Measuring Diet Quality: Where we are and where we might want to go

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McGill Institute for Global Food Security
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Outline

I. Background and Definitions

II. Where we are now

III. Different uses of diet quality indexes
    - Special case: the role of diet quality where obesity is associated with food insecurity

IV. Where we might want to go – simplified proxies
    - uses of simplified indicators
    - Measurement level
Definitions of DQIs

- Dietary Quality indicators (DQIs) aim to assess the overall diet and categorize individuals according to the extent to which their eating behaviour is “healthy”.

- Predefined indexes assess dietary patterns based on current nutrition knowledge.

- Developed primarily for nutritional epidemiology to assess dietary risk factors for NCDs, but their use is expanding.
Primary data source of DQI’s: Individual dietary data collection tools

24 h quantitative intake recalls, dietary records and food frequency questionnaires (FFQ)

FFQs concentrate on foods/nutrients of special interest while 24h recalls collect information on complete intake – all food eaten and their quantities
Different uses of individual food intake data and DQIs

The main purpose for collecting detailed quantitative food intake data was and is still to investigate associations between nutrients, foods or other elements of the diet and health outcomes. DQIs have been repeatedly validated against outcomes.

Dietary intake surveys are also undertaken to provide estimates of national nutritional status.

More recent uses of individual dietary intake surveys include identification of vehicles for food fortification and evaluation of the risks related to possible hazards in food (European Food Safety Authority).
### Dietary records

#### BEFORE BREAKFAST

<table>
<thead>
<tr>
<th>Food/Drink</th>
<th>Description and Preparation</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange Juice</td>
<td>Robinson's whole orange - sweetened</td>
<td>1 Glass</td>
</tr>
</tbody>
</table>

#### BREAKFAST

<table>
<thead>
<tr>
<th>Food/Drink</th>
<th>Description and Preparation</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef Patty with onion</td>
<td>Homecooked cold</td>
<td>3 Oz.</td>
</tr>
<tr>
<td>Tea</td>
<td></td>
<td>1 Cup</td>
</tr>
<tr>
<td>Milk</td>
<td>Skimmed White</td>
<td>15 Teaspoons</td>
</tr>
<tr>
<td>Sugar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### MID MORNING - between breakfast time and lunch time

<table>
<thead>
<tr>
<th>Food/Drink</th>
<th>Description and Preparation</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coffee</td>
<td>Maxwell House Instant Coffee</td>
<td>1 Mug</td>
</tr>
<tr>
<td>Sugar</td>
<td>White</td>
<td>15 Teaspoons</td>
</tr>
<tr>
<td>Cake</td>
<td>Homemade Date Cake</td>
<td>16 Oz.</td>
</tr>
</tbody>
</table>

#### LUNCH

<table>
<thead>
<tr>
<th>Food/Drink</th>
<th>Description and Preparation</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ham Monken Skin</td>
<td>Microwaved deep fried in oil (Crisp &amp; Dry)</td>
<td>6 Oz.</td>
</tr>
<tr>
<td>Chips</td>
<td></td>
<td>7 Oz.</td>
</tr>
<tr>
<td>Peas</td>
<td>Birds Eye (Frozen)</td>
<td>12 Oz.</td>
</tr>
<tr>
<td>Bread</td>
<td>Home bakey White toasted</td>
<td>1 Slice 1/4 thick</td>
</tr>
<tr>
<td>Apple Pie</td>
<td>Homemade White sprinkled on</td>
<td>3/8 Teaspoon</td>
</tr>
<tr>
<td>Sugar</td>
<td>White - sprinkled on</td>
<td></td>
</tr>
<tr>
<td>Custard</td>
<td>Birds - made with &quot;skimmed milk&quot;</td>
<td>Small Fruit Dishes</td>
</tr>
</tbody>
</table>

#### TEA - between lunch time and the evening meal

<table>
<thead>
<tr>
<th>Food/Drink</th>
<th>Description and Preparation</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tea</td>
<td>Typhoo - tea bag</td>
<td>1 Mug</td>
</tr>
<tr>
<td>Milk</td>
<td>Skimmed White</td>
<td>15 Teaspoons</td>
</tr>
<tr>
<td>Sugar</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biscuit</td>
<td>Chocolate Digestive Fox's</td>
<td>1</td>
</tr>
</tbody>
</table>

