From food expenditure to food consumption

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Use of Household Budget Surveys as a surrogate to access food consumption data

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Why use food expenditure ($) to estimate food consumption (g,ml)?

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- If food consumption data (e.g., from 24hr recall, food frequency questionnaire) is not available
- **Advantages**
  - Available and up-to-date Household Budget Surveys for many countries
  - Cost-effective
- **Limitations**
  - Surrogate (expenditure as proxy for consumption)

Exploiting Household Budget Surveys' food expenditure data

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Data requirements

- **Composition of each HH (age, gender) = raw data**
- **Amount spent in food per HH (not population mean) = raw data**

- Energy requirements table per age & gender
- Country-specific food price database
- Conversion factors (cooking, yield) for specific foods
- Regional or country-specific food composition table (kcal/food)

1. Adult male equivalent (AME)

Limitation: we cannot know how much of the household's expenditure corresponds to each member's consumption

Solution: express household composition in terms of energy needs of a reference individual

Energy needs per age and gender

- In this example, adult male = 2600 cal
- Express others' energy needs as a fraction of this reference value
- Energy needs for each age/gender group divided by 2600 = AME

Estimated Calorie Needs per Day by Age, Gender, and Physical Activity Level.

Estimated amounts of calories[a] needed to maintain calorie balance for various gender and age groups at three different levels of physical activity. The estimates are rounded to the nearest 200 calories for assignment to a USDA Food Pattern. An individual's calorie needs may be higher or lower than these average estimates.

	Male			Female[c]		
Activity level[b]	Sedentary	Moderately active	Active	Sedentary	Moderately active	Active
Age (years)						
2	1,000	1,000	1,000	1,000	1,000	1,000
3	1,200	1,400	1,400	1,000	1,200	1,400
4	1,200	1,400	1,600	1,200	1,400	1,400
5	1,200	1,400	1,600	1,200	1,400	1,600
6	1,400	1,600	1,800	1,200	1,400	1,600
7	1,400	1,600	1,800	1,200	1,600	1,800
8	1,400	1,600	2,000	1,400	1,600	1,800
9	1,600	1,800	2,000	1,400	1,600	1,800
10	1,600	1,800	2,200	1,400	1,800	2,000
11	1,800	2,000	2,200	1,600	1,800	2,000
12	1,800	2,200	2,400	1,600	2,000	2,200
13	2,000	2,200	2,600	1,600	2,000	2,200
14	2,000	2,400	2,800	1,800	2,000	2,400
15	2,200	2,600	3,000	1,800	2,000	2,400
16	2,400	2,800	3,200	1,800	2,000	2,400
17	2,400	2,800	3,200	1,800	2,000	2,400
18	2,400	2,800	3,200	1,800	2,000	2,400
19–20	2,600	2,800	3,000	2,000	2,200	2,400
21–25	2,400	2,800	3,000	2,000	2,200	2,400
26–30	2,400	2,600	3,000	1,800	2,000	2,400
31–35	2,400	2,600	3,000	1,800	2,000	2,200
36–40	2,400	2,600	2,800	1,800	2,000	2,200
41–45	2,200	2,600	2,800	1,800	2,000	2,200
46–50	2,200	2,400	2,800	1,800	2,000	2,200

https://www.fns.usda.gov/estimated-calorie-needs-day-age-gender-and-physical-activity-level

Build an AME reference table

- Express household composition in "standardized" units = allow for comparisons

Age	Female		Male	
	Energy (cal)	**AME**	Energy (cal)	**AME**
2	1000	1000/**2600** = 0.38	1000	1000/**2600** = 0.38
3				
…				
19-25				
26-45	2000	2000/**2600** = 0.77	2600	2600/**2600** = 1
…				
…				
76+	1800	1800/**2600** = 0.69	2200	2200/**2600** = 0.85

