Nutrition Environment Measures Study (NEMS)

Overview
Why study nutrition environments?

• Obesity is epidemic
• Psychological & social factors don’t fully explain diet & physical activity
• Food environments are not well understood
• Need to understand the food environment in order to develop interventions
Environments are believed to be important among the multiple levels of determinants of nutrition and physical activity.

Environmental Causes of Obesity

- Increased eating
- Decreased energy expenditure
The Rationale for NEMS

Why do a MEASUREMENT study?

→ In order to do good research, we need reliable and valid measures, yet…

→ Good measures of nutrition environments don’t exist.

→ We need to understand the practical side of measures (time, efficiency)
Soft Drink Single Serving Size, 1950 - 2002

- 8 ounces
- 12 ounces: 5¢ per oz.
- 20 ounces: 4¢ per oz.
- 42 ounces: 2.3¢ per oz.
with permission from McDonald’s Corporation
This model blends public health, health psychology, & urban planning perspectives ➔ Guides developments of measures & research priorities

Model of Community Nutrition Environments

[Glantz, Sallis, Saelens & Frank 2005]
Types of Nutrition Environments

1. Community *
2. Consumer *
3. Organizational
4. Informational

• Moderating & mediating pathways hypothesized

* Less studied; may have broad effects
Community & Consumer Nutrition Environments

- **Community nutrition environments** =
  - Type & location of food outlets
  - Accessibility (e.g., hours, drive-thru)

- **Consumer nutrition environments** =
  - Availability of healthful food choices
  - Pricing, promotion, placement
  - Information availability
In Conclusion…

- This model is a starting point
- Complex research & practice area
- Greater priority is needed for nutrition environments
• NEMS-S and NEMS-R are research-tested measurement tools

• NEMS was originally developed for research

• NEMS can be used for community assessment, advocacy, and intervention
Nutrition Environment Measures Study (NEMS)
Aims of NEMS

1. Develop measures of nutrition environments – retail & food service outlets (stores, restaurants)

2. Test the inter-rater reliability and test-retest reliability of nutrition environment measures

3. Examine sampling and generalizability issues
The Most Important Measurement Concepts:

Validity

Reliability
Validity

• Whether an instrument measures what it proposes to measure

• Measures reflect true differences in the things they intend to measure
Types of Reliability Examined in NEMS

1. Inter-rater reliability (equivalence)

2. Test-retest reliability (stability)
Reliability in NEMS

1. Inter-rater reliability:

Two raters go to same store/restaurant, same day, same time…

Do they get the same results?
Reliability in NEMS

2. Test-retest reliability:

The same rater goes to the same store/restaurant, one week apart...

Do they get the same results?

This assumes that stores don’t change that fast, but we’re not sure...It depends on measures that aren’t too subject to “random error.”
Test-Retest Reliability and Inter-Rater Reliability

- **Rater #1**
  - Test-Retest Reliability
  - Inter-Rater Reliability

- **Rater #2**
  - Test-Retest Reliability

Time 1

Time 2 (T1+1 week)
Phases of the Study

1. Pre-test

Preliminary work:
- develop measures
- test measures
- revise/improve measures for formal research purposes

Where? Atlanta neighborhoods: Decatur (high walk) & Toco Hills (low walk)
Phases of the Study (cont’d)

2. Main measurement study

Collect data to allow us to calculate test-retest reliability & inter-rater reliability in 4 neighborhoods around schools

Where? High/low walk & high/low SES neighborhoods in metro Atlanta

High walk, high SES
High walk, low SES
Low walk, high SES
Low walk, low SES
Selection of Communities & Identification of Food Outlets

- Communities selected using maps, census data, GIS
- Outlets enumerated by project staff – online directories, business directories, health department, etc.
Measures of Nutrition Environments in Stores

< Grocery Stores & Convenience Stores >

- **Availability** of healthful choices
- **Prices**
  - Compare healthy to less healthy, grocery to convenience stores, etc.
- **Quality** of fresh produce
Measures of Nutrition Environments in Stores

< Grocery Stores & Convenience Stores >

Core Categories of Foods

Milk   Ground Beef   Baked Goods
Fruits Hot Dogs Frozen Dinners
Bread Vegetables Baked Chips
Fruit Juice
Convenience Stores:
Consumer Nutrition Environment Measures
Measures of Nutrition Environments in Restaurants

< Fast-Food & Sit-Down Restaurants >

Sources of Information:
- Internet
- Menu
- Visit, observation
- Interview manager
Measures of Nutrition Environments in Restaurants

< Fast-Food & Sit-Down Restaurants >

• Availability of healthful choices
• Prices
  – Compare healthy to less healthy, fast-food vs. sit-down restaurants, etc.
• Promotion, Information
• Facilitators & Barriers
• Kid’s Menus
Restaurant Measures
Restaurant Measures:

