

Advances in dietary assessment methodologies and tools

EuroFIR symposium April 2018

Janet Cade



What will I be covering?



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Opportunities

Nutritools

myfood24

Future...



PUBLIC RELEASE: 9-OCT-2013

40 years of federal nutrition research fatally flawed

University of South Carolina study shows flaws in NHANES data

UNIVERSITY OF SOUTH CAROLINA



 PRINT  E-MAIL

Four decades of nutrition research funded by the Centers for Disease Control and Prevention (CDC) may be invalid because the method used to collect the data was seriously flawed, according to a new study by the Arnold School of Public Health at the University of South Carolina.

‘Recent reports have asserted that, because of energy underreporting, dietary self-report data suffer from measurement error so great that findings that rely on them are of no value.’
Subar et al, J Nutr 2015;145:2639–45.

Why do we need to improve?



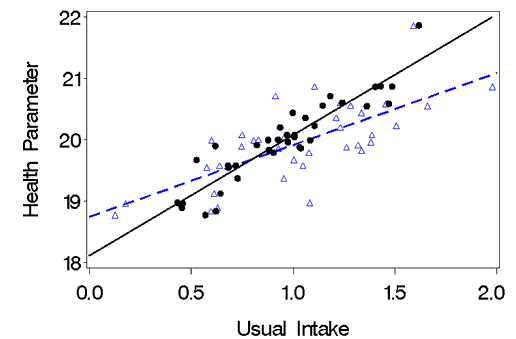
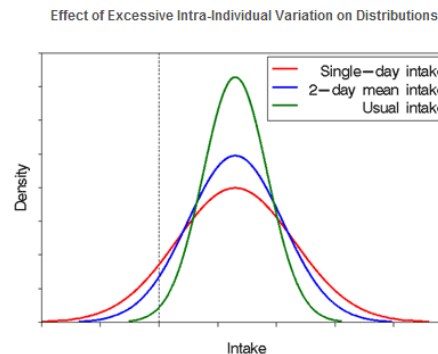
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- can't adequately answer research questions!

Reducing measurement error

Improve accuracy of usual dietary intake assessment

Strengthen associations between diet & disease



Development of Nutritools website



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Create a WIX site!



Home

Dietary Assessment Guidelines

Dietary Assessment Tools

Food Questionnaire Creator

Glossary

Useful Links

Welcome to Nutritools

Supporting dietary assessment through guidance and access to validated interactive dietary assessment tools. Funded by the UK Medical Research Council.



Best Practice Guidelines

Step-by-step guidance helping you select the best dietary assessment tool (DAT) for your research. Based on expert consensus.



Strength and Weaknesses of DATs

Compare different types of DATs to determine which DAT is the most suitable for your research.



Tool E-Library

View and access validated DATs through the Tool E-Library, which provides detailed information on the tool characteristics, validation study protocol, validation results and the special considerations of the tool.



Visualisation Plots

Compare the characteristics of the DATs, validation study design and the statistical validation data through our Bubble and Summary plots.



Food Questionnaire Creator

Create and develop new food questionnaires or use existing validated questionnaire that have been transformed from paper to web-based on the Food Questionnaire Creator (FQC). Map questions to the latest food databases for easier data collection and nutrient analysis.



Useful Links



Best Practice Guidelines



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57 experts, 2 Delphi rounds.

4 Stages: 8 questions to consider.

Define:

What you want to measure in terms of dietary intake.

Investigate:

The different types of DAT and their suitability for your research question.

Evaluate:

Existing tools to fine-tune your choice of most appropriate DAT.

Think Through:

The implementation of your chosen DATs.

What?

Characteristics of the main dietary component of interest.

Who?

Considerations around the characteristics of study participants.

When?

Time frame considerations.

Cade *et al.* *BMC Medicine* (2017) 15:202
DOI 10.1186/s12916-017-0962-x

BMC Medicine

GUIDELINE

Open Access



DIET@NET: Best Practice Guidelines for dietary assessment in health research

Janet E. Cade^{1*}, Marisol Warthon-Medina¹, Salwa Albar², Nisreen A. Alwan³, Andrew Ness⁴, Mark Roe⁵, Petra A. Wark^{6,7}, Katharine Greathead¹, Victoria J. Burley¹, Paul Finglas⁵, Laura Johnson⁸, Polly Page⁹, Katharine Roberts^{10,11}, Toni Steer⁹, Jozef Hooson¹, Darren C. Greenwood¹², Sian Robinson^{13,14}
and on behalf of the DIET@NET consortium



Tool Library – of validated tools

Tool Library

Below is a list of different filter options to help you focus on particular Tool types. Filter options are categorised in Tool Characteristics and Validation Method Characteristics.

Tool Filter

Tool Type ⁱ

- Food Diary Weighed
- Food Diary Estimated
- Food Checklist
- Dietary Recall
- Diet Histories
- Food Frequency Questionnaire

Dietary Exposure ⁱ

- Full Nutrient (Energy, Macro & Micronutrient)
- Energy
- Macronutrients
- Micronutrients
- Food Groups

Timeframe Tool Measures ⁱ

- Short
- Medium
- Long
- Multiple

Reporting Method ⁱ

- Retrospective
- Prospective
- Usual

Format ⁱ

Validation Method Filter

Sex ⁱ

- Male Only
- Female Only
- Both

Lifestage ⁱ

- Infants and toddlers
- Children
- Adolescents
- Adults
- Elderly

Comparator ⁱ

- Food Diary Weighed
- Food Diary Estimated
- Food Checklist
- 24 Hour Recall
- Diet Histories
- Food Frequency Questionnaire
- Biomarkers
- Doubly Labelled Water
- Other

Year of Tool Validation ⁱ

- 1980-89
- 1990-99
- 2000-09

Below is a list of all the identified and validated Tools. Scroll through and select a Tool to display more information.

