Beef Consumption is Positively Correlated to Mid-Arm Muscle Area in Older Adults in Ohio

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ABSTRACT

Background: Older adults are at risk of developing sarcopenia, the loss of muscle mass during aging. This condition can increase disability and decrease function, strength, and quality of life. Additionally, older adults are at risk of nutritional deficiencies such as protein, vitamin B12, and zinc. Beef is a naturally nutrient-rich food that may help to prevent some of these health concerns.

Objective: To determine the relationship of beef intake to nutrition status, body composition, and strength, and biochemical measures of vitamin and mineral status, inflammation and blood lipids in older adults in Ohio.

Design: 142 older adults completed a Diet History Questionnaire, and questionnaires related to nutrition status, activity, and mental status. Subjects also underwent measurements of body composition and strength, and a subset took part in a blood draw to determine biochemical measurements.

Results: Beef intake was positively correlated to muscle mass as measured by mid-arm muscle area (R = 0.128, P = 0.030), and was not associated with overall nutrition status as measured by the Mini Nutrition Assessment (MNA), or other measurements of body composition and strength. Beef consumption was not associated with biochemical measures of zinc, vitamin B12, or inflammation. Beef intake was negatively correlated to total (R = -0.179, P = 0.035) and HDL (R = -0.247, P = 0.004) cholesterol but not LDL cholesterol or triglycerides.

Conclusions: Beef intake was positively associated with mid-arm muscle area, a predictor of muscle mass, in older Ohioans. Consuming beef in moderation may be a healthy way in which older adults can preserve muscle mass and decrease the risk of sarcopenia.

BACKGROUND AND SIGNIFICANCE

• Older adults are the most rapidly growing segment of the population in the United States. Older adults are expected to constitute 19.6% of the population by the year 2050 (Centers for Disease Control).

• Older adults are at increased risk of protein deficiency as well as zinc and vitamin B12.

• One-third of people over the age of 60 are not consuming the recommended 0.8 grams of protein per kilogram body weight per day (USDA Survey of Food and Nutrient Intakes by Individuals).

• Adequate dietary protein may help preserve muscle mass, which progressively decreases with increasing age. This decrease in muscle mass, termed sarcopenia, has been associated with decreased functional status, increased disability, and decreased quality of life (1).

• Beef is a high source of all of these nutrients. A three-ounce serving of beef provides 50% RDA for protein, 39% RDA for zinc, and 37% RDA for vitamin B12. Beef is a naturally nutrient-dense food that may potentially help older adults decrease their risk of several nutrient deficiencies.

RESEARCH SUPPORT

This research was supported by the United States Department of Agriculture and the Ohio Agricultural Research and Development Center.

SUBJECTS AND METHODS

Subjects: 142 ambulatory, free-living older adults from Ohio between the ages of 60 and 88. Biochemical measures were completed on 56 subjects.

Methods:

- Diet History Questionnaire (DHQ)
- Nutrition Status
- Mini Nutrition Assessment (MNA)
- Anthropometry
- Height (cm), Weight (kg), BMI (kg/m²)
- Midarm Circumference (MAC, cm)
- Triceps skinfold (TSF, mm)
- Midarm Muscle Area (MAMA, cm²)
- MAMA equations:
  - Females: [(MAC – π × TSF) / 4 n] – 6.5
  - Males: [(MAC – π × TSF) / 4 n] – 10.0
- Calf circumference (CC, cm)
- Sagittal abdominal diameter (SAD, cm)
- Activity
- Modified Baecke Questionnaire for Older Adults
- Pedometer
- Handgrip strength (kg)
- Short Orientation-Memory-Concentration Test
- Geriatric Depression Scale
- Perceived Social Support Scale
- Biochemical Measurements
  - Vitamin B12 status (serum vitamin B12)
  - Zinc status (plasma zinc, 5-nucleotidase)
  - Blood lipids (TC, LDL, HDL, TG)
  - Liver enzymes (AST, ALT)
  - Inflammation (TNF-α, IL-6).