Eat more!
NEMS Raters in the Field
# Nutrition Environment Measures Study (NEMS)

## Food Outlet Cover Page

**Rater ID:**

**Store ID:**

**Date:**

**Start Time:**

**End Time:**

**Number of cash registers:**

### Grocery Store

### Convenience Store

### Other

**Restaurant ID:**

**Site Visit**

**Date:**

**Start Time:**

**End Time:**

**Menu/Internet Review**

**Date:**

**Start Time:**

**End Time:**

**Other Visit/Interview**

**Date:**

**Start Time:**

**End Time:**

**Comments:**

__________________________________________

__________________________________________

---

**Nutrition Environment Measures Study (NEMS)**

**Cover Page**

8250013302
# Fruit

<table>
<thead>
<tr>
<th>Produce Item</th>
<th>Available Yes</th>
<th>Price</th>
<th>Unit</th>
<th>Quality</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bananas</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Apples</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Oranges</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Grapes</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Cantaloupe</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Peaches</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Strawberries</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Honeydew Melon</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Watermelon</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Pears</td>
<td></td>
<td>$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Types: [ ]

---

**Nutrition Environment Measures Study (NEMS)**

**Measure #2: FRUIT**

Rater ID: [ ]
Store ID: [ ]

- ○ Grocery Store
- ○ Convenience Store
- ○ Other

### Availability and Price

**Comments**

- Nutrition Environment Measures Study (NEMS)
- Measure  | 2: FRUIT
- Rater ID: [ ]
- Store ID: [ ]
- Date: [ ] / [ ] / [ ]
- Month: [ ]
- Day: [ ]
- Year: [ ]
- ● Red delicious
- ○ Navel
- ● Red seedless
- ○ Seedless
- ○ Anjou
- ○ Other
- ○ No

- Grocery Store
- Convenience Store
- Other

- Yes
- No

- [ ]

- Nutrition Environment Measures Study (NEMS)
- Measure  | 2: FRUIT
- Rater ID: [ ]
- Store ID: [ ]
- Date: [ ] / [ ] / [ ]
- Month: [ ]
- Day: [ ]
- Year: [ ]
- ● Red delicious
- ○ Navel
- ● Red seedless
- ○ Seedless
- ○ Anjou
- ○ Other
- ○ No

- Grocery Store
- Convenience Store
- Other

- Yes
- No

- [ ]

---

**Measure Complete** [ ]

---

0450176946
# Nutrition Environment Measures Study (NEMS)

## Measure #3: VEGETABLES

<table>
<thead>
<tr>
<th>Produce Item</th>
<th>Available</th>
<th>Price</th>
<th>Unit</th>
<th>Quality</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td></td>
<td>1 lb</td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td></td>
<td></td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Sweet Peppers</td>
<td></td>
<td></td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td></td>
<td></td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Lettuce</td>
<td></td>
<td></td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Corn</td>
<td></td>
<td></td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Celery</td>
<td></td>
<td></td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Cucumbers</td>
<td></td>
<td></td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td></td>
<td></td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Cauliflower</td>
<td></td>
<td></td>
<td>Yes</td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

11. Total Types: [ ]
### Nutrition Environment Measures Study (NEMS)
#### MEASURE #5: HOT DOG

**Availability and Price**

<table>
<thead>
<tr>
<th>Item</th>
<th>Available</th>
<th>Price/pkg.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Healthier option:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Oscar Mayer Fat-free Wieners (turkey/beef)</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>2. Fat-free other brand</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>3. Light Wieners (turkey/pork)</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>4. Light beef Franks (1/3 less calories, 50% less fat)</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>5. Turkey Wieners (1/3 less fat)</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>6. Other</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td><strong>Regular option:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Oscar Mayer Wieners (turkey/pork/chicken)-regular</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td><strong>Alternate Items:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Beef Franks (regular)</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>9. Other</td>
<td></td>
<td>$</td>
<td></td>
</tr>
</tbody>
</table>
# Nutrition Environment Measures Study (NEMS) MEASURE #10: BAKED CHIPS

**Rater ID:**

**Store ID:**

**Date:**

- **Month:**
- **Day:**
- **Year:**

**Availability & Price**

Low-fat chips =<3g fat/serving

<table>
<thead>
<tr>
<th>Item</th>
<th>Available</th>
<th>Price</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy Option:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Baked Lays Potato Chips</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 1/8 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>5 1/2 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>2. Alternate Item:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>2 3/4 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>5 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>3. # of varieties of low-fat chips (any brand)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Regular Option (select most comparable size to healthier option available):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Lays Potato Chips Classic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>2 3/4 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>5 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>5. Alternate Item:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1/2 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>2 3/4 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
<tr>
<td>5 oz.</td>
<td></td>
<td>$</td>
<td></td>
</tr>
</tbody>
</table>
Findings
• **88 Stores** (90.6% completion rate)
  – 24 grocery stores
  – 64 convenience stores
  – 16-27 stores per neighborhood