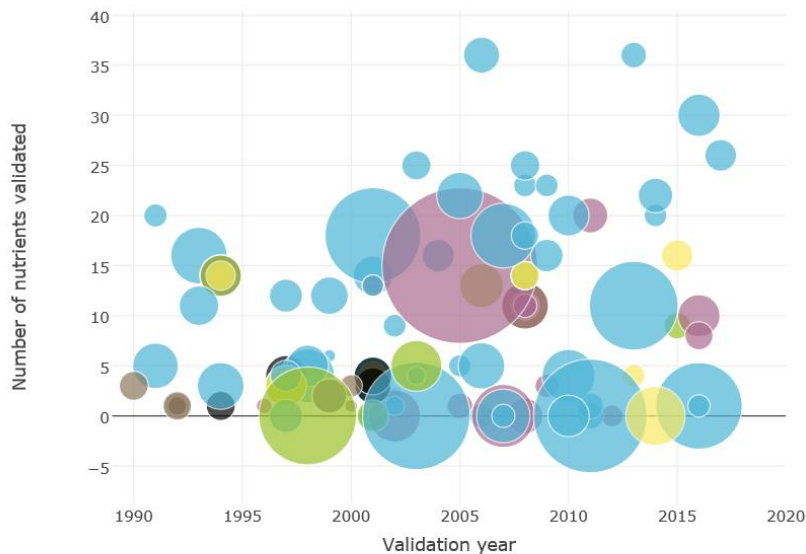
	24h Recall	Bingham	
	24h Recall	Little	
	48h Recall	Price	
	7 day Estimated Food Diary	Bingham	
	7 day Food Checklist	Bingham	
	72-hour recall (Mediterranean region of Spain)	Schröder	
	CADET	Cade	PDF FQC
	Cambridge FFQ	Bingham	
	Day in the Life Questionnaire (DILQ)	Edmunds	
	DEGS FFQ	Haftenberger	W PDF
	Diet History	Black	
	Diet History	Livingstone	
	Diet History Interview	Jackson	PDF
	Dietary Instrument for Nutrition Education (DINE)	Roe	
	Dietary Recall Questionnaire	Moore	PDF
	Dietary Targets Monitor (DTM)	Dong	W
	DietQ FFQ	Broadfield	
	Estimated Food Diary	Lanigan	W
	European Community Respiratory Health Survey-II	Hooper	



Tool Visualisation –

Compare tools visually using the bubble plot. Click on each bubble to display summary information.

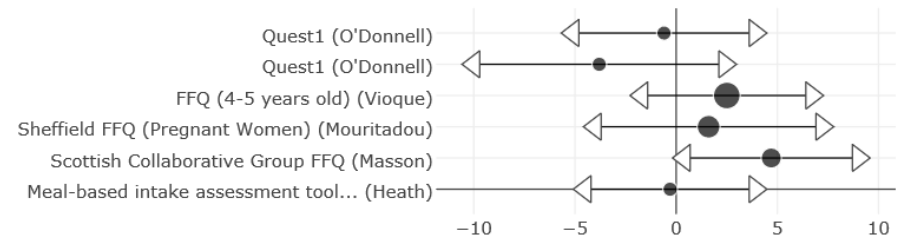
Y variable:



Colour of bubble equates to tool type, and size of bubble equates to sample size.

The summary plots are a visual approach to compare the mean difference in intakes for certain nutrients between the dietary assessment tools and the comparators used in the validation studies.

X variable:



Difference between DAT and reference method

The arrows represent the upper and lower limits of agreement and the size of the bubble equates to the sample size.

Click on the bubble or arrows to display summary information including the lifestage of the population validated, the comparator used and the specific data points of the mean difference and limits of agreement which are needed to compare the assessment tools.

Not all validation papers are included in the graph and some of the data points are median differences, click on the bubbles to find out.

Some results have been calculated using statistical techniques based on the published data. To find more information read the validation article.



Will link to NDNS food database to support selection of key foods.

Janet Cade [Log out](#)

[Home](#)

[Dietary assessment guidelines](#)

[Tools](#)

[FFQ creator](#)

[Glossary](#)

[Useful links](#)

- [Create questionnaires](#)
- [All questionnaires](#)
- [Manage projects](#)
- [All projects](#)

Calcium in children

[Questionnaire details](#)

[Response headings](#)

[Questions & portions](#)

[Portion lookup](#)

[Question mapping](#)

[Documents](#)

[Finalise questionnaire](#)

Question groups

Milk, whole

Name

Milk, whole

Milk, whole

Name

Milk, whole

Response type

Use category lookup for portions

Required to be mapped to a food table

Response heading	Questionnaire-defined portion/score	
Never	<input checked="" type="checkbox"/>	Delete heading
< 1 per month	<input checked="" type="checkbox"/>	Delete heading
1- 3 x/month	<input checked="" type="checkbox"/>	Delete heading
1 per week	<input checked="" type="checkbox"/>	Delete heading
2 - 6 x/week	<input checked="" type="checkbox"/>	Delete heading
daily	<input checked="" type="checkbox"/>	Delete heading
> 1 per day	<input checked="" type="checkbox"/>	Delete heading

Other useful information.....