Calculate number of AME per household

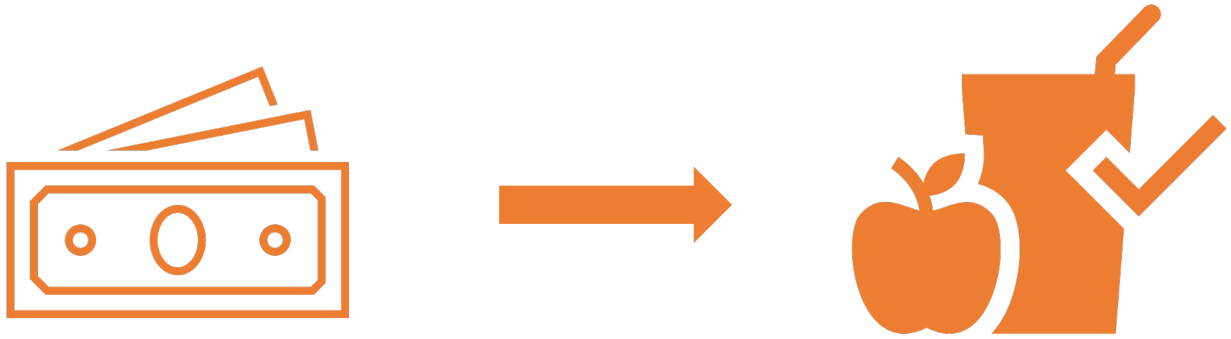
- From survey's household composition (raw data) and reference AME table
- Ex. Household 1: 1 boy (2 years old) and 1 man (27 years old)

	Age group = 2 years				Age group = 26-45 years				...	Total AME
	No. of F	**AME**	No. of M	**AME**	No. of F	**AME**	No. of M	**AME**		
HH1	0	0	1	0.38	0	0	1	1		1.38
HH2										
...										
HH N										

2. Time frame

- Ex. Survey tracked expenditure for 2 weeks
- Divide amount spent per food item by a conversion factor (e.g., 14) to obtain expenditure per household per day

	Food A		Food B		Food N
	$ spent in 14 days	$/HH/day	$ spent in 14 days	$/HH/day	…
Household 1	140	10			
Household 2	280	20			
…					
Household N					



3. From expenditure to consumption

For each household and food item, convert **$ to grams**

Build a price per food reference table

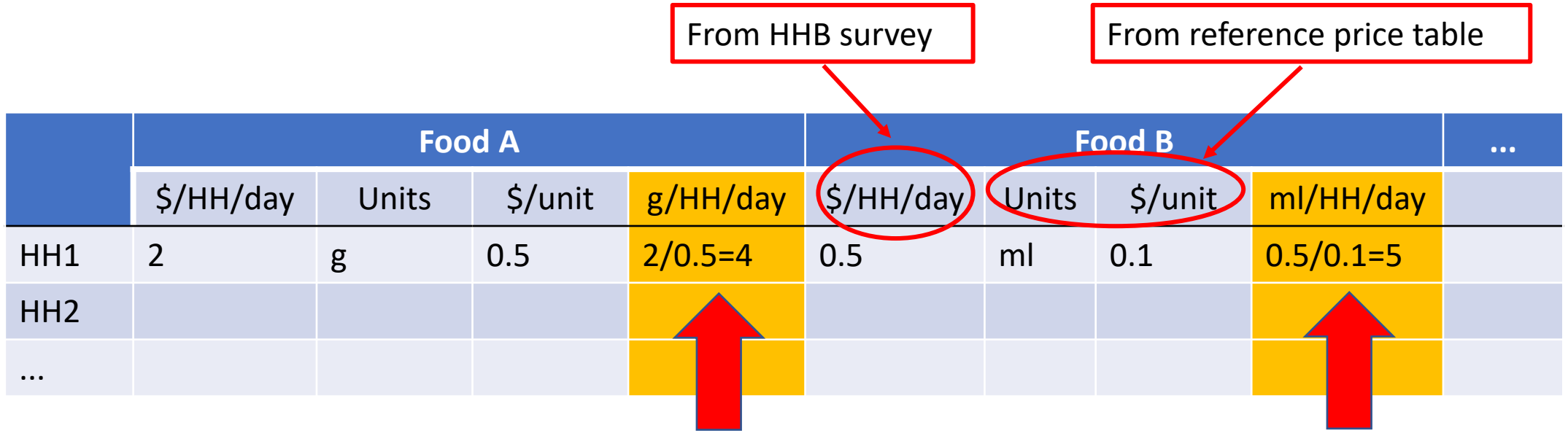
- For every food item in the Household Budget Survey, based on **country specific database for food price**
- Food items are quantified according to their characteristics (e.g., bread=g; milk=ml; eggs=number of eggs)
- Ex. Afghanistan (AFN)