• **301 Restaurants**
  – 217 restaurants assessed:
    • 102 fast food (99% completion rate)
    • 115 sit-down (100% completion rate)
  – 129 SDR’s in high-walk, high-income area
    • Sample of 40
High Income/
High-Walkability
High Income/Low-Walkability
# Inter-Rater Reliability of NEMS Store Observations

<table>
<thead>
<tr>
<th>Variable/Indicator</th>
<th>Inter-Rater Reliability (2 raters, same day)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% agreement</td>
<td>Kappa/V</td>
</tr>
<tr>
<td>Any fruit – availability</td>
<td>96.47%</td>
<td>.93</td>
</tr>
<tr>
<td>Any vegetables – availability</td>
<td>100%</td>
<td>1.00</td>
</tr>
<tr>
<td>Baked chips</td>
<td>96.47%</td>
<td>.92</td>
</tr>
<tr>
<td>Lean ground beef</td>
<td>98.82%</td>
<td>.96</td>
</tr>
<tr>
<td>100% Whole grain bread</td>
<td>92.94%</td>
<td>.83</td>
</tr>
<tr>
<td>Skim/Low-fat milk</td>
<td>100%</td>
<td>1.00</td>
</tr>
<tr>
<td>Hot dogs (regular vs. fat-free)</td>
<td>100%</td>
<td>1.00</td>
</tr>
<tr>
<td>Reduced- calorie frozen dinner</td>
<td>100%</td>
<td>1.00</td>
</tr>
<tr>
<td>Low-fat baked goods</td>
<td>95.29%</td>
<td>.88</td>
</tr>
</tbody>
</table>

*a Cramer’s V statistic was used when Kappa could not be computed due to asymmetric rater response dimensions*
## Test-Retest Reliability of NEMS Store Observations

<table>
<thead>
<tr>
<th>Variable/Indicator</th>
<th>Test-retest Reliability (1 rater, 2 weeks apart)</th>
<th>% agreement</th>
<th>Kappa/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any Fruit – availability</td>
<td></td>
<td>92.68%</td>
<td>.85</td>
</tr>
<tr>
<td>Any Vegetables – availability</td>
<td></td>
<td>96.34%</td>
<td>.91</td>
</tr>
<tr>
<td>Baked chips</td>
<td></td>
<td>95.12%</td>
<td>.89</td>
</tr>
<tr>
<td>Lean ground beef</td>
<td></td>
<td>98.78%</td>
<td>.96</td>
</tr>
<tr>
<td>100% Whole grain bread</td>
<td></td>
<td>90.24%</td>
<td>.75</td>
</tr>
<tr>
<td>Skim/low-fat milk</td>
<td></td>
<td>97.56%</td>
<td>.95</td>
</tr>
<tr>
<td>Hot dogs (regular vs. fat-free)</td>
<td></td>
<td>98.78%</td>
<td>.95</td>
</tr>
<tr>
<td>Reduced calorie frozen dinners</td>
<td></td>
<td>98.78</td>
<td>.96</td>
</tr>
<tr>
<td>Low-fat baked goods</td>
<td></td>
<td>93.90%</td>
<td>.84</td>
</tr>
</tbody>
</table>

*a* Cramer’s V statistic was used when Kappa could not be computed due to asymmetric rater response dimensions.
Grocery Stores vs. Convenience Stores: Availability of Fruit & Vegetables

**Types of Fruit**

<table>
<thead>
<tr>
<th>G.S.</th>
<th>C.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

**Types of Vegetables**

<table>
<thead>
<tr>
<th>G.S.</th>
<th>C.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>
Grocery Stores vs. Convenience Stores: Availability of Fat-Free Hot Dogs & Baked Chips

- Fat-Free Hot Dogs: G.S. 35% vs. C.S. 0%
p < .001

- Varieties of Baked Chips: G.S. 1.5 vs. C.S. 0.5
p < .01
High- vs. Low-Income Neighborhoods: Availability of Fruits & Vegetables

- Types of Fruit
  - Hi SES: 5
  - Low SES: 2
    - p < .01

- Types of Vegetables
  - Hi SES: 5
  - Low SES: 2
    - p < .01
High- vs. Low-Income Neighborhoods: Availability Fat-Free Hot Dogs & Baked Chips