Statistical Analysis:

- Kendall’s tau (non-parametric correlation coefficient used for abnormal data distribution) - correlations of the various parameters to beef consumption
- Pearson’s correlation coefficient - correlations of the various parameters to protein intake
- Multiple linear regression models - relationship between beef consumption, protein intake, and various health outcome measures

RESULTS

<table>
<thead>
<tr>
<th>Response Variable</th>
<th>Correlation with Beef Intake</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MNA</td>
<td>0.169</td>
<td>0.751</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>0.056</td>
<td>0.328</td>
</tr>
<tr>
<td>CC (cm)</td>
<td>0.053</td>
<td>0.354</td>
</tr>
<tr>
<td>SAD (cm)</td>
<td>0.076</td>
<td>0.186</td>
</tr>
<tr>
<td>MAMA (cm²)</td>
<td>0.039*</td>
<td>0.030*</td>
</tr>
<tr>
<td>Handgrip (kg)</td>
<td>0.052</td>
<td>0.365</td>
</tr>
<tr>
<td>TC (mg/dl)</td>
<td>-0.179*</td>
<td>0.035*</td>
</tr>
<tr>
<td>HDL (mg/dl)</td>
<td>-0.247*</td>
<td>0.004*</td>
</tr>
<tr>
<td>LDL (mg/dl)</td>
<td>-0.146*</td>
<td>0.004*</td>
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<tr>
<td>ALT (U/L)</td>
<td>0.139</td>
<td>0.112</td>
</tr>
<tr>
<td>AST (U/L)</td>
<td>-0.019</td>
<td>0.828</td>
</tr>
<tr>
<td>IL-6 (pg/ml)</td>
<td>0.055</td>
<td>0.556</td>
</tr>
<tr>
<td>TNF-α (pg/ml)</td>
<td>0.009</td>
<td>0.921</td>
</tr>
<tr>
<td>Vitamin B₁₂ (pg/ml)</td>
<td>-0.121</td>
<td>0.153</td>
</tr>
<tr>
<td>Zinc (µg/ml)</td>
<td>-0.048</td>
<td>0.866</td>
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<tr>
<td>5'-Nucleotidase (U/L)</td>
<td>-0.003</td>
<td>0.987</td>
</tr>
<tr>
<td>Hemoglobin (g/dl)</td>
<td>0.002</td>
<td>0.280</td>
</tr>
<tr>
<td>Ferritin (ng/ml)</td>
<td>-0.091</td>
<td>0.350</td>
</tr>
<tr>
<td>Transferrin Receptor (nmol/ml)</td>
<td>0.159</td>
<td>0.086</td>
</tr>
</tbody>
</table>

Conclusions:

Mid-arm muscle area (MAMA) was significantly and positively correlated to beef consumption in older adults, even after accounting for the effects of protein intake, age, gender, activity and consumption of all meat, fish, and poultry. In contrast, beef consumption was not associated with changes in biochemical markers or anthropometric measurements. Calf circumference and MNA scores, although not correlated to beef consumption, were correlated to percentage of kilocalories consumed in the form of protein.

Dietary guidance from health professionals working with older adults has advocated limiting red meat consumption, thus restricting the variety of protein sources available to those who choose to follow a healthy diet. Previous research suggests that diets including moderate amounts of lean beef do not increase risk of chronic disease (2) and therefore indicate that beef can be encouraged as one option for meeting protein needs. Beef is a naturally nutrient-rich food that can be included in the diet in moderation for older adults. Our study supports this recommendation by demonstrating that red meat may aid in maintaining muscle mass, without adversely affecting other biochemical or anthropometric measurements in older adults.

REFERENCES


FIGURE 1: Histogram of average daily beef consumption of older adults in Ohio as measured by the Diet History Questionnaire

FIGURE 2: Scatterplot of the relationship between average daily beef consumption and mid-arm muscle area for older adults in Ohio (R=0.128, p=0.030).