:0</th>
<th>14:0</th>
<th>16:0</th>
<th>18:0</th>
<th>MUFA</th>
<th>PUFA</th>
<th>18:2</th>
<th>18:3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avocado oil</td>
<td>1 TBSP</td>
<td></td>
<td>11.9</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>11.3</td>
<td>0.7</td>
<td>72.6</td>
<td>13.9</td>
<td>12.9</td>
</tr>
<tr>
<td>Beef tallow</td>
<td>1 TBSP</td>
<td></td>
<td>46.8</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>23.5</td>
<td>17.8</td>
<td>39.3</td>
<td>3.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Butter</td>
<td>1 TBSP</td>
<td></td>
<td>53.6</td>
<td>2.6</td>
<td>2.7</td>
<td>7.8</td>
<td>22.6</td>
<td>10.4</td>
<td>22.0</td>
<td>3.2</td>
<td>2.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Canola oil</td>
<td>1 TBSP</td>
<td></td>
<td>7.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>4.4</td>
<td>6.8</td>
<td>65.1</td>
<td>29.0</td>
<td>19.6</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>1 TBSP</td>
<td></td>
<td>86.8</td>
<td>5.9</td>
<td>44.9</td>
<td>16.9</td>
<td>7.9</td>
<td>2.9</td>
<td>5.9</td>
<td>1.5</td>
<td>1.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Lard</td>
<td>1 TBSP</td>
<td></td>
<td>36.9</td>
<td>0.1</td>
<td>0.2</td>
<td>1.3</td>
<td>22.4</td>
<td>12.7</td>
<td>42.5</td>
<td>10.5</td>
<td>9.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Olive oil</td>
<td>1 TBSP</td>
<td></td>
<td>13.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>11.2</td>
<td>1.9</td>
<td>72.4</td>
<td>10.4</td>
<td>9.7</td>
</tr>
<tr>
<td>Palm oil</td>
<td>1 TBSP</td>
<td></td>
<td>49.3</td>
<td>0.0</td>
<td>1.0</td>
<td>43.5</td>
<td>4.3</td>
<td>37.0</td>
<td>9.3</td>
<td>9.1</td>
<td>9.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Palm kernel oil</td>
<td>1 TBSP</td>
<td></td>
<td>81.5</td>
<td>3.7</td>
<td>47.1</td>
<td>16.4</td>
<td>8.1</td>
<td>2.8</td>
<td>11.4</td>
<td>1.6</td>
<td>1.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>1 TBSP</td>
<td></td>
<td>15.7</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>10.4</td>
<td>4.4</td>
<td>22.8</td>
<td>57.7</td>
<td>51.0</td>
</tr>
</tbody>
</table>

* Listed as percent of total fatty acid content. Based on 13.6 g fatty acids/tablespoon (Tbsp.).

After reviewing the limited available evidence the NLA Expert Panel consensus is that if coconut oil is used it must be done sparingly by patients who would benefit from reductions in atherogenic cholesterol.”

1 TBS virgin coconut oil = 13.6 gm SF

1 TBS coconut oil or ¼ cup coconut milk = 11.7 gm SF

2000 kcal 15.5 gm/day = 7% of energy from SFA
Plant sterols and stanols (~2 g/day) are recommended for cholesterol lowering, as well as viscous fibers (5 to 10 g/day or even greater, if acceptable to the patient), as adjuncts to other lifestyle changes. **Strength of Evidence B**

However, individuals with phytosteroolemia (sitosterolemia) should avoid foods fortified with stanols and sterols (defect in at least one transporter e.g., ABC G5 and G8).
Predicting Reductions in LDL-C and Non-HDL-C

Diet low in saturated and trans fat and dietary cholesterol: -5 to -10%

Loss of 5% of body weight: -3 to 5%

2 g/day plant sterols/stanols

or

7.5 g/day viscous fiber: -4 to -10%

Total reduction: -12 to -25%
Nutrition Recommendations for Preventing CVD

Take Aways

Whole foods dietary patterns for patient’s specific dyslipidemia include fruits & vegetables, fiber-rich whole grains, fatty fish, nuts, seeds, legumes, lean protein and low-fat dairy.

Limit dietary cholesterol <200 mg/d. Most foods high in saturated fat are also high in dietary cholesterol.

Include dietary adjuncts viscous fiber, plant sterols/stanols, soy and omega-3 fatty acids.

Reduce sodium, sugar and saturated fat along with 5-10% weight reduction if overweight.

Refer to a RDN to personalize patients’ dietary pattern and nutrition goals.
2015 NLA Recommendation
Medical Nutrition Therapy: Promoting Success in Patients—Coordinated Care

- “An RDN plays an important role in counseling the patient to develop and implement an individualized cardioprotective eating plan (i.e., medical nutrition therapy [MNT] for dyslipidemia).”
  - MNT provided for 6 weeks to 6 months resulted in significant decrease in LDL-C (7–15%)
- “Other health professionals…are also important in achieving physical activity goals, stress management, identification and management of triggers for unhealthy eating patterns.”