- Fat free Hot Dogs: n.s., trend
  - Hi SES: 25%
  - Low SES: 5%

- Varieties of Baked Chips:
  - Hi SES: 1.6
  - Low SES: 0.8
  - p < .01
Shelf Space

Skim Milk vs. Full-Fat Milk

40% of shelf space was occupied by skim milk

This percentage was found to be higher in grocery stores & high SES areas
Cost Comparisons

Fruits (Bananas)

Bananas cost 32% more in convenience stores than in grocery stores.

\[ \frac{.62}{.47} = 132\% \text{ CS/GS (p<.001)} \]

Milk

The difference in cost of skim milk versus full fat milk was not significant.

\[ 0.99 = \text{ratio skim/full fat milk} \]
Cost Comparisons

Hot Dogs
Lean franks cost 15% more than regular-fat franks

Ground Beef
Lean meat costs 55% more than regular-fat

Chips
Low-fat chips cost 31% more than regular-fat

Juice
100% juice costs 53% more than juice drink
## NEMS Composite Mean Scores for Healthy Nutrition Environments in Stores

<table>
<thead>
<tr>
<th></th>
<th>Grocery Stores (n=24)</th>
<th>Convenience Stores (n=61)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>17.33</td>
<td>3.54</td>
</tr>
<tr>
<td>Price</td>
<td>0.13</td>
<td>1.54</td>
</tr>
<tr>
<td>Quality</td>
<td>5.13</td>
<td>0.077</td>
</tr>
<tr>
<td><strong>Total</strong>*</td>
<td>22.58</td>
<td>5.85</td>
</tr>
</tbody>
</table>

*Maximum possible total score is 50 points
NEMS Composite Mean Scores for Healthy Nutrition Environments in Stores

*Maximum possible total score is 50 points
## NEMS Composite Mean Scores for Stores By Neighborhood SES

<table>
<thead>
<tr>
<th></th>
<th>High Income (n=44)</th>
<th>Low Income (n=41)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Availability</strong></td>
<td>10.23</td>
<td>4.44</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>0.30</td>
<td>2.05</td>
</tr>
<tr>
<td><strong>Quality</strong></td>
<td>2.61</td>
<td>1.34</td>
</tr>
<tr>
<td>*<em>Total</em></td>
<td>13.14</td>
<td>7.83</td>
</tr>
</tbody>
</table>

*Maximum possible score is 50 points*
NEMS Composite Mean Scores for Stores By Neighborhood SES

- **Availability**
  - High income (n=44)
  - Low income (n=41)

- **Price**
  - High income (n=44)
  - Low income (n=41)

- **Quality**
  - High income (n=44)
  - Low income (n=41)

- **Total**
  - Maximum possible total score is 50 points
Restaurant Findings

Inter-Rater Reliability (% agreement):

Recording sources = 100%
Healthy choices shown = 86%
Total entrees = 78%
# Healthy entrees = 87%
Time for Completing Measures

Convenience stores
mean = 14.4 minutes; range = 10-18 min.

Grocery Stores
mean = 41.8 minutes; range = 30-66 min.

Restaurant site visits
mean = 11.5 minutes; range = 9-35 min

Menu reviews
mean = 35 minutes
## Nutrition Environment Comparisons by Restaurant Type

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sit-down (n=115)</th>
<th>Fast Food (n=102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy entrée available</td>
<td>20.9%</td>
<td>36.3%</td>
</tr>
<tr>
<td>Proportion of entrees that are healthy</td>
<td>3.2%</td>
<td>8.8%</td>
</tr>
<tr>
<td>Healthy main dish salads available</td>
<td>9.6%</td>
<td>24.5%</td>
</tr>
<tr>
<td>Proportion of healthy main dish salads</td>
<td>11.1%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Fruit available</td>
<td>11.3%</td>
<td>11.9%</td>
</tr>
<tr>
<td>Non-fried vegetables available</td>
<td>53.0%</td>
<td>26.5%</td>
</tr>
</tbody>
</table>
Kid’s Menu Review By Restaurant Type

Available

Healthy choice

100% juice

Low-fat milk

Sit-down

Fast food
Limitations

Other venues where food is sold not included

May have left out some important variables
What We DO and DO NOT Know

- Environmental vs. individual/social determinants?
- Distribution of unhealthy environments (SES, etc.)
- How much environmental change is needed?
37 states in the U.S. with 200 people trained, 2 from Canada, 1 from Netherlands and 1 from Japan
NEMS in Research

- NIK Study (Neighborhood Influences on Kids) – 40 neighborhoods in San Diego & Seattle [B. Saelens, PI; NIEHS]
- Supplement to ARIC in Baltimore [M. Franco, Johns Hopkins University]

NEMS in Practice

- Wisconsin state & local obesity prevention
- Filipino community in San Diego
Let’s build a better mousetrap...