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▾ Databases

▸ Food Composition Databases

▸ Specialist Databases

▸ Database Directories

▾ Food Composition Resources

- **European Food Information Resource**

Covering: what are food composition databases, how they are made and their quality and adherence to standards.



▾ Food Composition Databases

- **Foods Standards Australia New Zealand (FSANZ)**

- NUTTAB (NUTrient TABLEs for use in Australia) - Australia's reference nutrient database. Consists of 2668 foods with 245 food components.
- AUSNUT (AUStralian Food and NUTrient Database) - survey specific nutrient databases that support national nutrition surveys. Consists of 5740 foods with 51 food components.



- **The Austrian food composition table**

The ÖNWT (Austrian Nutrition Table) contains nutritional information, allergen information, synonyms and serving sizes. Consists of 8000 foods with 120 food components.



- **Belgian Food Database**

Consists of 1200 foods with 32 food components.

- **Canadian Nutrient File**

Consists of 5807 foods with 150 food components.

- **Czech Food Composition database**

The Czech Food Composition Database food record contains data on 569 food items food components. Data processed and documented in accordance with the standard procedure of the international net of excellence EuroFIR.

- **The official Danish Food Composition Database**

The Danish Food Composition Database food record contains data on 1049 food items for up to 92 food components.

! Data Systems)

Experts aiming to improve the quality, availability, reliability and



or judging the quality of data on food composition;
ful data on food composition;
on, and dissemination of new data on the composition of foods, beverages and their
loped; and
access, retrieval, interchange, and general harmonization of food composition data.

[Home](#) | [Dietary Assessment Guidelines](#) | [Dietary Assessment Tools](#) | [Glossary](#) | [Help/FAQ](#) | [Useful Links](#)

Glossary of Terms



A

Absolute Validity

The extent to which a measure exactly captures the concept it intended to reflect. This is usually assessed in comparison to a 'gold standard' measure.

Accuracy

The extent to which a measured value is close to that of the true value. Low accuracy can be a result of bias or systematic error in measurement.

Actual Nutrient Intake

Reflects nutrient intakes over a specified period of time, for example from a 24h recall or food diary. Taking into account cooking and food portion sizes. This is in comparison to usual nutrient intake which would be obtained from an FFQ asking about frequency of consumption of a list of foods.

Adjustment

Measuring diet with new technology



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Technology category	Examples
Computer	<ul style="list-style-type: none">• Web based 24h recall/diary/FFQ (eg. ASA24, myfood24)• Non web based
Mobile phone	<ul style="list-style-type: none">• Self monitoring apps (My Meal Mate; My Fitness Pal etc)• Tweets – geo location
Camera	<ul style="list-style-type: none">• Non automated cameras• Automated cameras (eg. SenseCam, DietCam)
Others	<ul style="list-style-type: none">• Consumer data ('big' data)• Bar code scanner• Wearable sensors (chewing, swallowing)

