Small devices – Big potentials
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USDA

Baylor College of Medicine

DEPARTMENT OF PEDIATRICS

NIDDK NATIONAL INSTITUTE OF DIABETES AND DIGESTIVE AND KIDNEY DISEASES

NATIONAL CANCER INSTITUTE

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Automated dietary intake assessment
Overview of technology-based methods

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Most common methods of dietary assessment

- Food frequency questionnaire (FFQ)
- Food record (FR)
- 24 hour dietary recall (24hdr)
- Nutritional biomarkers

(FE Thompson et al. J Acad Nutr Diet 2010; 110:48-51)

Common FFQ Methods

- Time interval of assessment: last year, month, week?
- Data collection instrument: list of foods, food groups
- Variables assessed: frequency of intake, usual portion size
- Conversion data: nutrients per average portion size for each food/group
- Output: average daily frequency of food group intake, average daily nutrient

$$\sum_{j=1}^{x} \sum_{i=1}^{y} freq\ xi \cdot portion\ xi \cdot nutrient\ ij$$

FFQ Strengths

- Simple, easy, covers long time interval (usual/habitual intake)
- Minimal participant burden
- Minimal staff time, professional dietary competence & training
- Correlated 0.3 to 0.8 with other measures of same constructs (is that good or not?)

FFQ Weaknesses

- Limitation of memory over time interval
- Influences of seasonality in off season
- Requires averaging/estimate of central tendency
- Doesn’t allow for variability in portion
- Assumes no intentional change in diet (e.g. dieting, illness, price)
- Variability in intake across foods in a category
- Variability in nutrients in foods within a category
- Cannot obtain info on meals

FFQ Technology Changes Over Time

- Use bubble forms/scannable
- Respond directly to computer
- Internet based with touch screen picture responses
- FIVVR – images + voice record

Most of the technology innovations do nothing to mitigate the likely sources of error.

Common FR Methods

- Food diary: record all foods & portions consumed on a selected day or over sequential days
  - Weighed FR: weigh foods before & after

FR Strengths

- If done as specified, minimizes errors of memory & attention
- If weighed: no error in portion size estimation

FR Weaknesses (1)

- FR often completed at end of day or end of week
  - Becomes a set of 24hdrs?
- Self selection bias in response to response burden
- Requires high levels of literacy, numeracy & motivation
- Problems of not knowing ingredients in foods
- Consecutive days: correlated errors

FR Weaknesses (2)

- Reactivity: may change behavior when confronted with record
  - Eat simply to avoid recording
  - Social desirability
- Costs of sophisticated staff to process the data

FR Technology Changes Over Time (1)

- Audio recording reports
- Use smartphone to take images before and after meals
- Electronic diary
- Linking a kitchen scale to a computer & identifying foods within categories

FR Technology Changes Over Time (2)

- Food bar code reader and an electronic scale & modem to transmit data by telephone
- Bar code reader with booklet of bar codes for 187 food items, type of meal, and amount eaten
- New apps for recording diet
  - Little validation research

Common 24hdr Methods

- Randomly selected nonconsecutive day: no warning
- Interviewer conducted
- Use dietary interview software: guides
- Previous day or previous 24h

24hdr Strengths

- Random days/no prior notice minimizes reactivity
- Interviewer minimizes literacy concerns
- Nonconsecutive days minimizes correlated errors

24hdr Weaknesses (1)

- Errors due to inattentiveness & memory
  - Intrusions, omissions (usual vs. yesterday)
- Errors increase with time since intake
  - Memory decay
- Portion size errors
  - Numeracy
- Only one day – not usual/habitual
  - Need multiple days – increased burden & costs

24hdr Weaknesses (2)

- If consecutive days: correlated errors
- Costs of automated systems
- Costs of training in use of system
- Cost of sophisticated staff & their time needed to collect the data (interviewing, coding, processing & quality control)

24hdr Processing Technology (1)

- Used to be all done by hand
- Compared manual processing with using software in processing
  - However, nutrient estimates vary substantially across software employed
- Automated the interview questions (enhance consistency of interview)
  - NDSR
  - USDA AMPM

2hhdr Processing Technology (2)

- Others combined FFQ + 24hdr + multiple pass
- Self administered 24hdr (for children) (FV)
  - ASA24 – computer conducted 24hdr using AM-PM
- Use smartphone to take images before and after meals
  - Have dietitians identify foods & portion sizes
  - Add voice recognition to smartphones

Common Nutritional Biomarker Methods

- Obtain biological sample (e.g. blood, urine, biopsy, hair, toenail)
- Analyze in an appropriate lab (e.g. flame spectrophotometer)

Nutritional Biomarker Strengths

- Biomarkers reflect dietary intake without errors of self report

New Biomarker Method

- Metabolomics

Nutritional Biomarker Weaknesses

- Seldom direct relationship between biomarker and intake
- Biological influences on biomarker value (e.g. smoking, adiposity)
  - Some homeostatically controlled
- Fears for providing (shot)
- Costs for collection
- Costs for analyses
- Specific to a nutrient

Long history of technology in dietary assessment

- Current goal:
  - Dietary assessment requiring no volitional effort in dietary assessment
    - One ideal: tooth implanted with sensors that identify foods during consumption
      - Throat sensor recording swallows to assess portion?
    - Second ideal: image systems that capture & record images at brief intervals throughout the day
      - Automatically
        - Identifies before & after images
        - Identifies foods
        - Identifies portion sizes

THANK YOU!

Dank u wel (Dutch)

Dêkuji! (Czech)

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