Date: 23/10/1933
Typical results of 24 h intake survey - micronutrients

Table 8: Percentages of the populations with inadequate usual intake of micronutrients

<table>
<thead>
<tr>
<th>Region</th>
<th>Children 24-59 months old</th>
<th>Women of reproductive age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kampala</td>
<td>S-W</td>
</tr>
<tr>
<td>Vitamin A</td>
<td>69</td>
<td>52</td>
</tr>
<tr>
<td>Vitamin B-1</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Vitamin B-2</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Niacin</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Vitamin B-6</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Folate</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Vitamin B-12</td>
<td>32</td>
<td>65</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Iron</td>
<td>75</td>
<td>57</td>
</tr>
<tr>
<td>Zinc</td>
<td>82</td>
<td>78</td>
</tr>
<tr>
<td>Calcium</td>
<td>88</td>
<td>79</td>
</tr>
</tbody>
</table>
Typical results of 24 h intake survey-macro nutrients

<table>
<thead>
<tr>
<th>Table 7: Estimated usual nutrient intake distributions of energy, fat, protein and fiber for women of reproductive age. Macronutrient</th>
<th>Region</th>
<th>5th</th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
<th>95th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy (kcal)</td>
<td>Kampala</td>
<td>1547</td>
<td>1700</td>
<td>1957</td>
<td>2256</td>
<td>2582</td>
<td>2920</td>
<td>3149</td>
</tr>
<tr>
<td></td>
<td>S-W</td>
<td>1666</td>
<td>1892</td>
<td>2308</td>
<td>2826</td>
<td>3404</td>
<td>3977</td>
<td>4345</td>
</tr>
<tr>
<td></td>
<td>North</td>
<td>1359</td>
<td>1507</td>
<td>1767</td>
<td>2074</td>
<td>2400</td>
<td>2708</td>
<td>2899</td>
</tr>
<tr>
<td>Fat (g)</td>
<td>Kampala</td>
<td>25.3</td>
<td>28.8</td>
<td>35.5</td>
<td>44.0</td>
<td>54.0</td>
<td>64.2</td>
<td>70.9</td>
</tr>
<tr>
<td></td>
<td>S-W</td>
<td>10.3</td>
<td>13.5</td>
<td>20.9</td>
<td>62.3</td>
<td>48.3</td>
<td>65.8</td>
<td>77.6</td>
</tr>
<tr>
<td></td>
<td>North</td>
<td>23.8</td>
<td>28.4</td>
<td>37.2</td>
<td>48.8</td>
<td>62.9</td>
<td>78.4</td>
<td>89.2</td>
</tr>
<tr>
<td>Protein (g)</td>
<td>Kampala</td>
<td>32.4</td>
<td>36.6</td>
<td>44.4</td>
<td>54.2</td>
<td>65.1</td>
<td>76.1</td>
<td>83.1</td>
</tr>
<tr>
<td></td>
<td>S-W</td>
<td>31.3</td>
<td>37.4</td>
<td>49.3</td>
<td>65.4</td>
<td>84.9</td>
<td>106.0</td>
<td>119.0</td>
</tr>
<tr>
<td></td>
<td>North</td>
<td>44.5</td>
<td>48.2</td>
<td>54.8</td>
<td>62.8</td>
<td>71.5</td>
<td>80.0</td>
<td>85.4</td>
</tr>
<tr>
<td>Fiber (g)</td>
<td>Kampala</td>
<td>16.2</td>
<td>18.7</td>
<td>23.3</td>
<td>29.1</td>
<td>35.9</td>
<td>42.7</td>
<td>47.2</td>
</tr>
<tr>
<td></td>
<td>S-W</td>
<td>27.9</td>
<td>32.9</td>
<td>42.3</td>
<td>54.4</td>
<td>68.5</td>
<td>82.9</td>
<td>92.3</td>
</tr>
<tr>
<td></td>
<td>North</td>
<td>23.7</td>
<td>26.4</td>
<td>31.1</td>
<td>36.8</td>
<td>42.9</td>
<td>48.8</td>
<td>52.5</td>
</tr>
<tr>
<td>Fiber (g/100 kcal)</td>
<td>Kampala</td>
<td>1.05</td>
<td>1.10</td>
<td>1.19</td>
<td>1.29</td>
<td>1.39</td>
<td>1.46</td>
<td>1.50</td>
</tr>
<tr>
<td></td>
<td>S-W</td>
<td>1.67</td>
<td>1.74</td>
<td>1.83</td>
<td>1.92</td>
<td>2.01</td>
<td>2.08</td>
<td>2.12</td>
</tr>
<tr>
<td></td>
<td>North</td>
<td>1.74</td>
<td>1.75</td>
<td>1.76</td>
<td>1.77</td>
<td>1.79</td>
<td>1.80</td>
<td>1.81</td>
</tr>
</tbody>
</table>
Where we are now
A myriad of Diet Quality Indicators

