Dietary CLA Intake in Humans
What do we know? What should we know?

Shelley McGuire, Ph.D.
Department of Food Science and Human Nutrition
Washington State University, Pullman, WA USA

Mark McGuire, Ph.D.
Department of Animal and Veterinary Sciences
University of Idaho, Moscow, ID USA
Parodi (1977) identified CLA in cow’s milk.
CLA is found naturally in foods from ruminant animals
  – Smaller amounts in other meats and oils (?)
Most publications documenting CLA content of foods have focused on beef and dairy products.
CLA supplements now also being consumed.
Food Frequency Questionnaires

- Estimates *chronic* intakes of individuals
- Asks “do you eat **cheese**?; how often?; how much?”
- Limited by
  - Completeness of questionnaire
  - Ability of person to recall accurately
  - Adequacy of nutrient database for foods
Methodologies, cont.

- Weighed, Written Diet Records (usually 3 d)
  - Record of *current* intake
  - More difficult for subjects
    - May change intake behaviors
    - Difficult for children
  - Completeness and accuracy of nutrient database key
Chemical Analysis of Food Duplicates (3 d)
- Gold Standard
- Most labor intensive for subjects
  - May change intakes (collecting food is not easy or convenient)
  - Difficult for children
- More expensive
- Accuracy limited by ability to chemically analyze composite foods.
<table>
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<th>Nation</th>
<th>Subjects</th>
<th>Method</th>
<th>CLA Intake (mg/d)</th>
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<tr>
<td>Australia</td>
<td>Adults</td>
<td>NR</td>
<td>500-1000</td>
<td>Parodi, 1994</td>
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<tr>
<td>U.S.</td>
<td>Adults</td>
<td>NR</td>
<td>1000</td>
<td>Ip, 1994</td>
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<td>Diet records</td>
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<td>Salminen, 1998</td>
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<td>Adults, Low Dairy</td>
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<td>90</td>
<td>“</td>
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<td>College-Aged Females</td>
<td>“”</td>
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<td>Lactating Women, High Dairy</td>
<td>Diet records</td>
<td>291</td>
<td>Park, 1999</td>
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<td>Lactating Women, Low Dairy</td>
<td>“”</td>
<td>15</td>
<td>“</td>
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<tr>
<td>Finland</td>
<td>Adult Women</td>
<td>FFQ</td>
<td>132</td>
<td>Aro, 2000</td>
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</tbody>
</table>
Effect of Methodology on Estimates

Subjects
- Males; $n = 46$; age: 32 ± 2 yr
- Females; $n = 47$; age: 30 ± 2 yr
- Healthy, free-living
- Methods used
  - Food frequency questionnaire
  - 3-d weighed, written food records
  - Biochemical analyses of 3-d food duplicates

Ritzenthaler et al., *Lipids*, 2001
“Total CLA” and c9,t11-CLA (rumenic acid; RA) content of foods obtained from published (n = 9) and unpublished data.

Data entered into computerized dietary assessment program

- Food Processor®, ESHA Research, Salem, OR
- 190 food items
Dietary Sources of CLA
Written Food Records

- Dairy: 60%
- Beef: 32%
- Pork/Poultry/Other: 8%

This, of course, reflects nature of database.

Ritzenhaler et al., *Lipids*, 2001
Estimates by Methodology
“Total CLA”

Same differences found for RA

Ritzenthaler et al., Lipids, 2001
Some Conclusions

- Majority of CLA/RA from dairy products.
- Males consumed more than females.
- Written records and FFQ underestimated intakes.
  - Under-reporting on written records and FFQ?
  - Inadequate CLA/RA database?
- What about other age groups?
CLA Intakes in Early Life. Why Should We Care?

Major focus of my research program. Dietary “programming” during growth and development?
Breast cancer may be initiated prenatally or in early life.
  – de Waard et al., 1988; Anbazhagan et al., 1994

CLA (specifically RA) consumption during “adolescence” in rats has lasting impact on ↓ risk of mammary cancer.
  – Ip et al., 1995,1997,1999

Maternal consumption of linoleic acid during pregnancy ↑ risk for mammary cancer in female offspring.
Breastfeeding and Breast Cancer

Having been breastfed ↓ risk of mammary cancer in later life (baby)
- Titus-Ernstoff et al., 1998
- Increased exposure to anticarcinogenic lipids like CLA?

Breastfeeding ↓ risk of mammary cancer (mom)
- Ing et al., 1977; McTiernan et al., 1986; Yoo et al., 1992; Siskind et al., 1989; Newcomb et al., 1994
- Increased exposure of breast tissue to anticarcinogenic lipids like CLA?