- Humanitarian Data Exchange's Global Food Prices Database
- FAO's Food Price Monitoring & Analysis tool
- Local data
- …

Food item	Units	Database provides price per X units	Price (AFN)	AFN/unit
Rice, white	g	100	9.20	9.20/100 = 0.092
Apples	g	300	20.17	20.17/300=0.067
…				

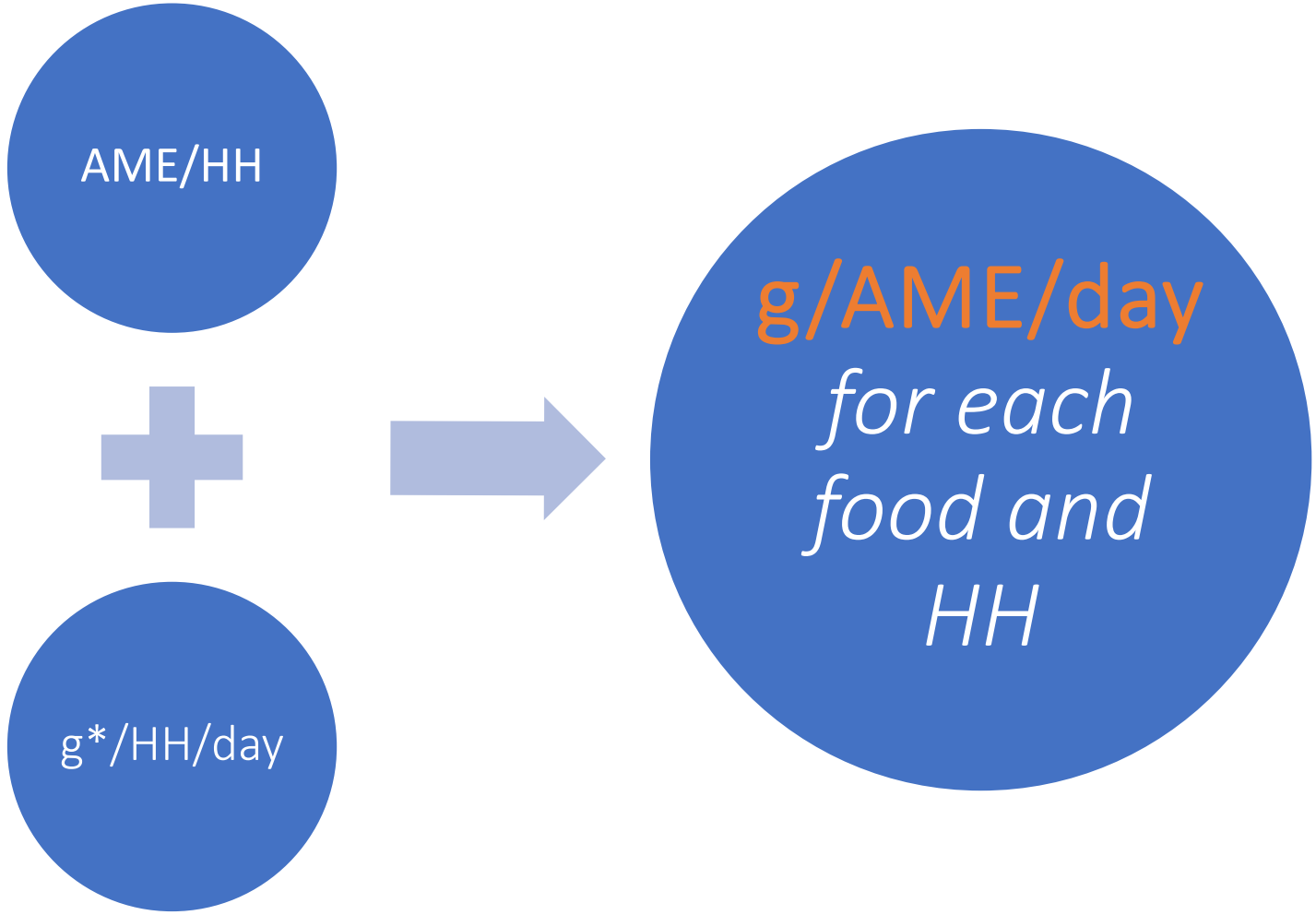
Calculate **quantity** purchased per household