AHEI - Alternative Healthy Eating Index
DQI – Diet Quality index (risk assessment of health outcomes)
DQI-I Diet Quality Index-International (related to nutrition transition)
DQI-R Diet Quality Index Revised
FBQI Food-Based Quality Index
FPI Food Pyramid Index
HDI Healthy Diet Indicator
HEI Healthy Eating Index (monitor diet intake for nutrition promotion)
HFI Healthy Food Index
MDQI Mediterranean Diet Quality Index
MDS Mediterranean Diet Score
PANdiet
## Different types of DQIs

<table>
<thead>
<tr>
<th>Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrient-based</td>
<td>Requires the conversion from food weights to nutrient content using FCTs. Comparison to requirements, Adequacy ratios, etc.</td>
</tr>
<tr>
<td>Food/food group based</td>
<td>Use dietary guidelines for recommended portions and frequencies or simple FG count</td>
</tr>
</tbody>
</table>
| Combination Indexes (the vast majority) | No standardized approach to content and to scoring  
E.g. DQI, HEI and HDI  
Often include a measure of diet variety as well.  
*Different DQ scores not comparable and are often country-specific.* |
Different components of combined DQIs

Variety – within and across food groups

Adequacy – nutrients (compared to requirements) or food groups (quantities or servings)

Moderation - nutrients/foods to consume in moderation

Overall balance (of macronutrients)
HEI - 2010

Nine adequacy components (to increase in diet) (# servings):
1) total fruit, 2) whole fruit  3) total vegetables  4) greens and beans  5) **whole grains** 6) dairy 7) total protein foods (meat and beans) 8) seafood and plant proteins and 9) fatty acids.

Three moderation components (to decrease in diet):
1) **Refined grains** 2) sodium and 3) empty calories (solid fats, alcohol, added sugars)

The closer the diet is to the recommendation of the component, the higher the score.
Two variety components
overall food group and within food group diversity

Eight adequacy components (to increase in diet):
1) vegetables, 2) fruits 3) grains 4) fiber 5) protein 6) iron 7) calcium 8) Vitamin C

Five moderation components (to decrease in diet):
1) Total fat 2) saturated fat 3) cholesterol 4) sodium 5) empty calories (foods with low nutrient density)

Two overall balance components
Macronutrient ratio and fatty acid ratio

SCORES BASED ON SERVINGS, g/d, RDAs ETC
Constructing a DQ Score

Choice of the index components to include
- Assigning foods to food groups – degree of aggregation (e.g. fruits and vegetables separate or combined?)
- Choice of cut-off values for assigning points
- Exact quantification of the index components judged against the cut off values
- Adjustment (or not) for energy intake
- Deciding the relative contribution of individual components to the total score (weights?)