APPENDIX
Fatty Acid Profiles of Common Fats & Oils

- Saturated Fatty Acids
- Monounsaturated Fatty Acids
- Polyunsaturated Fatty Acids

- **Solid Fats**
  - Coconut Oil*
  - Palm Kernel Oil*
  - Butter
  - Beef Fat (Tallow)
  - Palm Oil*
  - Pork Fat (Lard)
  - Chicken Fat
  - Shortening**

- **Oils**
  - Cottonseed Oil
  - Salmon Oil
  - Peanut Oil
  - Soybean Oil
  - Sesame Oil
  - Olive Oil
  - Corn Oil
  - Avocado Oil
  - Sunflower Oil
  - Safflower Oil
  - Canola Oil

2015-2020 Dietary Guidelines for Americans
### TABLE 1 Clinical Recommendations for Specific Dietary Patterns, Foods, and Nutrients

<table>
<thead>
<tr>
<th>Nutrition/Food Item</th>
<th>Level of Evidence Available and Included in This Paper</th>
<th>Recommendations for Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dietary pattern with added fats, fried food, eggs, organ and processed meats, and sugar-sweetened beverages (Southern diet pattern)</td>
<td>Prospective studies</td>
<td>Avoid ✓</td>
</tr>
<tr>
<td>Dietary cholesterol</td>
<td>RCTs and prospective studies along with meta-analyses</td>
<td>Limit ✓</td>
</tr>
<tr>
<td>Canola oil</td>
<td>RCT meta-analyses show improvement in lipids but no prospective studies or RCTs for CVD outcomes</td>
<td>In moderation ✓</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>RCT meta-analyses and observational studies on adverse lipid effects. No prospective studies or RCTs for CVD outcomes</td>
<td>Avoid ✓</td>
</tr>
<tr>
<td>Sunflower oil</td>
<td>No prospective studies or RCTs for CVD outcomes</td>
<td>In moderation ✓</td>
</tr>
<tr>
<td>Olive oil</td>
<td>RCTs supporting improved CVD outcomes</td>
<td>In moderation ✓</td>
</tr>
<tr>
<td>Palm oil</td>
<td>RCTs and observation studies showing worsened CVD outcomes</td>
<td>Avoid ✓</td>
</tr>
<tr>
<td>Antioxidant-rich fruits and vegetables</td>
<td>RCTs and observational studies showing improved CVD outcomes and improvements in blood lipids</td>
<td>Frequent ✓</td>
</tr>
<tr>
<td>Antioxidant supplements</td>
<td>RCTs and prospective and observational studies show potential harm</td>
<td>Avoid ✓</td>
</tr>
<tr>
<td>Nuts</td>
<td>RCT and large prospective and meta-analysis studies showing improved CVD outcomes</td>
<td>In moderation ✓</td>
</tr>
<tr>
<td>Green leafy vegetables</td>
<td>Large meta-analyses and variably sized observational studies as well as a large prospective study</td>
<td>Frequent ✓</td>
</tr>
<tr>
<td>Protein from plant sources</td>
<td>Large observational and prospective studies</td>
<td>Frequent ✓</td>
</tr>
<tr>
<td>Gluten-containing foods</td>
<td>Observational studies and RCTs</td>
<td>Avoid if sensitive or allergic</td>
</tr>
</tbody>
</table>

### Summary of heart-harmful and heart-healthy foods/diets

<table>
<thead>
<tr>
<th>Evidence of harm; limit or avoid</th>
<th>Inconclusive evidence; for harm or benefit</th>
<th>Evidence of benefit; recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut oil and palm oil are high in saturated fatty acids and raise cholesterol</td>
<td>Virgin coconut oil</td>
<td>Extra-virgin olive oil reduces some CVD outcomes when consumed in moderate quantities</td>
</tr>
<tr>
<td>Eggs have a serum cholesterol-raising effect</td>
<td>High-dose antioxidant supplements</td>
<td>Blueberries and strawberries (&gt;3 servings/week) induce protective antioxidants</td>
</tr>
<tr>
<td>Juicing of fruits/vegetables with pulp removal increases caloric concentration*</td>
<td>Juicing of fruits/vegetables without pulp removal*</td>
<td>30 g serving of nuts/day. Portion control is necessary to avoid weight gain.†</td>
</tr>
<tr>
<td>Southern diets (added fats and oils, fried foods, eggs, organ and processed meats, sugar-sweetened drinks)</td>
<td>Gluten-containing foods (for people without gluten-related disease)</td>
<td>Green leafy vegetables have significant cardioprotective properties when consumed daily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plant-based proteins are significantly more heart-healthy compared to animal proteins</td>
</tr>
</tbody>
</table>

Thank You!

Questions?