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Selecting a Measure of Dietary Intake for Children

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Common Question

I want to measure 3rd grade students' fruit and vegetable intake as the primary outcome for my study. I only have a couple of minutes, so I need to do it with one or two questions. What do you have?

(but impossible)

Diet Assessment

- Every measure has error
- Diet measures are fraught with error
- How much error can you tolerate?
 - Can you afford not to detect a true difference?
 - Can you afford not to detect a true relationship?

(For review of specific scales see: JW McClellan et al, Journal of Nutrition Education 2001, 33: S35-S48)
(For review of studies see: T Baranowski et al, Preventive Medicine 2004, 38: S1-S13)

Issues in Selecting a Method

- SPECIFIC TO YOUR STUDY -

➤ Prior Assessment

- Validity
- Reliability
- Sensitivity to change

➤ Precision

- Level of detail
- Habitual behavior
- Reactivity

➤ Appropriateness

- Developmental
- Ethnic
- Regional

➤ Implementation

- Procedures
- Conversions
- Respondent burden
- Staff burden

➤ Costs

- Financial

See Baranowski & Simons-Morton Journal of School Health 1991, 61: 195-7)

Developmental Considerations

- 0-7 years
 - Probably need a proxy reporter or observer
- 8-10 years
 - May need assistance (national surveys)
- 11-13 years
 - Cognitive capabilities not clear
- 14 years +
 - Answer like adults?

Characteristics of diet among adolescents

- Rapidly changing eating habits
- Unstructured eating (snacks, meal skipping)
- Eating away from home (31% foods)
- High levels of restrained eating

Characteristics related to diet assessment

- Increased under reporting with age
- Difficulty with time reference
- Greater under reporting among obese (high levels of overweight)
- Data collection in schools - challenging

Most of method research done in adults

- Methods usually work less well in children

Common Methods of Assessing Validity of Diet Assess

Compare against

- Observation of consumption - quantitative
 - At the food level
 - Reactive?
- Doubly labeled water - quantitative
 - Energy expenditure/intake
 - 2 weeks: urine/saliva
- Biomarkers – non quantitative
 - Nutrient specific
 - Blood sample

What do we usually want to do with dietary intake

➤ Dependent measure

- Diet intervention work? (attenuation)

➤ Classification

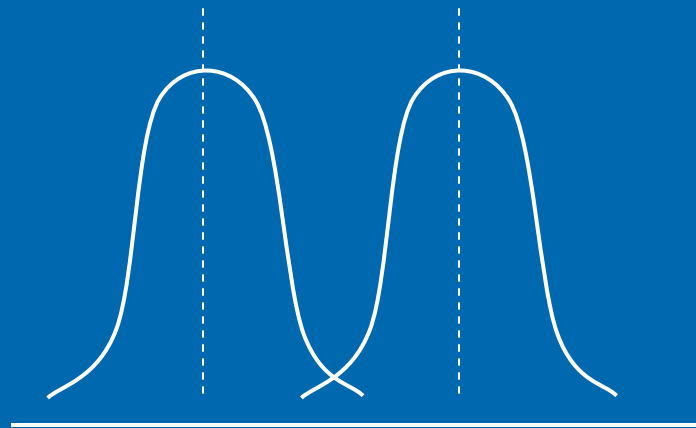
- Is this person in a high/low consuming group? (misclassification error)

➤ Correlation with other variables

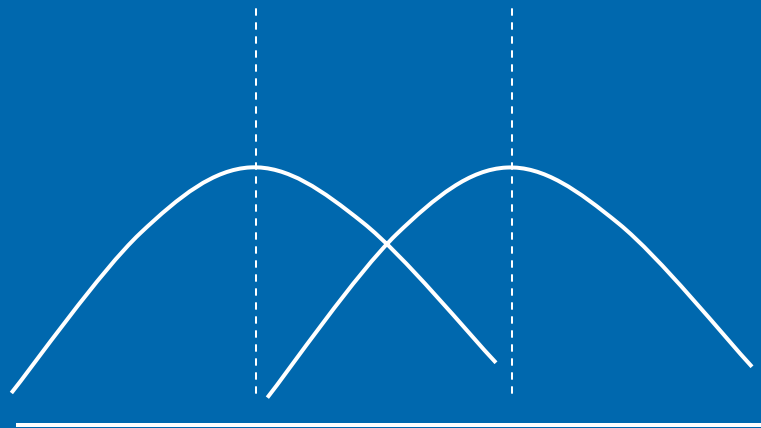
- Do children with this psychosocial characteristic eat more/less? (attenuation)