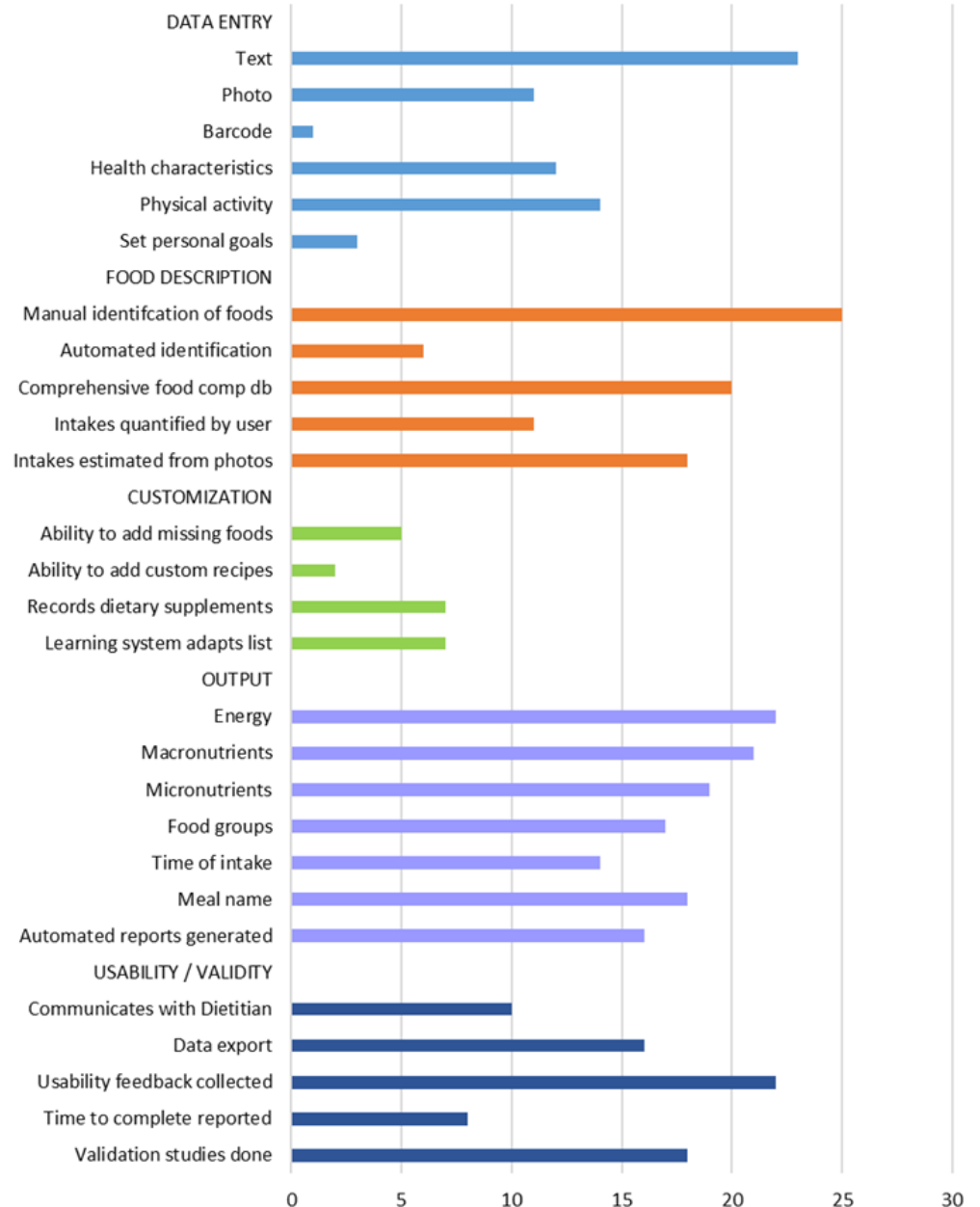
ILSI review of online tools

29 tools for measuring diet:

- 23 used manual reporting
- 11 used images
- Most reported energy and macronutrients
- Only 10 communicated with health professional
- Validation limited or not undertaken at all

Quality standards required.

Features Summary Rating: 29 Dietary Assessment Tools



myfood24

– a new tool to help researchers



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<https://www.myfood24.org/web/>

DEMO / LOGIN

CONTACT US



HOME

ABOUT US

SOLUTIONS

RESEARCH

TEACHING

HEALTH

COMMERCIAL

NEWS

**Dietary
Assessment for
Researchers and
Health
Professionals**



MyFood x

https://www.myfood24.org/food/diary

myfood 24

Food Diary Project Instructions Help? Logout

myfood24 demo

Welcome, myfood24 User44 - Please tell us everything that you had to eat and drink **yesterday** from midnight to midnight.

+ Make a List Submit Food Diary

Food Diary

Breakfast

Lunch

Evening

Snack

Drink

Clear Diary

Submit Food Diary

Food Search --- Recipe Builder

weetabix

All Recently used Saved Recipes filter by category filter by

Found 31 item(s) matching your search

Item	Brand
Weetabix	Weetabix
Weetabix Chocolate Spoonsize	Weetabix
Weetabix Crispy Minis Caramel & Nut	Weetabix
Weetabix Crispy Minis Chocolate Chip	Weetabix
Weetabix Crispy Minis Fruit & Nut	Weetabix
Weetabix Crispy Minis Honey	Weetabix
Weetabix Crispy Minis Strawberry	Weetabix
Weetabix Crispy Minis Wholegrain	Weetabix



Found 49 item(s) matching your search

Item	Brand
Rice pudding, canned	Non brand (generic) - Close Item

Select box or enter weight directly in "Total portion size"

I consumed around: Please select one

42g (1 tablespoon)	200g (average portion)	213g (small can)	425g (large can)
--------------------------	------------------------------	---------------------	---------------------

Quantity: 1.00

Total portion size: g

Select meal: Lunch

What time did you eat?:

Hide This + Add to Diary

Need a converter?

MyFood - Internet Explorer provided by MaPS Faculty
 http://demo.leeds-myfood.f.ripplefect.com/food/diary

File Edit View Favorites Tools Help

MyFood Leeds MyFood Amends D...

tonight.

Today

Breakfast

Bran Flakes
Portion: 41g

Lunch

Evening

Snack

Drink

Clear Diary

Submit myFood diary

Food Search Recipe Builder

bran flakes

category filter by brand

Brand

Non brand (generic) + Add Item

Non brand (generic) + Add Item

Tesco + Add Item

Value Bran Flakes

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Have you missed any of these items?

The food item you added is commonly consumed with:

- Yogurt, whole milk, plain
- milk, skimmed, average
- milk, semi-skimmed average
- milk, whole, average
- Sugar, white

OK



myfood24 demonstration i...

Thank You!

for participating in myfood24

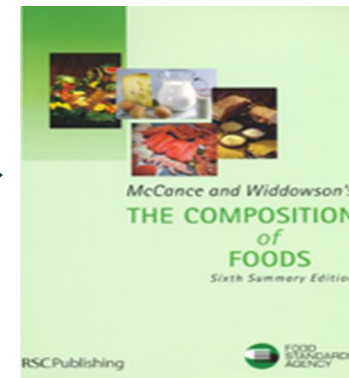
Thank you for participating in this project. You have completed your entry on myfood24 and it is now safe to close your browser.

Your Nutrient Summary	Project Consumption	Adult Reference Intake*
Energy	5,152kJ	8400KJ
Calories	1,222kcal	2000kcal
Protein	67g	44g
Fat	28g	70g
of which saturates	13g	20g
Carbohydrates	185g	250g
of which sugars	83g	90g
Fibre (AOAC)	14g	24g

Internet | Protected Mode: On

Mapped on energy, fat, protein, & carbohydrate

~45,000 items
8 nutrients



3,500 items
120 nutrients

Over 50% within 10% agreement for energy

Largest food groups mapped:

- cakes, biscuits, etc (6918 items, 18%);
- alcoholic drinks (5692 items, 15%);
- sauces & condiments (3635 items, 9%).

