Measurement of the Food Environment: State of the Science and Issues

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Measures of the Food and Built Environments: Enhancing Research Relevant to Policy on Diet, Physical Activity, and Weight: November 1, 2007
Purpose

- Overview: State of the science
- Reliability and Validity issues
- Data reduction issues
- Recommendations
Overview

- **NCI literature review**
  - Environments: Schools, neighborhoods (food stores and restaurants), worksites
  - Measures: Instruments, sales analysis, market basket, nutrition analysis, GIS
Overview

- NCI literature review
  - 137 articles reviewed
  - 77% since 2000
  - 60% neighborhoods
  - 32% schools
  - 8% worksites
  - 13% report some psychometric property of a measurement tool
Examining reliability and validity

- **Reliability**
  - Test-retest
  - Inter-rater
  - Cronbach’s alpha

- **Validity**
  - Face
  - Criterion
  - External
  - Discriminant
  - Predictive
What we are learning about reliability:

- Good reliability is demonstrated across most studies that report it, particularly inter-rater reliability using observational methods.

- Reliability assessments assessing quality of the environment or recognition of signage are weaker.

- Suggests that our data collection instruments, protocol and training for observers are good.
Validity in environmental measures

- **Face validity:** The tool appears to measure our concept of interest
  - Is our self-report tool assessing perceptions of the environment or perceived barriers in the environment?

- **Criterion validity:** Essential for confidence that our measurement tools accurately represent the environment
  - To what extent are the food options in the neighborhood represented in D&B data?

- **External validity:** Essential for dissemination
  - Are tools generalizable across neighborhoods?
  - Are tools generalizable across health outcomes of interest?
Validity in environmental measures

- **Discriminant validity**: Essential for the purpose of ranking or categorizing environments based on some health dimension that we care about
  - How does one neighborhood, worksite, school differ on some dimension of obesogenicity, cancer or cardiovascular risk?

- **Predictive validity**: Essential for the purposes of evaluating environmental change and for linking environment with outcomes
  - Does the tool show change in the environment?
  - Does the tool measure some factor that is related to an outcome that we care about?
What are we learning about validity of tools?

- Examples: Community and consumer nutrition environments
  - Powell, 2007
  - Giskes, 2007
  - Glanz, 2007
  - Saelens, 2007
Food access and neighborhood characteristic in the USA

- Powell, et al 2007

- First comprehensive national study of availability of food stores across the USA and associations with neighborhood characteristics

- Examined chain supermarkets, non-chain super-markets, grocery stores, and convenience stores and availability in neighborhoods (income; race; location)

- Addresses issue of external validity, uses multivariate analysis
Food access and neighborhood characteristic in the USA

Results:

- Low income neighborhoods have fewer chain supermarkets and convenience stores, and more non-chain grocery and grocery stores as compared to middle income groups.

- After controlling for neighborhood income, there are large disparities by race in the availability of chain supermarkets.

- Rural areas have fewer food stores of all types.

(Powell, et al 2007)
Limitations of the study per authors

- Geographic analysis limited to within zip codes
- Results subject to measurement error related to non-random representation of food stores in commercial data bases
- Misclassification of store types may be due to limitations in accuracy in the D&B data

(Powell et al, 2007)
Food access and neighborhood characteristic in the USA

- **Other limitations**
  - Ecological in nature: cross-sectional data
  - Potential confounders of the relationship between neighborhood characteristics, food options available and purchasing behaviors not made
  - Link between the availability of stores, people’s purchasing patterns, diet and health risks not made
Where do people get their food?

- Do people shop within their neighborhoods/zip code/mother’s zipcode?
- How far are they willing to travel to get the food that they want?
- How many and what kinds of store do they usually shop at?
- What factors influence their choices of where they get their food?
Examined the relative contribution of perceived and objective price and availability of recommended foods to household income differences in food purchasing.

Food groups examined: Bread, baked beans, fruit juice, canned fruit, milk, cheese, yogurt, ground beef, chicken, tuna, margarine, butter, cooking fat.