In outcome studies, unreliability reduces effective sample size

Effective sample = $n R$



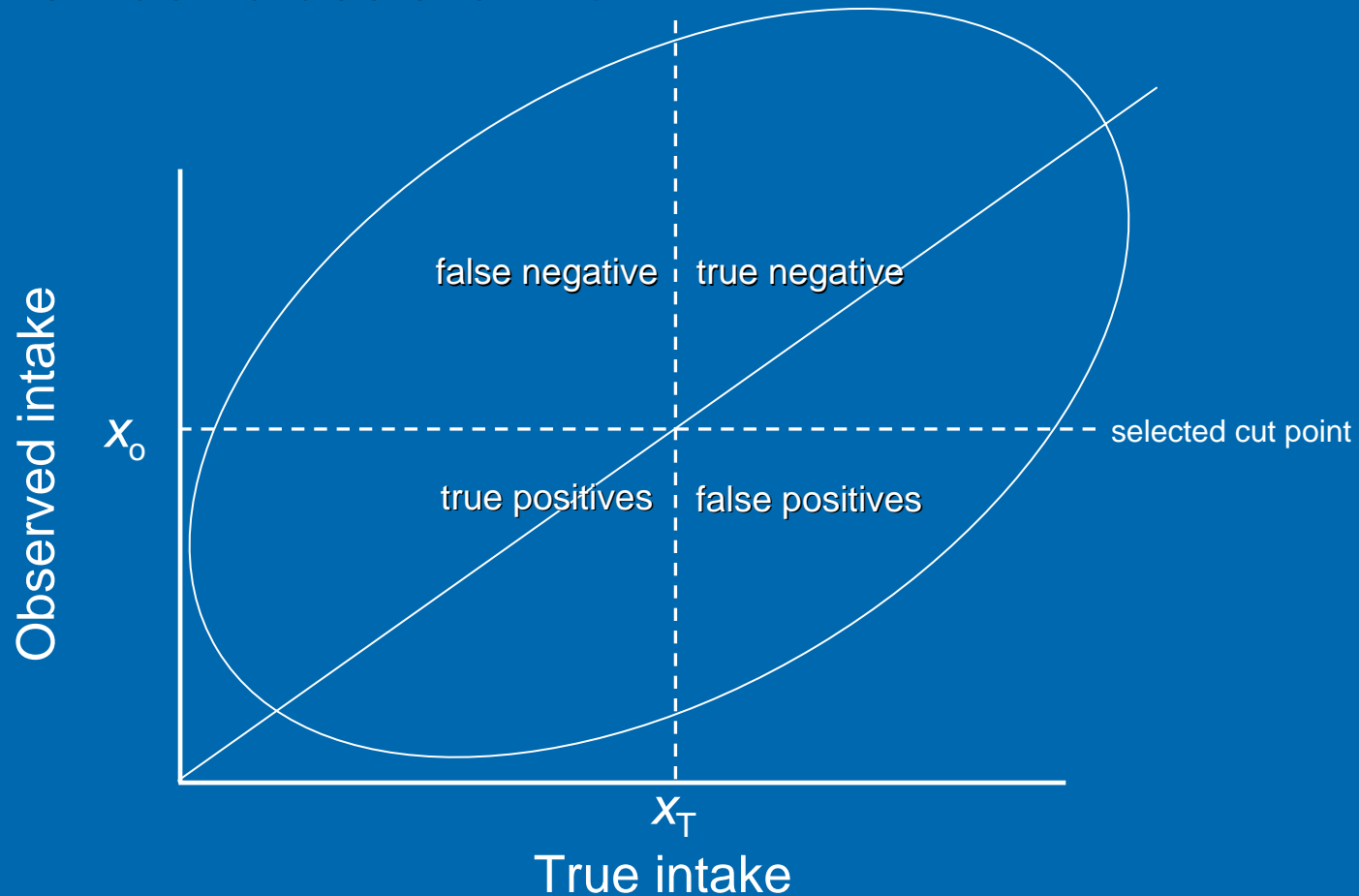
TRUE



OBTAINED

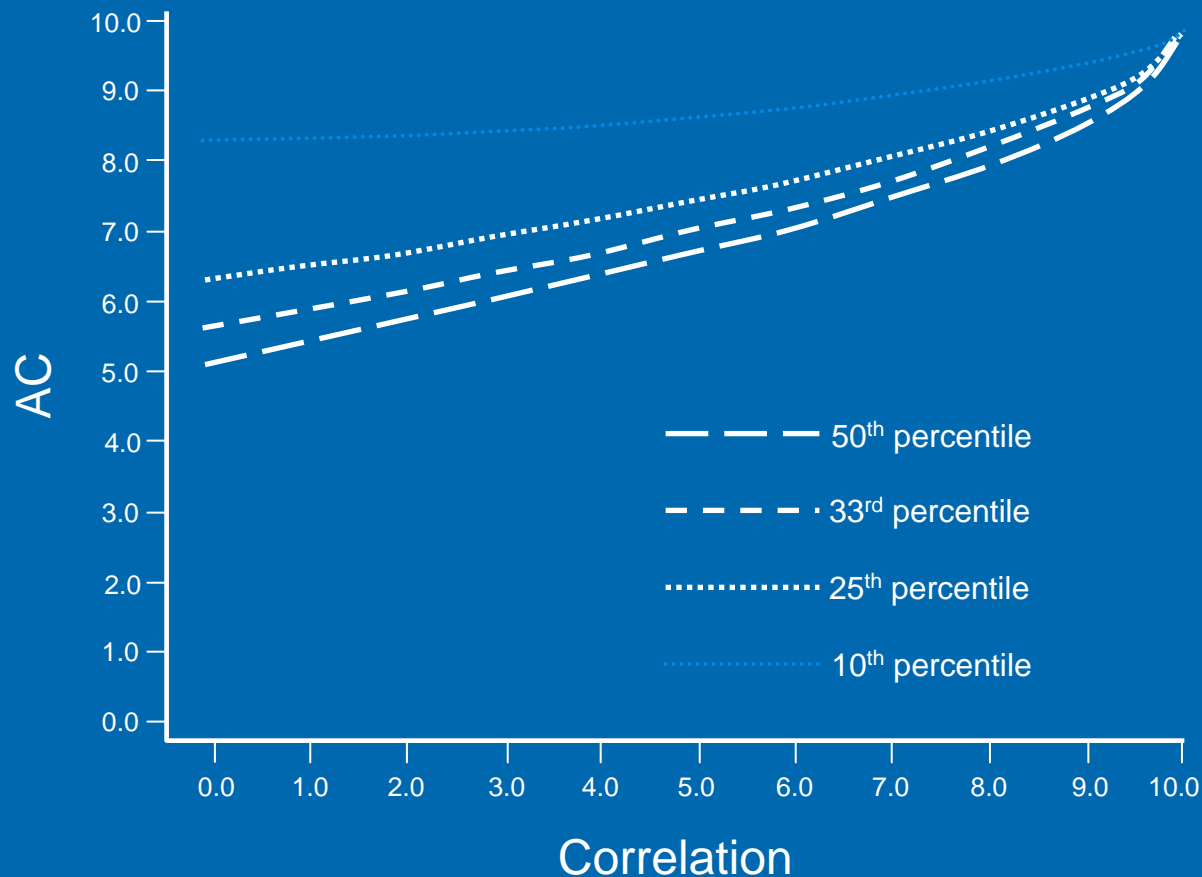
Misclassification Error

Identification of the errors of assignment of a single cut point when the true values are known



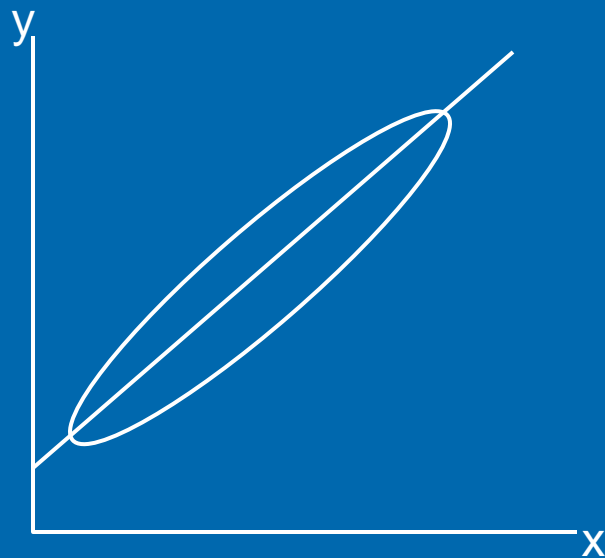
Misclassification Error

Accuracy (AC) for four percentile cut points as the correlation between true and observed values increases