Brand/Code	Description	kcal	fat	prot	cho	totfat	totprot	totcarb
6178115	Farmhouse Mature Cheddar	420	34.9	25.4	0.1	0.1	21.7	0.7
100	12346	416	34.9	25.4	0.1	0.1	21.68	723
16219	Sprats, fried	415	35.0	24.9	0.0	0.0	(5.30)	240
12134	Cheese, Cheddar, average	412	34.4	25.5	0.1	0.1	21.70	670
12136	Cheese, Cheddar, Canadian	423	35.3	26.2	0.1	0.1	22.20	640
12259	Cheese, hard, average	411	34.5	24.9	0.1	0.1	21.61	687
12139	Cheese, Cheddar, New Zealand	424	35.4	26.3	0.1	0.1	22.30	630

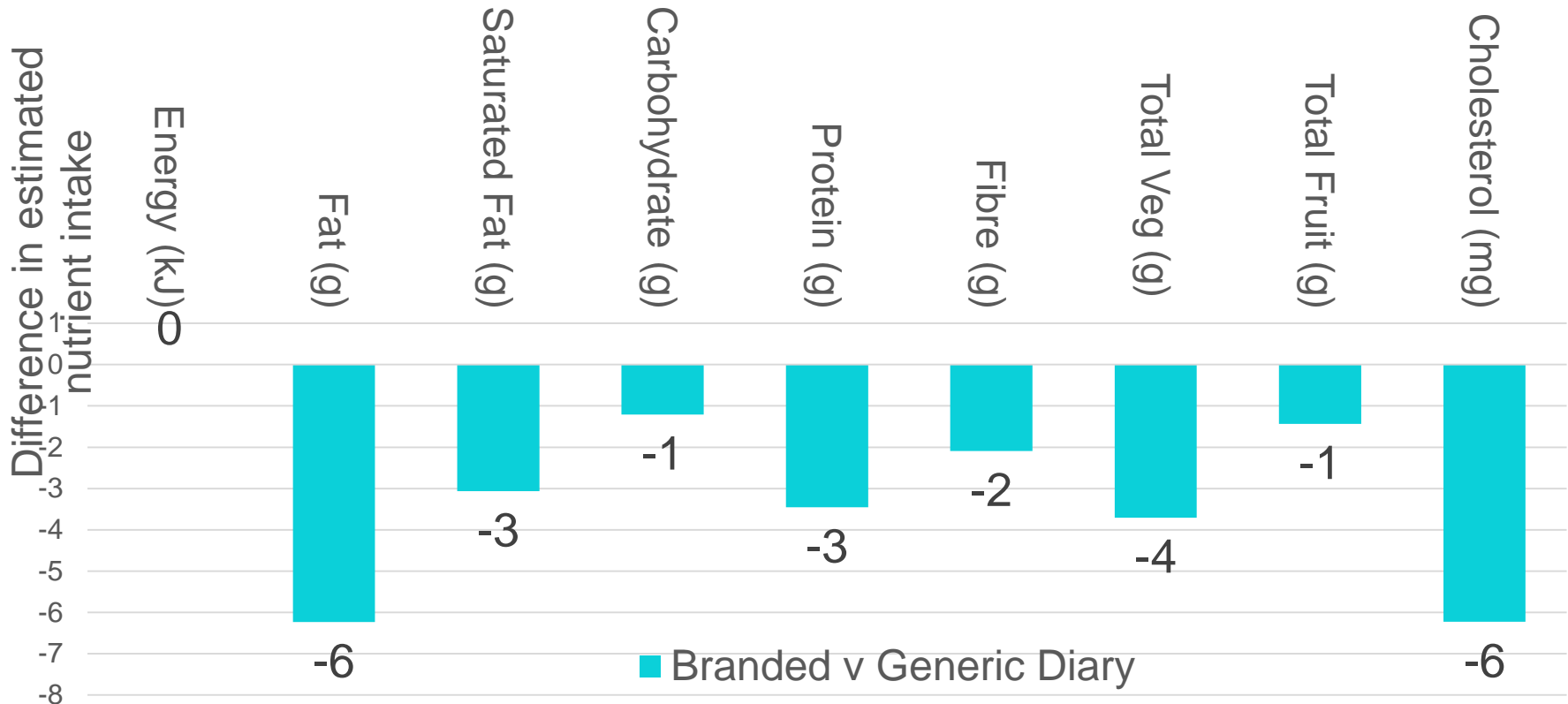
1. Carter, M. C., Hancock, N., Albar, S. A., Brown, H., Greenwood, D. C., Hardie, L. J., Frost G.S, Wark, P.A., Cade, J. E. (2016). Development of a new branded UK food composition database for an online dietary assessment tool. *Nutrients*, 8(8). doi:[10.3390/nu8080480](https://doi.org/10.3390/nu8080480)

Choosing branded items



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	/100g	Kcal	Protein	CHO
White bread	Generic (n=25)	267 Range: 167 to 341	9.1 Range: 7.6 to 12.1	47 Range: 23 to 78
White bread	Branded (n=225)	250 Range: 83 to 366	8.7 Range: 2.1 to 13.9	48 Range: 17 to 78

