



IDAMES state of the art report on dietary assessment methods

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Objective

The objective of the present state of the art report was to provide an overview of dietary assessment methods, including those presently used within the European Union as well as innovative methods that have recently emerged, for the purpose of planning the IDAMES pilot study

Section 1:

Validation of dietary assessment methods 1990 – 2008

Section 1: Literature search method

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none">• English language, 1990 - June 2008, within the European Union• free-living, non-pregnant population• relative validity assessed	<ul style="list-style-type: none">• dietary instrument specific to certain nutrients or foods• feeding study or intervention

Search: ISI web of science, reference list checks

Keywords: diet, food, nutrition, energy, basal metabolic rate, calibration, biomarker, carotenoid, validation, urin* nitrogen, urin* potassium, fatty acid, doubly labeled water, plasma vitamin C

Biomarkers used in the majority of studies

Method	n
Food frequency questionnaires (FFQ)	66
Weighed food record (WFR)	33
Diet diary (DD)	28
24hour recall (24HR)	24
Diet history (DH)	12
Other	9

66% validated against biomarkers

34% compared to other reported dietary instruments

Biomarkers included in Section 1 review

1) Recovery:

Doubly labeled water (DLW), 24hour urinary nitrogen (U-N),
24hr urinary potassium (U-K)

2) Concentration:

Plasma β carotene, serum ascorbic acid, serum tocopherol,
serum retinol, serum/adipose tissue fatty acids

3) Replacement:

24hr urinary sodium, serum/urinary phytoestrogens

Dietary instruments relative to DLW

Author	Methods	Subjects	Results
Livingstone et al, 1990	7d WFR	16 M, 15 F, 17 – 54 y	7d WFR < DLW
Black et al, 1997	16 – 21 d WFR	28 M, 55 – 87 y 28 F, 50 – 65 y	WFR:DLW : mean ratio 0.89 (<i>r</i> 0.47)
Rothenberg et al, 1998	1 month DH	12 M & F 73 y	DH < DLW kcal by 12% (NS); DH and DLW <i>r</i> NS
Kroke et al, 1999	10 – 12x 24HR, 1 yr FFQ	75 M, 40 – 67y; 59 F, 35 - 66 y	FFQ-kcal < DLW by 22% (<i>r</i> 0.48; similar results for 24HR)

U-N: correlations with dietary instruments

Where urine samples verified as complete by PABA *

- **U-N correlated most strongly with WFR-N**
 r 0.60 - 0.79
- **DD-N vs U-N r 0.35 – 0.65; one NS exception**
- **FFQ-N vs U-N r 0.15 – 0.46**
- **24HR-N vs U-N r 0.10 – 0.91**

* Bingham and Day, 1997; Bingham et al., 1997; Daures et al. 2000, Bingham et al. 2001; Day et al., 2001; McKeown et al. 2001; Petersen et al. 1992; Bingham et al., 1995; Black et al., 1997; Kroke et al, 1999; Slimani et al, 2003

Section 2:

Review of 24 hour recalls

Section 2: Overview of 24HR

24HR method: remember and report all foods and beverages consumed in the preceding 24 hours

- Interviewer administered (face-to-face or by telephone) or self-administered (paper or web-based)
- No significant differences between telephone and face-to-face interviews (Casey et al. 1999; Jonnalagadda et al. 2000; Tran et al. 2000; Bogle 2001; Brustad et al. 2003; Baxter 2003)

Applications:

- reference method in validation/calibration studies
- estimation of population means and distributions of dietary intake

Literature search: review of 24HR

Search: MEDLINE, EMBASE, Science Citation Index, bibliographies and hand-searches

Keywords: 24-hour, method, calibration, validation, under-reporting, mis-reporting weighed records, diet records, duplicate diets, biomarker, nutrition, doubly-labeled water, urinary nitrogen, urinary potassium, plasma carotenoids

Inclusion/exclusion:

- relativity validity assessed (other dietary assessment methods, biomarkers, observation)
- no exclusion based on age, publication year, region

24HR vs DLW and U-N among adults

Energy underreported in 24HR by 3 – 26% (Lof et al., 2004; Bathalon et al., 2000; Trabulsi et al., 2001; Sawaya et al., 1996; Tran et al., 2000; Subar et al., 2003; Kroke et al., 1999; Slimani et al., 2003; Freedman et al., 2004)

Protein underreported in 24HR by 11 – 28%
(Subar et al., 2003; Kroke et al., 1999; Slimani et al., 2003)

24HR-kcal and DLW r 0.21 – 0.65

24HR-protein and U-N r 0.22 – 0.91

(Samuel-Hodge et al. 2004; Blanton et al. 2006; Bingham and Day, 2001; Gonzales et al. 1997; Johnson et al. 1998; Kroke et al. 1999; Pisani et al. 1997; Katsouyanni et al. 1997; Olafsdottir et al. 2006; Slimani et al. 2003)

24HR validity among children

DLW study:

Overreporting of EI when compared to TEE from DLW in preschool children (Montgomery et al., 2005; Olinto et al., 1994)

Observational studies:

- accuracy higher among students with packed lunch vs. purchased lunches (Warren et al., 2003)
- 67% - 78% of consumed foods were reported, 12 – 24% of remaining reported foods were not consumed during the study period (Baxter et al., 2003; Baranowski et al. 2002, Lytle et al., 1993)

Main findings from the review of 24 HR

- 24HR used in large-scale surveys like NHANES, EPIC-calibration, national dietary surveys, etc.
- structured 24HR agreed well with biomarkers and observations
- misreporting associated with: age, gender, culture, BMI, etc.
- repeat 24HR needed for adjustment for day-to-day variability
- computer-assisted repeated 24HR recommended for pan-European dietary monitoring surveys (EFCOVAL)

Section 3:

Overview of innovative dietary assessment methods

Section 3: Literature search methods

- English language articles published between 2002 and 2009
- MEDLINE, EMBASE, bibliographies, websites (e.g. NCI) and Internet search engines (e.g. Google Scholar).
- industrialized countries, excluded intervention/clinical studies.

Keywords:

Food/nutrient/dietary intake, food consumption, assessment/monitor, methods/methodology, Food Frequency questionnaire (FFQ)/diet questionnaire (DQ), Diet/food/24 Hour-recall (24HDR/24HR), Food/diet record, food/diet diary, **technically new, innovative, computer-/web-based, internet, online, digital and electronic.**

Innovative dietary assessment methods

New Method	Validation Studies	Feasibility Studies and other
PDA	5	2
Picture-sort FFQ	2	
Smart-card		3
Bar code scanner		2
Computer-tools		3
Web-FFQ	2	3
Web-24 HR		2

Personal digital assistant (1)

Wellnavi

handheld personal digital assistant with camera and mobile phone card

- digital photos of foods and drinks consumed
- display screen for inputting the ingredients of the meal
- electronic data transfer to a dietitian; real time dietary data assessment possible

Wang, D.H., et al. 2002

Wellnavi – Studies

Author	Methods	Subjects	Results for nutrient intake
Wang et al, 2006	Wellnavi vs. 1d-WFR ¹	28 F 19.3 ± 0.5 y	$r = 0.21-0.81$ + less burden & time consuming (57%)
Kikunaga et al, 2007	Wellnavi vs. 5d-WFR ¹	75 M & F 48.8 ± 10.2 y	$r = 0.34-0.78$ + underestimation

Personal digital assistant (2)

DietMatePro

PDA with integrated Web-based technology

- selection of foods from the USDA-database and specification of portion sizes
- immediate web-based transfer form dietary data, date and time of consumption
- individualization of database

Beasley et al., 2005

DietMatePro – Studies

Author	Methods	Subjects	Results for nutrient intake
Beasley et al, 2005	DietMatePro vs: 1) 24HDR ¹ 2) Weighed meal	39 M & F 53 ± 1,7 y	1) $r = 0.51-0.80$ 2) $r = 0.42-0.79$
Beasley et al, 2008	DietMatePro vs: 1) 24HDR ¹ 2) Paper-diary	174 M & F	1) $r = 0.41-0.71$ 2) $r = 0.63-0.83$

PDAAs:

Weaknesses	Benefits
<ul style="list-style-type: none">• high technical and staff requirements → expensive• training required• inaccurate estimation of portion size	<ul style="list-style-type: none">• usefully measure of individual dietary intake for a variety of nutrients• immediate data transfer• facilitated data coding• useful to reach low-literacy groups, e.g. children, elderly

Web-based method validation results

Author	Methods	Subjects	Results
Beasley et al, 2008	Web-DHQ ¹ vs: 1) PDHQ ² 2) 24 HR ³ 3) 4d-FR ⁴	218 M & F 54.9 ± 14.4 y	1) $r = 0.82$ 2) $r = 0.31$ 3) $r = 0.41$ (for nutrient intake)
Matthys et al, 2007	Web-based FFQ vs 3d-WFR ⁵	104 M & F	$r = 0.20$ to 0.64 (for food intake)

¹DHQ: Diet History Questionnaire

²PDHQ: Paper-Diet History Questionnaire

³HDR: 24 Hour dietary recall

⁴FR: food record

⁵WFR: weighted food record

Web-based FFQ characteristics

Weaknesses	Benefits
<ul style="list-style-type: none">• finite food list with often closed ended response categories• measurement error• burden & selection bias<ul style="list-style-type: none">- cognitive difficult- computer literacy	<ul style="list-style-type: none">• higher data quality<ul style="list-style-type: none">- immediate data check• less costs<ul style="list-style-type: none">- no costs for printing, postage• decreased administrative demands<ul style="list-style-type: none">- no transfer of data to an electronic format, automatic detection of incomplete or implausible answers• higher compliance of participants<ul style="list-style-type: none">- completion any time & location, reminder messages, personalized feedback, interactive help features

Hanning et al, 2007; Balter et al, 2005

Summary of the state of the art report

- WFR correlated most strongly with recovery biomarkers, followed by DD
 - concentration biomarkers less consistent ranking
- Structured 24HR performs well in large studies; repeated recalls needed
- Emerging methods tend to be web-based; feasibility studies are positive but limited validation work published

Full state of the art report available at www.idames.eu

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