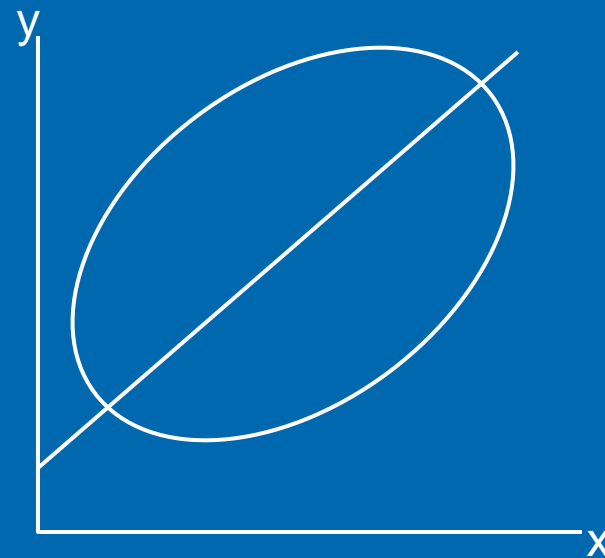


Correction for attenuation

$$r_T \sqrt{R_x R_y} = r_{xy}$$



High reliability



Low reliability

Most common tools for measuring intake

- Food Frequency Questionnaire (FFQ)
- 24 hour dietary recall
- Food Record

- Innovative Methods

Food Frequency Questionnaire (FFQ)

Time covered

- life long
- long ago
- last year
- last month
- last week

Diet assessed

- whole diet
- FV/fiber
- dietary fat
- specific
micronutrients
- portion size?

Age group

- all adults
- children specific
- seniors specific
- ethnic specific
- proxies for
young children

Strengths of the FFQ

- Assesses entire diet re: specific nutrients or food groups
- Averages across time interval (<day to day var)
- Done in a short time interval (<1hr?)
- Requires no special expertise to administer
- Straight forward conversion to foods/nutrients
- Infrequent updating of nutrient data base or foods needed