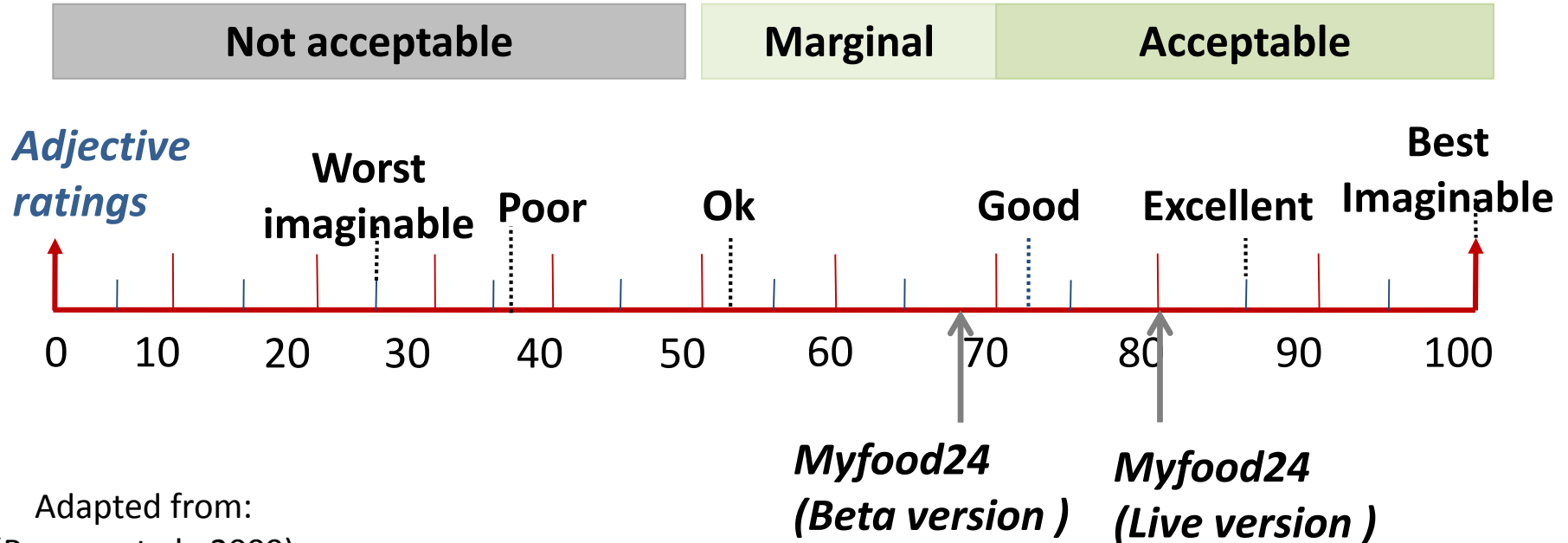


Usability testing - adults



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Acceptability ranges



Adapted from:
(Bangor et al., 2009)

Validation study:

(Wark, Frost, Imperial – data collection; Hardie - biomarkers) UNIVERSITY OF LEEDS



myfood24

Oxford WebQ

Did you eat any bread or crackers yesterday? No Yes [\[Show Help\]](#)
E.g. toast, sandwiches, rice cakes, bread rolls, hotdog roll, crumpets, tortilla wraps.

Bread	Amount	None	1/2	1	2	3	4	5	6+
Sliced bread	Slice	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Flour type:

- White
- Granary, brown, mixed flours
- Wholemeal
- Other - please describe:

Extras:

- Seeded (inside and/or on top)

Bread

- Sandwich baguette, ciabatta, panini, or sub
- Large sandwich bap, stotty, pitta

Independent biomarkers:

- urinary nitrogen; potassium; sodium (Recovery);
- sucrose; fructose (Predictive)
- plasma vitamins C, E, β -carotene (Concentration).
- total energy expenditure (Sensewear)



Results:

(Greenwood – analysis, submitted in revision)



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- Biomarkers from 212 participants
- myfood24 gave *similar results* to more costly & time consuming interviewer-based multiple pass recall
 - median total E intake: men 2044 kcal (NDNS 2107 kcal).
 - median women: 1613kcal (NDNS 1595kcal)
- *Both dietary assessment approaches led to attenuation compared to biomarkers*

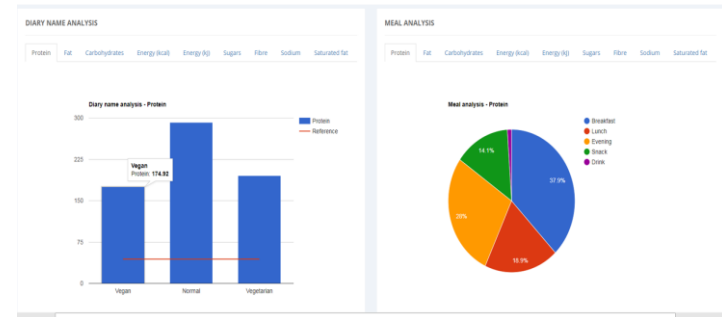
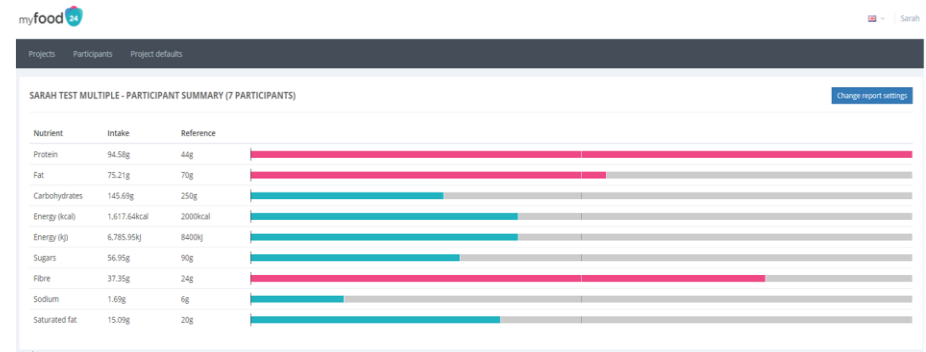
A screenshot of the myfood24 login interface. The header shows the myfood24 logo. Below it, there is a 'Welcome to myfood24.' message and a 'Login' section. The login section includes a text input field for the email address (j.e.cade@leeds.ac.uk) and a password field. There is a 'Login' button and a link for 'Forgot Password / Set Your Password?'. A 'Try a Demo' button is located at the bottom left.