Data collection included individual and environmental-level data collection methods from 50 census collector districts (CCD).
Linking neighborhood characteristics with purchasing behaviors

Results:

- 14.4% shopped outside the 50 CCDs
- Lower SES groups less likely to buy recommended items
- Environmental level: Recommended choices were stocked by almost all supermarkets
- Individual level: People believed that most recommended items were available
- Perception of price differentials did not match actual price differentials

(Giskes et al, 2007)
Linking neighborhood characteristics with purchasing behaviors

- Perceived availability and price were associated with purchasing recommended foods

- Suggests that people’s behavior is influenced by their own reality

- “…raises the issue of whether the singular focus on the objective environment … is really improving our understanding about the relationship between the environment and health-related behaviors.” page 47 (Giskes et al, 2007)
Examining choice within the neighborhood: Consumer nutrition environment

- Work began with shelf inventories
- Market-basket surveys, restaurant checklists
- State of the science: NEMS-S and NEMS-R
Tools to assess the consumer nutrition environment: NEMS-S and NEMS-R

**NEMS-S (Glanz et al, 2007)**

- Created and tested a tool to assess the availability of healthy options, prices and quality within retail food stores
- 10 food categories or food items are evaluated
- Examples: Fresh fruits/vegetables; lean vs regular ground beef; whole grain versus refined bread
- Evaluated tool in 85 stores in Atlanta area (24 grocery; 64 convenience)
Tools to assess the consumer nutrition environment

NEMS-R (Saelens et al. 2007)
- Created and tested a tool to assess the availability of healthy options, prices and quality within restaurants
- 33 characteristics of “within restaurant environment” were evaluated
- Examples: Healthy entrée available; proportion of entrees that are healthy; kids meal available; baked chips available; nutrition information posted
- Evaluated tool in 217 restaurants in Atlanta area (102 fast food and 115 sit down)
Tools to assess the consumer nutrition environment

- **NEMS-S and NEMS-R (Saelens et al, 2007)**
  - Excellent development and pretesting
  - Inter-rater and test-retest reliability is excellent for both tools
  - Simple tools, feasible and lower cost option for assessing stores and restaurants
  - Simple scoring, parsimonious amount of data
  - Dissemination plan: web and training
Tools to assess the consumer nutrition environment

- **NEMS-S and NEMS-R: Discriminant and predictive validity**
  - NEMS-R: Of the 33 characteristics evaluated, fast food restaurants scored higher on being healthy in 42% of the categories and for 9 of the categories, the difference was statistically significant.
  - NEMS-S: Discriminant validity is seen between healthier options between type of stores and income levels of neighborhoods but comparisons are made between all grocery stores and convenience stores.
  - Do they have predictive validity across nutrition-related issues in communities?
  - How are they related to what people buy or the health of communities?
External validity

- Is environment, like politics, local?
- What is the external validity related to disease outcome? Is a tool to assess cancer risk also useful for obesity prevention?
- What is the external validity related to neighborhoods and communities? Will the same tool have utility across different communities?
- Are we looking for a set of tools or a process that can be used to design community and disease specific tools?
Data reduction issues
Example: IDEA/TREC

- Etiologic, longitudinal research examining factors that may influence weight gain during adolescence
- Funded by NCI as part of the TREC initiative
- A cohort of 349 youth has been recruited and the first of three measurement periods completed.
- Data are collected at multiple levels including the youth, parent, home environment, school environment and neighborhood using GIS.
School-level data collected in IDEA (n=116 schools)

- Principal survey
- Vending data
- A la carte data
- School stores
<table>
<thead>
<tr>
<th>Full Product Name (e.g., Nacho Cheese Doritos)</th>
<th>Internal Code**</th>
<th>Price</th>
<th>Package Size (oz. or g.)</th>
<th># Servings per Package*</th>
<th>Calories per Serving*</th>
<th>Fat Grams per Serving*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

* This information may need to be entered into the form after returning to the office.
** These codes will need to be entered prior to data entry.
# High School A La Carte Observation Form

**School Store Form**

Instructions: Please check the box if the associated a la carte food and beverage items are available for student purchase in the cafeteria or in the school store. This form should not include anything sold in vending machines.