Summary: lactation/breastfeeding may impart protection against mammary cancer for mom and infant.
CLA Intake by Infants

Myriad CLA isomers in human milk
CLA in human milk, but not infant formula sold in U.S.
- McGuire et al., Nutr Res 1999
Estimates of Human Milk CLA

CLA (mg/g lipid)

- Australia, Hare Krishna
- Australia
- Germany
- US
- US, high dairy
- US, low dairy
- US
Nutritional Regulation of Infant CLA Intake

Maternal CLA consumption $\rightarrow$ ↑ human milk CLA.

- High dairy fat
  - Park et al., *Lipids*, 1999
  - Anderson et al., *FASEB*, 2002
- CLA supplements
  - Masters et al., *Lipids*, 2002
- CLA-enriched cheese
  - Ritzenthaler et al., *FASEB*, 2002

Infant CLA consumption related to maternal diet.
CLA Intake in Breastfed Babies

Subjects
- Exclusively breastfeeding women (n = 10); healthy infants

Methods
- Complete breast expression at each nursing for 24 h
- Representative milk sample collected from each nursing session.
- Composite sample analyzed for RA
- Milk consumption estimated by 24 hr “weigh back” method
- RA intake calculated
  - milk consumption x RA concentration of milk
Breastfed Babies, results

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean ± SEM</th>
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</thead>
<tbody>
<tr>
<td>Milk RA (mg/g)</td>
<td>0.34 ± 0.09</td>
</tr>
<tr>
<td>Milk Fat (%)</td>
<td>4.05 ± 0.51</td>
</tr>
<tr>
<td>Milk Consumption (g/d)</td>
<td>790.4 ± 130.7</td>
</tr>
<tr>
<td>RA Intake (mg/d)</td>
<td>108.2 ± 34.3</td>
</tr>
<tr>
<td>RA Intake (mg/kg/d)</td>
<td>20.0 ± 8.9</td>
</tr>
</tbody>
</table>

Harrison et al., unpublished data
Subjects
- Boys ($n = 20; 10.0$ y)
- Girls ($n = 20; 10.3$ y)
- 3-d weighed, written food records
- Most data collected in summer

CLA Intake
School-Aged Children

CLA Intake RA Intake

Intake (mg/d)

Edwards et al., unpublished data
Effect of Gender on CLA Intake

Edwards et al., unpublished data

Intakes (mg/kg/d)

CLA  RA

Girls  Boys

P < 0.05
Effect of Age

\[ y = 27.015x^{-0.9733} \]

\[ R^2 = 0.1764 \]

\[ P < 0.01 \]

Edwards et al., unpublished data
Summary of Intake Data
CLA Intakes Over Lifespan
U.S. Data

Harrison et al. & Edwards et al., unpublished data; Ritzenthaler et al., 2001
CLA Intakes Adjusted for Body Weight

\[ y = -3.3431 \ln(x) + 12.693 \]

\[ R^2 = 0.7233 \]

Harrison et al. & Edwards et al., unpublished data; Ritzenhaler et al., 1999
Are we getting enough?

Ip et al., 1994
- 0.05% (of diet) provided as CLA
  ↓ mammary tumor yield (53%)
- 22.9 mg CLA/kg body wgt/d

Harrison et al. & Edwards et al., unpublished data; Ritzenthaler et al., 1999
Are we getting enough?

Aro et al., 2000

- Highest intakes of CLA (203 mg/d) associated with 60% reduction in breast cancer risk.
- 3.1 mg CLA/kg body wgt/d

Harrison et al. & Edwards et al., unpublished data; Ritzenthaler et al., 1999
Harrison et al. & Edwards et al., unpublished data; Ritzenthaler et al., 2001
Limitations to Current Knowledge

Inadequate food database

- Need more foods
  - Do we really understand CLA content of foods?
  - Example: margarine
- Need isomeric CLA concentrations
  - Can we realize biological benefits of CLA by diet?
  - Can agricultural practices be developed to aid in this goal?
  - Do we have to rely on pharmacological doses (i.e., supplements)
Limitations, cont.

Need to document intakes in meaningful ways.
- mg/g food (dry weight basis)/d
- mg/d
- mg/kg body weight/d

Better yet, need to identify biological indicators of chronic/current CLA intake
- Blood lipid fraction
- Cheek cell samples?

Diet vs. endogenous synthesis?

Continue to investigate CLA intakes throughout the lifespan.