- From **expenditure** (Household Budget Survey = $) to **grams**



	Food A				Food B				...
	$/HH/day	Units	$/unit	g/HH/day	$/HH/day	Units	$/unit	ml/HH/day	
HH1	2	g	0.5	2/0.5=4	0.5	ml	0.1	0.5/0.1=5	
HH2									
...									

Up to this point we have:



*Amount consumed may be expressed in units other than grams, depending on the product (e.g., ml)

4. Integrating the AME

- To obtain g/AME/day for each food item and each household
- Using previously calculated, per household:
  - Total number of **AMEs**
  - **g/HH/day** for each food item

	AME	Food A		Food B		...
		g/HH/day	g/AME/day	g/HH/day	g/AME/day	
HH1	1.38	4	4/1.38 = 2.9	0.5	0.5/1.38 = 0.36	
HH2						
...						

- Number of foods that need conversion
- Availability of conversion factors
- Country-specific adjustments
- …

5. Consumption adjustments

When amount food **consumed** ≠ amount **purchased** (e.g., because of cooking, peeling)

Determine amount consumed

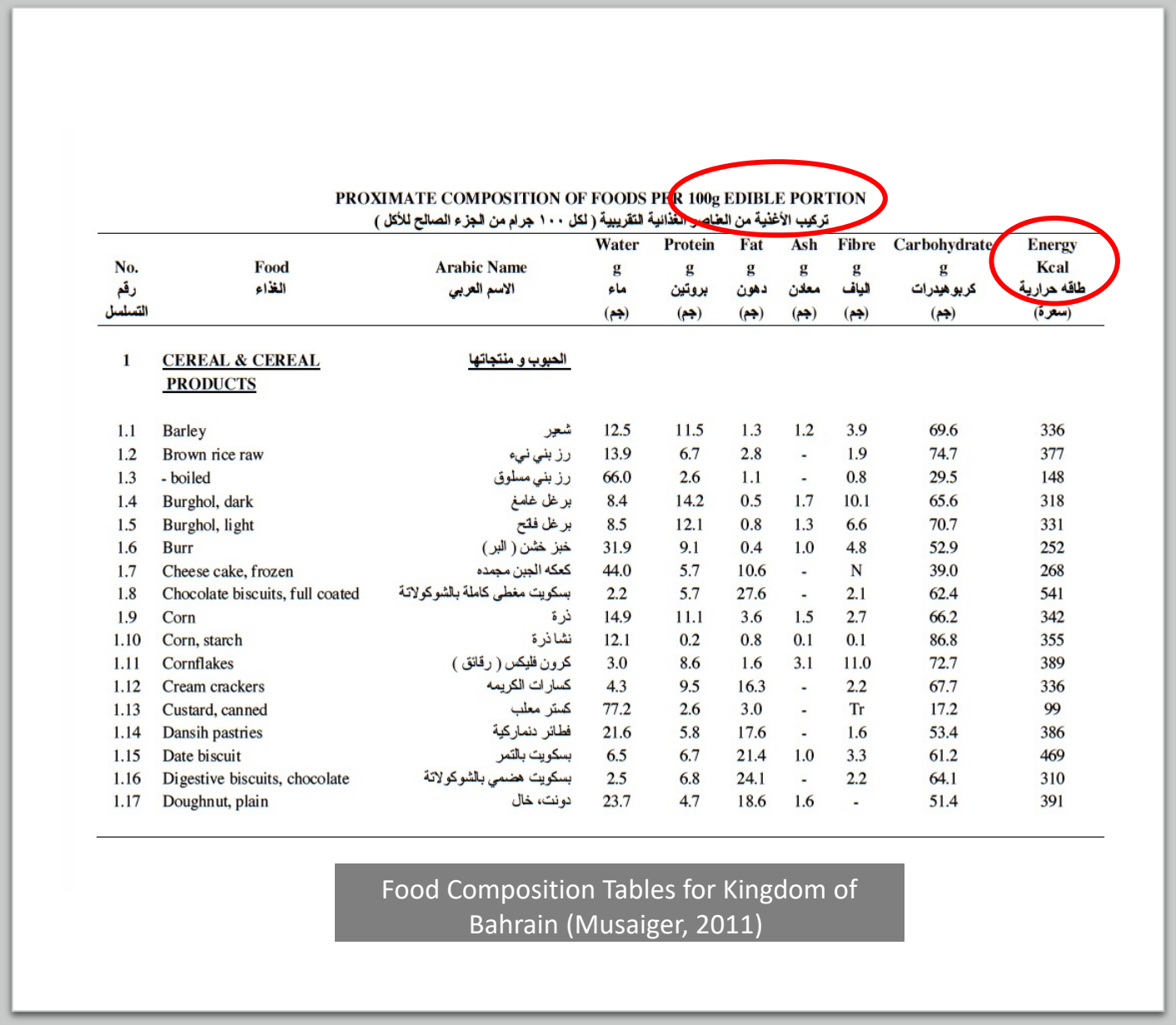
- Ex. Rice*
  - Factor 0.998 due to potential presence of dirt, AND
  - Factor 3.0 due to increase of weight during cooking
- Food B, consumed as purchased (no factors) = no change in g/AME/day

	Rice, white				Food B (no factors)		...
	g/AME/day	Edible	Yield	Adjusted g/AME/day	g/AME/day	g/AME/day	
HH1	10	0.998	3	10 x 0.998 x 3 = 29.94	5.2	5.2	
HH2							
...							

*Gimou, M.-M., Charrondiere, U.R., Leblanc, J.-C., & Pouillot, R. 2008. Dietary exposure to pesticide residues in Yaoundé: The Cameroonian total diet study. Food Additives and Contaminants, April 2008; 25(4): 458–471

6. Energy

- Exclude extreme values (under/over consumption)
- Determine the energy (kcal) per g (or ml, or other unit) of food
- Sources: country- or region-specific food composition tables
- Attention to units!



PROXIMATE COMPOSITION OF FOODS PER 100g EDIBLE PORTION

تركيب الأغذية من العناصر الغذائية التقريبية (لكل ١٠٠ جرام من الجزء الصالح للأكل)