Practicality for wide application

1) Lack of universal dietary guidelines
2) Most currently used DQIs are based on 24 quantitative intake data of individuals complex to administer

- require skilled enumerators (usually nutritionists)
- time consuming for data cleaning, data management and nutrient conversion - which can delay release of results by years
- On-going work to simplify the food conversion phase
Special case: the role of diet quality where obesity is associated with food insecurity
Exploring the association between food insecurity and excess weight gain

The increasing prevalence of overweight/obesity observed in many countries may be attributable to a complex web of genetic, psychosocial, economic, dietary, life cycle and environmental and behavioral factors
The association between food insecurity and excess weight gain

Food insecurity, when defined as poor access to food, is layered on top of these complex factors in ways that may lead to the “unexpected” observation of overweight/obesity in populations traditionally vulnerable to undernutrition.
Causal connections between food insecurity and excess weight

Even if not causal, excessive weight co-exists with food insecurity at mild - moderate levels in certain age and gender categories.
Causal connections between food insecurity and excess weight

The Food Security concept does not reflect how severe food insecurity can be associated with obesity (progression from mild/mod to severe would imply food deficiencies, not excessive weight)

Figure: Food insecurity severity along a continuous scale

<table>
<thead>
<tr>
<th>Mild food insecurity</th>
<th>Severe food insecurity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worrying about ability to obtain food</td>
<td>Reducing quantities,</td>
</tr>
<tr>
<td>Compromising quality and variety of food</td>
<td>Experiencing skipping meals</td>
</tr>
<tr>
<td></td>
<td>hunger</td>
</tr>
</tbody>
</table>
Food Security and obesity: Hypotheses in a multi-factoral context

Episodic nature of food insecurity and limited economic resources leading to overcompensation when resources become (periodically) adequate, such as when benefits received

Diet quality is a factor – limited access to more expensive healthy and fresh foods → consuming more energy-dense foods to satiate hunger.
Diet quality, food security and excess weight – what is known?

A number of studies have shown that both household and individual diets may be of inferior quality due to food insecurity related to limitations in both physical and economic access to affordable healthy foods.
Food insecurity and diet quality - Brazil

Daily consumption of selected food groups by category of food security (Campinas-Brasil 2004)
Food Security and obesity - Measurement issues

Need for accurate assessment of diet composition and eating frequencies of populations INCLUDING SNACKS and ways to capture consumption of HIGHLY PROCESSED FOODS

Measurement of food security and diet at individual level as well as household might help to disentangle age and gender differences in the relationship between excess weight and food insecurity
Importance of addressing overweight and obesity in food insecure populations

Overweight and obesity are risk factors for morbidity, disability and mortality from chronic diseases.

Food insecure and poor persons at risk of CD have fewer means for prevention and treatment such as accessing health care and improving diets.

Interrupt transmission to the next generation.

THERE IS A NEED TO BE ABLE TO SIMPLY AND CHEAPY MONITOR DIET QUALITY IN POPULATIONS WORLD-WIDE.
Where we might want to go
– simplified proxies
Monitoring dietary quality

CHANGES IN DIET QUALITY IN THE POPULATION

As countries improve their economic condition, diets changes to include more

- animal food products
- fats and oils
- Sugars
- ultra-processed foods

Declines in consumption of traditional protein sources such as legumes. (India)
Monitoring dietary quality

We need simple tools that are accessible to different levels of users

A proxy diet quality tool that

✓ Captures the concept of diet quality covering both adequacy and moderation
✓ Doesn’t require intensive analysis such as conversion of foods to nutrient content
✓ Is standardized and comparable across cultures
✓ Captures level of food processing
More desired characteristics

- Simple to administer and score
- Easily interpretable
- Inexpensive to administer
- Less time to analyze data

**USED FOR GLOBAL TRACKING OF LEVEL AND IMPROVEMENTS IN DQ – never for individual assessment or targeting for interventions**
## Level of burden for investigator and respondent (data collection and data analysis)

<table>
<thead>
<tr>
<th>Higher Burden</th>
<th>24 h quantitative recall to assess nutrient content of the diet / diet records or diaries (with repeats on non-consecutive days)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(example: HEI)</em></td>
<td>FFQ (food lists can be quite long)</td>
</tr>
<tr>
<td></td>
<td>Conversion of foods to nutrients (FCTs)</td>
</tr>
<tr>
<td></td>
<td>Analysis of adequacy wrt requirements</td>
</tr>
<tr>
<td>Lower burden</td>
<td>24 h qualitative recall (diet diversity)</td>
</tr>
<tr>
<td><em>(example: IDDS)</em></td>
<td>Qualitative or semi-quantitative food frequency by foods or food groups (various recall periods)</td>
</tr>
</tbody>
</table>
Issues in developing a universal proxy DQI