<table>
<thead>
<tr>
<th>Available?</th>
<th>Food and Beverage Items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a. 100% fruit juice or 100% vegetable juice?</td>
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<tr>
<td></td>
<td>b. Sweetened beverages such as regular soda pop, sports drinks, or fruit drinks that are not 100% juice?</td>
</tr>
<tr>
<td></td>
<td>c. Diet soft drinks?</td>
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<tr>
<td></td>
<td>d. Fruit (fresh, frozen, canned, or dried)?</td>
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<tr>
<td></td>
<td>e. Breadsticks, rolls, bagels, pita bread, or other bread products?</td>
</tr>
<tr>
<td></td>
<td>f. Low-fat cookies, crackers, cakes, pastries, or other low-fat baked goods?</td>
</tr>
<tr>
<td></td>
<td>g. Cookies, crackers, cakes, pastries, or other baked goods that are <strong>not</strong> low in fat?</td>
</tr>
<tr>
<td></td>
<td>h. Low-fat or nonfat yogurt?</td>
</tr>
<tr>
<td></td>
<td>i. Pizza, hamburgers, or sandwiches?</td>
</tr>
<tr>
<td></td>
<td>j. Lettuce, vegetable, or bean salads?</td>
</tr>
<tr>
<td></td>
<td>k. Other vegetables?</td>
</tr>
<tr>
<td></td>
<td>l. French fried potatoes?</td>
</tr>
<tr>
<td></td>
<td>m. Chocolate candy?</td>
</tr>
<tr>
<td></td>
<td>n. Other kinds of candy?</td>
</tr>
<tr>
<td></td>
<td>o. Salty snacks that are low in fat, such as pretzels, baked chips, or other low-fat chips?</td>
</tr>
<tr>
<td></td>
<td>p. Salty snacks that are <strong>not</strong> low in fat, such as regular potato chips or cheese puffs?</td>
</tr>
<tr>
<td></td>
<td>q. Low-fat or fat-free ice cream, frozen yogurt, or sherbet?</td>
</tr>
<tr>
<td></td>
<td>r. Ice cream or frozen yogurt that is <strong>not</strong> low in fat?</td>
</tr>
<tr>
<td></td>
<td>s. Milk?</td>
</tr>
<tr>
<td></td>
<td>t. Water?</td>
</tr>
<tr>
<td></td>
<td>u. Other? Please specify: ___________________________</td>
</tr>
</tbody>
</table>
Data generated across the 116 schools

- 13646 products recorded in vending
- 1640 products recorded in a la carte in the middle schools
- Time to collect, enter and analyze inventory data = 250 hours, and counting....
How do we reduce data?

- What aspect of the offerings do we care about?
  - Type of food
  - Nutrient
  - Portion size per package
  - Price
  - High fructose corn syrup? Processed versus not processed?

- What is the most efficient and accurate way to obtain that nutrient data?

- What criteria do we use to categorize the foods?
  - The IOM criteria? Healthy Generations? Dietary Guidelines?
  - Do we create an overall index of healthfulness for foods combining several nutrients?
How do we reduce data?

- How do we reduce the school-level data to create some index of “Obesogenity” on which we can categorize schools?

- How might different ways of creating this index impact relationships that we find?

- What is the balance between precision and utility?
In general…

- Appreciate the complexity of the issue
  - Diet behaviors different from smoking and PA
  - Eating required for life
  - Eating involves minute by minute decisions
  - Eating is an intimate part of all cultures
  - Eating is intensely personal
It’s the environment, stupid!
Interaction of the environment, individual and social factors by restricted/unrestricted settings

Proportion of variance explained for eating behaviors

Very restricted environment

Unrestricted environment
Recommendation #1: Put the individual back into the picture and examine:

- The intersection between the physical environment, perceptions of the environment and individual behavior
- The influence of the social environment
- Potential individual and social confounders of the relationship between the food environment and neighborhood characteristics
- Environmental variables as mediators and moderators of individual health-related outcomes
Recommendation #2: Continue to improve the quality of environmental-level measures

- Agree on terminology for psychometrics of environmental measures
- Pay more attention to the discriminant, predictive and external validity of measures
- Find a balance between the desire for precision and utility
Recommendation #3: Keep a focus on the rationale for assessing the nutrition environment

- Describe environments
- Test hypotheses
  - How does the environment affect health outcomes?
  - Can we change the environment?
  - Will a change in environment improve the health of populations?
Recommendation #3 cont.

- We cannot deny that we are interested in looking at causal inferences
- “Knowing is not enough; we must apply. Willing is not enough; we must do.” (Goethe)
- How are research findings translated into policy?
Recommendation #3, cont.

- Must have stronger study designs that begin to address causality
  - Natural experiments
  - Small studies manipulating the environment and examining response
  - Harvest existing data from intervention work that has manipulated the environment
Recommendation #4: Examine issues related to data reduction

- Dietary data especially prone to this issue
- Be more transparent in data reduction decisions/assumptions
- Support methodological research
Recommendation #5: Don’t miss the forest for the trees…or the trees for the forest

- Keep our eye on the purpose of assessing the environment
- How can the information be used to improve the health of populations?