New developments:



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- Teaching option with class feedback
- 19,000 users
- *Australian food tables* added in over 2,000 participants
- German and Danish versions, Arabic version planned
- Infant food modules
- Developing for clinical use - eg. weight loss, diabetes, ALS etc



myfood24

Willkommen bei myfood24

Vielen Dank für Ihre Teilnahme an diesem Forschungsprojekt mit myfood24. Mit 'myfood24' können Sie Ihre tägliche Ernährung protokollieren. Hierzu müssen alle Lebensmittel und Getränke, die innerhalb von 24 Stunden verzehrt wurden, online eingetragen werden.

Bitte geben Sie Ihre E-Mail-Adresse und das erhaltene Passwort ein um mit der Eingabe zu beginnen.

Login

Geben Sie Ihre Login-Daten ein

Frühstück

Mittagessen

Abendessen

Snack

Getränk

Ale Einträge löschen

Nach Lebensmitteln und Getränken suchen

Alle Kategorien

Suchergebnisse

Lebensmittel

Marken

Sortieren

Wählen Sie eine vorgegebene Portion aus oder geben Sie das Gewicht bei 'Portionsgröße' an.

Diese Menge habe ich ungefähr verzehrt (Bitte auswählen)

30g Protein

Anzahl: 1,00

Another example: self monitoring app My Meal Mate for weight loss



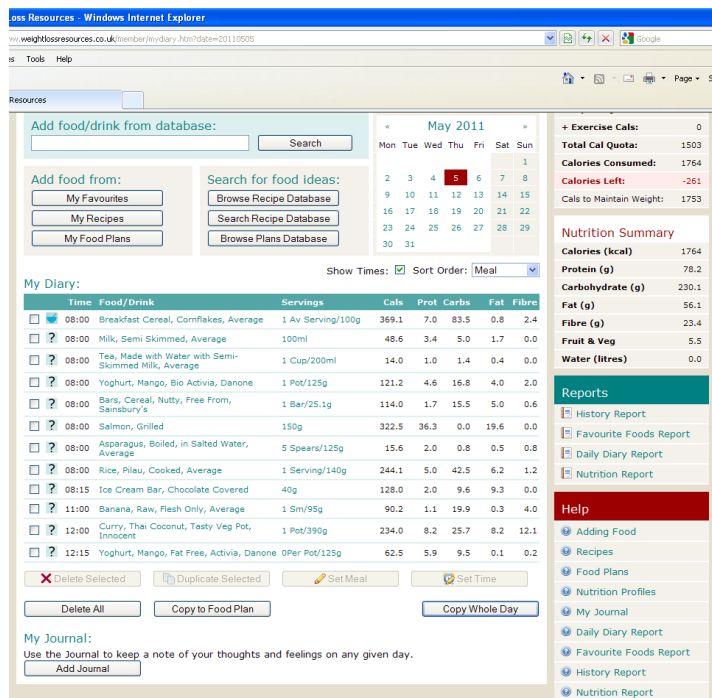
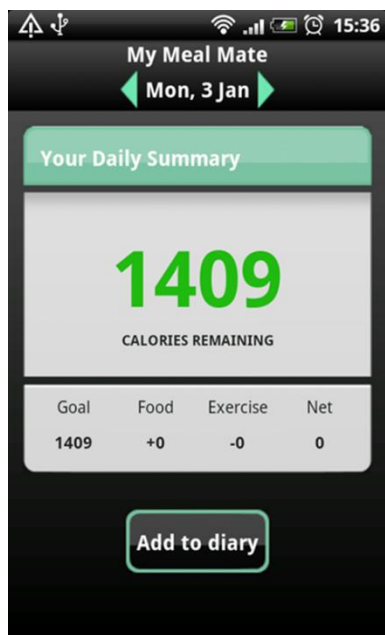
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Randomised to 3 groups (n=128)

MMM app

Online food diary

Paper food diary



food and
exercise
daily diary



weightlossresources.co.uk

Carter, M. C., Burley, V. J., Nykjaer, C., & Cade, J. E. (2013)
Journal of medical Internet research, 15(4). doi:10.2196/jmir.2283