Different levels of data collection: Food environment, supply, local, individuals by age/sex

Possible to get beyond limitation of using national dietary guidelines to develop a cross-culturally comparable tool?
Different uses of DQI proxies

Global/national tracking for NCD prevention

Global Monitoring Framework

Mortality & Morbidity
- Unconditional probability of dying between ages 30 and 70 years from cardiovascular diseases, cancer, diabetes or chronic respiratory diseases
- Cancer incidence by type of cancer

Risk Factors
- Harmful use of alcohol (3)
- Low fruit and vegetable intake
- Physical inactivity (2)
- Salt intake
- Saturated fat intake
- Tobacco use (2)
- Raised blood glucose/diabetes
- Raised blood pressure
- Overweight and obesity (2)
- Raised total cholesterol

National Systems Response
- Cervical cancer screening
- Drug therapy and counseling
- Essential NCD medicines & technologies
- Hepatitis B vaccine
- Human Papilloma Virus vaccine
- Marketing to children
- Access to palliative care
- Policies to limit saturated fats and virtually eliminate trans fats

Total number of related indicators in brackets

25 Indicators

World Health Organization
Given the difficulties of defining the universally agreed comprehensive “healthy” diet, it may be necessary to look at a quite reduced indicator of several questions that address the key issues in NCD prevention.

The WHO Global NCD Framework proposes several dietary indicators:

Mean intake (g/d) of fruits and vegetables, of salt and of saturated fat (quantities)
Dietary indicators in use for tracking population trends

The Canadian Chronic Disease Indicator Framework collects, through health surveys:

**Healthy Eating**: % of population that reports consuming fruit and vegetables at least 5 times/day, population aged 12+ years (proxy for quantified F&V intake)

**Unhealthy Eating**: % of population that reports drinking sugar-sweetened beverages daily, population aged 5 to 19 years

**Target population**: policy and program decision-makers and health professionals
Different uses of DQI proxies

Research on the effects of food insecurity on diet quality and implications for NCDs or impact of interventions to improve food security

Food Insecurity Among Adults

- Obesity (women only)
- Diabetes
- Heart disease
- Depression and fatigue
- Poor health status
Different uses of DQI proxies

Evaluation of nutrition-enhancing agricultural projects, programmes and policies (main outcome=better quality diets of the population)
A food system includes all processes and infrastructure involved in feeding a population: growing, harvesting, processing, packaging, transporting, marketing, consumption, and disposal of food and food-related items.

**FOOD SYSTEMS ARE GLOBAL**
# Measurement level – NATIONAL FOOD SUPPLY – COMMODITY BASED

<table>
<thead>
<tr>
<th>Dietary Energy Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share of diet energy from cereals, roots and tubers</td>
</tr>
<tr>
<td>Average protein supply</td>
</tr>
<tr>
<td>Supply of fruits and vegetables, oils and fats, sugars (disaggregated by industrial use)</td>
</tr>
</tbody>
</table>
Measurement level of diet quality – FOOD ENVIRONMENT

Homes, schools, stores, restaurants, community gardens, soup kitchens, food banks and other physical settings where the cost and availability of food influence what people eat.

FOOD ENVIRONMENTS ARE LOCAL AND CULTURAL
Food deserts are defined as parts of the country with little or no supply of fruit, vegetables, and other healthful whole foods, usually found in impoverished areas. This is largely due to a lack of grocery stores, farmers’ markets, and healthy food providers.

Food deserts are failures of the food system and food environment.
Measurement level of diet quality – HOUSEHOLDS & INDIVIDUALS

Through research studies, population surveys (nutrition, household budget and expenditure, DHS, etc), *public opinion polls*
Measuring Diet Quality: Discussing where we might want to go

Thank you very much.