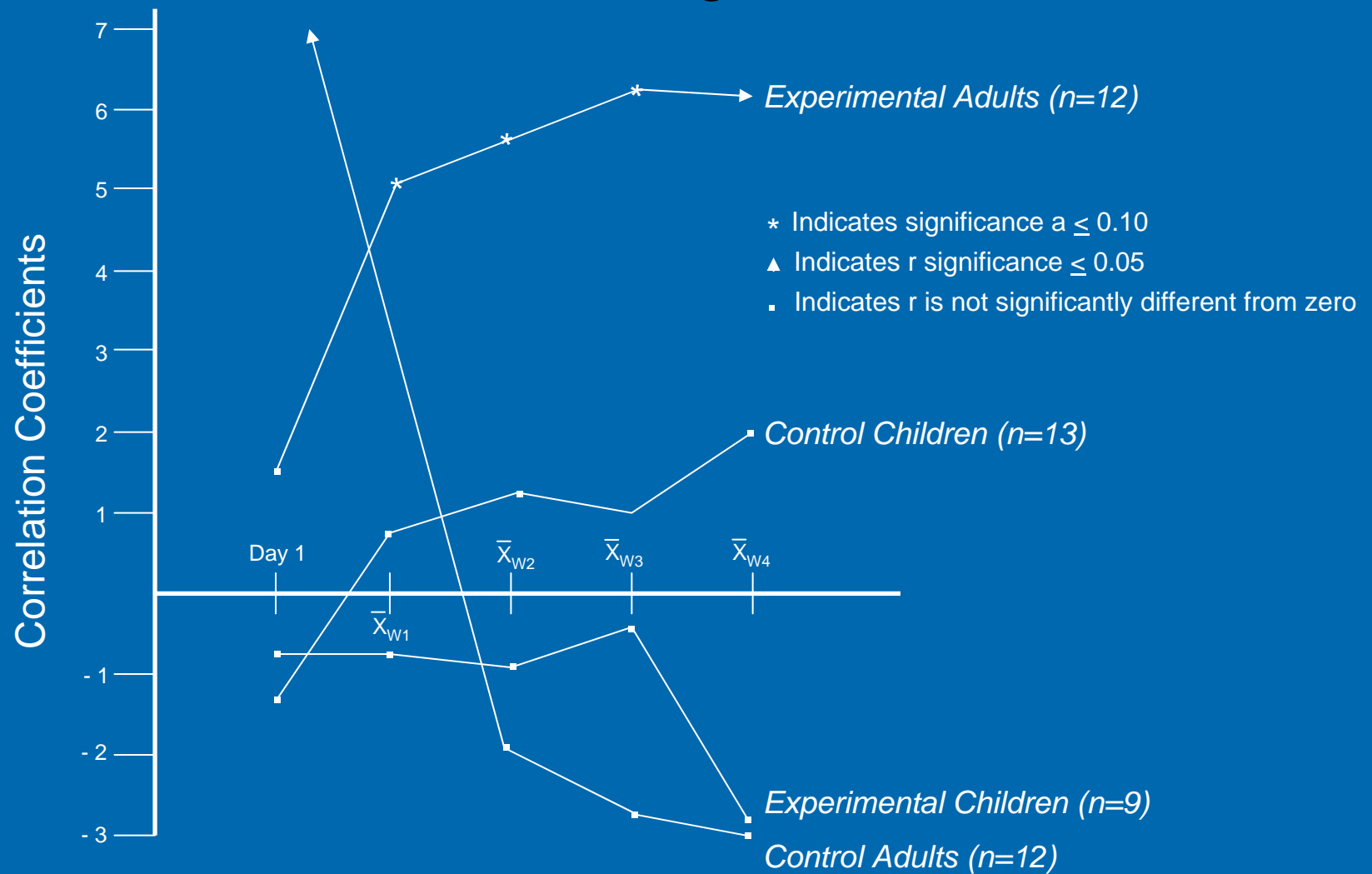
Major Method Issues

Food Frequency Questionnaire

Adults:

- Supposed to cover long time, but test retest rel is low
- Error structure
 - Correlated errors
- Longer q'naires – higher over estimation
- Requires year long memory
 - Season effects?
- Requires averaging across irregular consumption
- Portion size est. adds little
- Identify under/over reporters & modify

Correlations backward in time between a retrospective estimate of minutes of aerobic activity per day from self-monitoring forms



Usual Method of FFQ Validation

FFQ vs multiple 24hdr

- Problem: Common self report errors

OPEN (Observing Protein and Energy Nutrition) Study
(among mostly middle class adults)

| Correlations | | Men | Women |
|--------------|-------|------|-------|
| Energy | 24hdr | 0.39 | 0.24 |
| | FFQs | 0.19 | 0.10 |
| Protein | 24hdr | 0.41 | 0.26 |
| | FFQs | 0.33 | 0.22 |

OPEN Study (Subar et al)

| % Under reporting against biomarker | | Men | Women |
|-------------------------------------|-------|--------|--------|
| Energy | 24hdr | 12-14% | 16-20% |
| | FFQs | 31-36% | 34-38% |
| Protein | 24hdr | 11-12% | 11-15% |
| | FFQs | 30-34% | 27-32% |

- Under reporting increased with level of intake

When is FFQ appropriate

- Only need to determine a person's relative position in a distribution on a particular food/nutrient
 - Better for group differences
 - Will use large samples
- Time & resource limited
- An instrument has been validated for the variable of interest in the target population under similar circumstances

24 Hour Dietary Recall

Time covered

- yesterday
- last 24 hrs
- multiple recent days
- one meal/ lunch
- food recognition form

Diet assessed

- everything
- foods
- portion sizes
- add ons

Age groups

Variables possible

- foods/beverages consumed
- nutrients consumed
- meals/snacks pattern
- who was there
- when occurred
- duration of meal
- was TV on?
- where consumed
- from where did food come?

Strengths of the 24hdr

- Assesses one day with some accuracy
- Provides a more detailed data set
 - Food groups
 - By day, meal, snack
 - Nutrients
 - By day, meal, snack
 - Times eaten/duration
 - Who present
 - TV on?
 - Location of eating
 - Source of foods
 - Food practices/add ons
 - Food prep methods

Major Method Issues

24 Hour Dietary Recall

Adults:

- Need multiple days of assessment to overcome day to day variability
 - How many days?

Error is a function of time

S. Domel Baxter (JADA 1997, 97:1293-8)

4th grade students

Design:

Thursday

Observe

School

Lunch

24hdr

("same day")

(within 90 min)

Friday

24hdr

("next day")

. . .