No. رقم التسلسل	Food الغذاء	Arabic Name الاسم العربي	Water g ماء (جم)	Protein g بروتين (جم)	Fat g دهون (جم)	Ash g معادن (جم)	Fibre g الياف (جم)	Carbohydrate g كربوهيدرات (جم)	Energy Kcal طاقه حرارية (سعرة)
1	CEREAL & CEREAL PRODUCTS	الحبوب و منتجاتها							
1.1	Barley	شعير	12.5	11.5	1.3	1.2	3.9	69.6	336
1.2	Brown rice raw	رز بني نيء	13.9	6.7	2.8	-	1.9	74.7	377
1.3	- boiled	رز بني مسلوق	66.0	2.6	1.1	-	0.8	29.5	148
1.4	Burghol, dark	برغل غامق	8.4	14.2	0.5	1.7	10.1	65.6	318
1.5	Burghol, light	برغل فاتح	8.5	12.1	0.8	1.3	6.6	70.7	331
1.6	Burr	خبز خشن (البر)	31.9	9.1	0.4	1.0	4.8	52.9	252
1.7	Cheese cake, frozen	كعكه الجبن مجمده	44.0	5.7	10.6	-	N	39.0	268
1.8	Chocolate biscuits, full coated	بسكويت مغطى كاملة بالشوكولاتة	2.2	5.7	27.6	-	2.1	62.4	541
1.9	Corn	ذرة	14.9	11.1	3.6	1.5	2.7	66.2	342
1.10	Corn, starch	نشا ذرة	12.1	0.2	0.8	0.1	0.1	86.8	355
1.11	Cornflakes	كرون فليكس (رقائق)	3.0	8.6	1.6	3.1	11.0	72.7	389
1.12	Cream crackers	كسارات الكريمه	4.3	9.5	16.3	-	2.2	67.7	336
1.13	Custard, canned	كستر معلب	77.2	2.6	3.0	-	Tr	17.2	99
1.14	Dansih pastries	فطائر دنماركية	21.6	5.8	17.6	-	1.6	53.4	386
1.15	Date biscuit	بسكويت بالتمر	6.5	6.7	21.4	1.0	3.3	61.2	469
1.16	Digestive biscuits, chocolate	بسكويت هضمي بالشوكولاتة	2.5	6.8	24.1	-	2.2	64.1	310
1.17	Doughnut, plain	دونت، خال	23.7	4.7	18.6	1.6	-	51.4	391

Food Composition Tables for Kingdom of Bahrain (Musaiger, 2011)

Build an energy per food reference table

- For every food item in the Household Budget Survey, based on the selected food composition table
- Convert to kcal/g (or applicable unit)
- Ex. Bahrain

Food item	Units	Source table provides energy per X units of edible portion	Energy (kcal)	kcal/unit
Barley	g	100	336	336/100 = 3.36
Brown rice, boiled	g	100	148	148/100=1.48
…				

Calculate energy intake per household

- Add energy intake from each food source
- Filter extremes (e.g., <1200 kcal/day; > 5100 kcal/day*)

	Food A = Barley			Food B			...	Total kcal/AME/day
	Adjusted g/AME/day	kcal/g	kcal/AME/day	Adjusted g/AME/day	kcal/g	kcal/AME/day		
HH1	2	3.36	2x3.36=6.72	0.5	6	0.5x6=3		6.72+3+...=
HH2								
...								

*Ingenbleek et al. 2017. Methodology design of the regional Sub-Saharan Africa Total Diet Study in Benin, Cameroon, Mali and Nigeria. *Food and Chemical Toxicology,* 109: 155-169

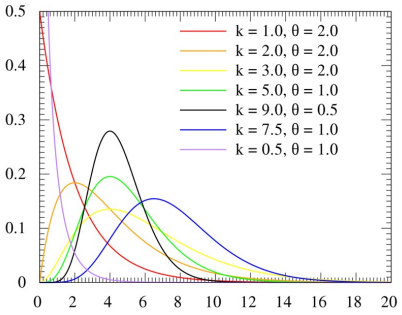
7. Final product = Amount of food consumed

- Amount consumed/AME/day for each food item*:

	Food A (g/AME/day)	Food B (ml/AME/day)	…
HH1	3.21	0.22	
HH2	0	6.21	
…			

✓ For probabilistic exposure assessment: consumption distribution

✓ For Total Diet Studies: identify foods to be analyzed



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*Amount consumed may be expressed in units other than grams, depending on the product (e.g., ml)

Thank you

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