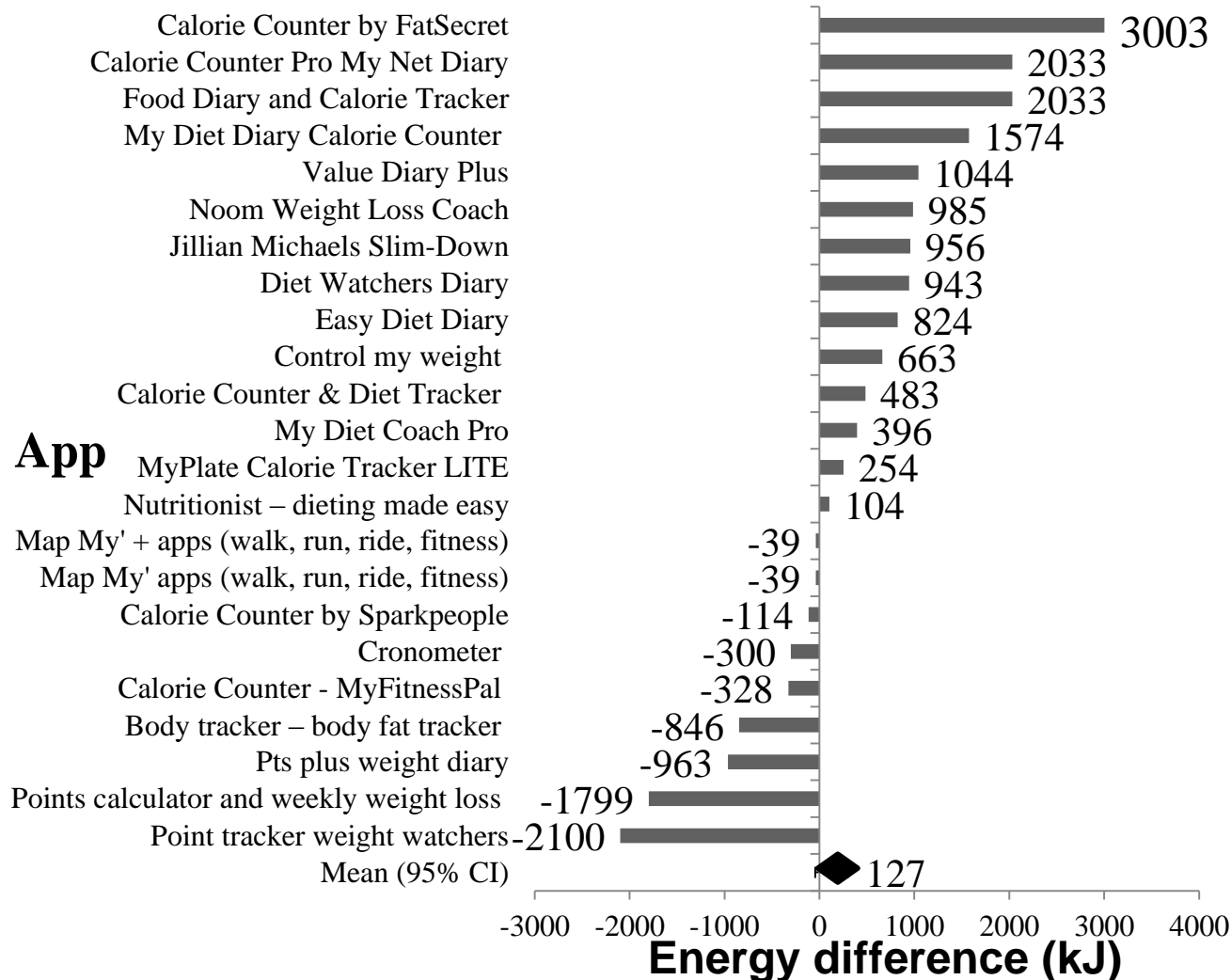
Reliability of diet data from apps

Chen et al, JMIR mHealth uHealth 2015;3(4):e104



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App v 3 day
diary:
E difference



New or 'big' data of relevance to food tracking?



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Food purchase, labels, loyalty card
Restaurant/fast food location

Twitter, social media
Town planning data



Travel – road maps
Census, national surveys

Healthcare data – 1^o care & 2^o care
Sensors (fitbits etc)

In development.....



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(a) Acoustic



(b) Visual



(c) Inertial



(d) EMG/EGG-based



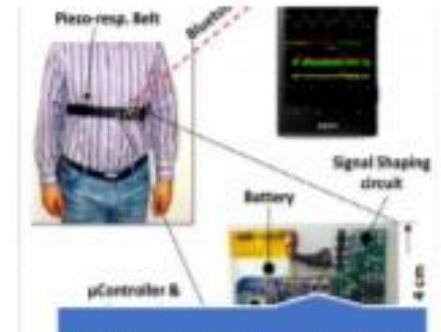
(e) Piezoelectric



(f) Fusion



(g) Electrical proximity sensing



(h) Respiratory inductance plethysmography

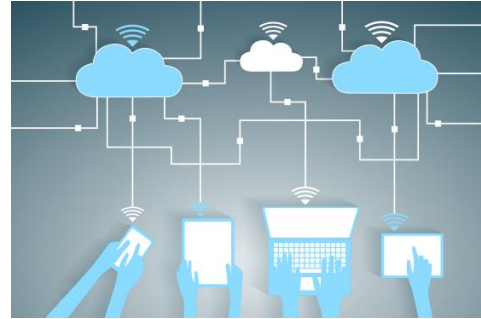


- Measuring food and nutrient intakes in populations is difficult
- Ability to link diet to health outcomes is limited by methods – including limited food tables
- Use of well designed tools including new technologies could help
- new tools and resources available to support researchers

Vision for the future:



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~ 50,000 foods on supermarket shelves

- Potential for a step-change in ability to reliably characterise food and nutrient intake in population studies

Thanks – and many more.....



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