Monday

24hdr

("after
weekend")

S Domel Baxter

| | Same Day | Next Day | After Weekend |
|------------------------------|----------|----------|---------------|
| Match Rate | 84% | 68% | 38% |
| Phantom Rate (Intrusions) | 5% | 13% | 48% |
| Omitted Rate (Forgotten) | 16% | 32% | 63% |

Can parents accurately report for their children?

Procedure Design:

Day 1

All day
observation
of child
(7am–7pm)

Day 2

Mother
proxy
24hr

Sample Design:

SES

Low

High

At home
 $\leq 4.5\text{hr}$

Not at
home
 $> 4.5\text{hr}$

Can parents accurately report for their children?

At home group: 27 of 29 could report

- Not at home group: 13 of 27 could report
- No difference by SES

Agreement & Errors of Mothers against Observation

| | All mothers | At home mothers | Not at home mothers |
|-------------------|-------------|-----------------|---------------------|
| Agreement | 65% | 67% | 62% |
| Over reporting | 10% | 9% | 12% |
| Under reporting | 18% | 19% | 16% |
| Partial Agreement | 7% | 5% | 10% |

(Baranowski et al JADA 1991, 91: 669-674)

Limitations of the 24hr

- Complicated to administer
 - Require RD, NDS cert?
- Multiple QC reviews
- Multiple non-contiguous days of assess
- Social desirability of response
- Substantial under reporting
- Takes 20-45 min/day to administer
- Benefits from NDS to prompt
- Portion size estimation problems
- Behav vs Epid Coding: What to Count?
- Complex program to est nutrients
- Regularly update program to est nutrients (20-30,000 new foods each year)
- Different software provide different nutrient estimates

Food Recognition Form

- List of foods
- Had yesterday? (yes/no)
 - by meal/snack

+++ 's easy for children to complete

- - - 's limited # of foods

only one day

no portion size

Food Records

Time covered

- multiple random days
- multiple sequential days
- one day

Diet assessed

- everything
- weighed or not?
- portion sizes
- add ons

Age groups

- “9 yot?

Variables Possible

- Same as 24hdr

Major Method Issues

Food Records

Children:

- Requires training
- Spelling problems (olivnacoqtal)
- Portion size problems – units/no referents
- Recall problems – if not done right after meal (fill out week's record in front of center)
- Needs daily supervision/prompting/review
- Substantial coding time
- Need multiple days
- If weighed – need equipment
 - takes special people

Financial Costs

- Paper copies
- Software
- Portable hardware
- Scales
- Staff time administrator
 - Dietitian
 - RA
- Staff time QC
- Data entry staff time

Biomarker solutions

- Blood sample
 - Carotenoids
- DLW – saliva
 - Total energy
- Transdermal infrared technology
 - Iron, carotenoids (machine can be trained), glucose

Surrogate Variables

- Home food availability
- Grocery store purchases receipts
- Store food availability

Statistical Manipulation

- Post adjust distributions of intake from existing methods
 - Propensity to be missing adjustment
(Carriquiry, J Nutr 2003, 133: 601S-8S)
(Baker et al, Biostatistics 2006, 7: 29-40)
 - Moment reconstruction
(Freedman et al, Biometrics 2004, 60: 172-181)

Innovations in Dietary Assessment

Technological solutions – minimal respondent burden

- Foods on trays with numbers
 - Take pictures before and after meal
 - Not catch spills/trades
- Point of purchase/service sales data
 - Supermarkets/groceries
 - Schools
 - Not consumption
 - Not who consumes

Innovations in Dietary Assessment

Technological solutions – more participant effort

- Use cell phone with video
 - Take and transmit pictures before and after meals
 - Use visual pattern recognition technique to identify foods and portions
- Use USP bar codes to identify foods
 - Queries for how much (also can be bar coded)
- Diet Self Monitoring PDA
 - Audio enhanced for children
- Prompted Momentary Time Sampling with PDA or Cell Phone

Innovations in Dietary Assessment

Technological solutions – substantial participant effort

- Computerized 24 hour dietary recall
 - Food Intake Recording Software System (FIRSt) (Baranowski et al JADA 2002, 102: 380-5)
 - ASA24 (Subar et al, 2006 abstract)
 - Moore et al (Euro J Clin Nutr 2005, 59: 809-16)
 - Teresita Hernandez
 - Zoellner et al (J Extension 2006, 44: 1-17)

Conclusions

- All measures have error
- Measures of diet have substantial error
 - Measures with children – even more error
- Tom's order or preference
 - 24hdr
 - FFQ (only if have to)
- Gadgets & widgets offer some promise for the future, but no hope now