

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

Surrogate: 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.

Activity level ^b	Male			Female ^c		
	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

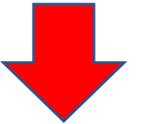
Build an AME reference table

- 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 (HH1): 1 boy, 2 years old and 1 man, 27 years old



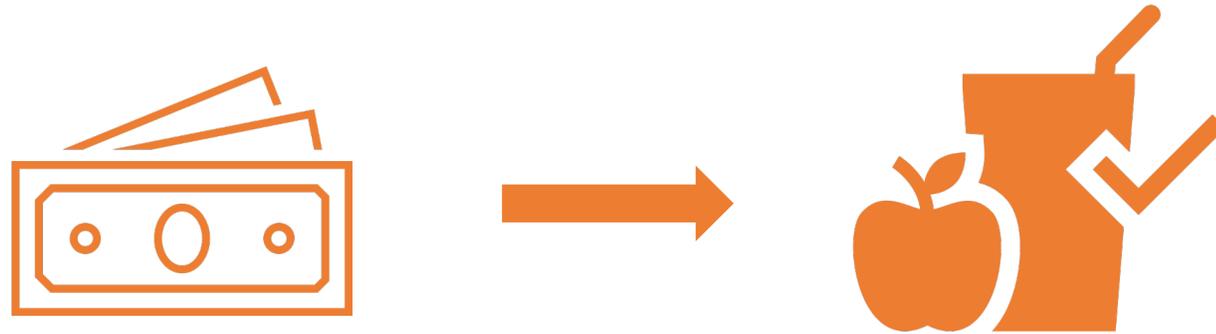
	Age group = 2 years				Age group = 26-45 years				...	Total AME
	No. of F	AME	No. of M	AME	No. of F	AME	No. of M	AME		
HH1	0	0	1	0.38	0	0	1	1	1.38	
HH2										
...										
HH N										

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

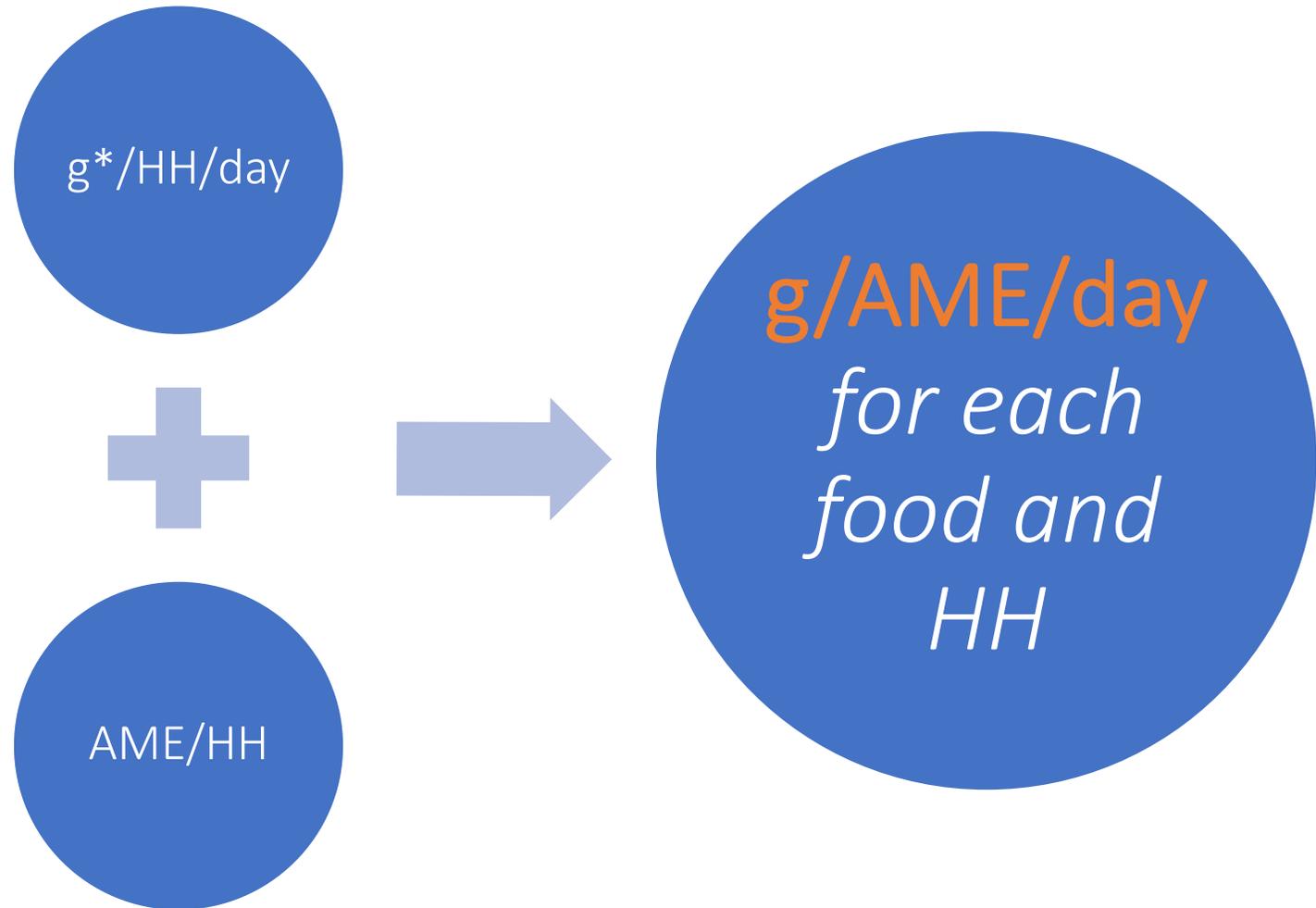
- From **expenditure** (Household Budget Survey = \$) to **grams**

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

From HHB survey

From reference price table

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						
...						



5. Consumption adjustments

When amount food consumed \neq 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

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

	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 100 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 طاقة حرارية (سعة)
1	<u>CEREAL & CEREAL PRODUCTS</u>	<u>الحبوب ومنتجاتها</u>							
1.1	Barley	شعير	12.5	11.5	1.3	1.2	3.9	69.6	336
1.2	Brown rice raw	رز بني نيه	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 غامغ	8.4	14.2	0.5	1.7	10.1	65.6	318
1.5	Burghol, light	برغل فتح	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	كعكة 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	نشاذرة	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 الكريمة	4.3	9.5	16.3	-	2.2	67.7	336
1.13	Custard, canned	كسترد 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	$2 \times 3.36 = 6.72$	0.5	6	$0.5 \times 6 = 3$		$6.72 + 3 + \dots =$
HH2								
...								



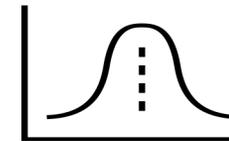
*Ingenbleek et al. 2017. Methodology design of the regional Sub-Saharan Africa Total Diet Study in Benin, Cameroon, Mali and Nigeria. *Food and Chemical Toxicology*, 109: 155-169

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 exposure assessment: consumption distribution
- For TDS: identify foods to be analyzed



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

Tunisian experience in food consumption survey



Available food consumption surveys in Tunisia

The National Household Budget, Consumption and Standard of Living Survey (*National Institute of Statistics : NIS*)

- a five-year survey (1968, 1975, ,2015, 2020 in progress)
- Household budget-consumption survey
- 3 components :

Volume A



Annual household expenditure

Volume B



Level of household food consumption in terms of quantities consumed

Volume C



access to community services such as Education and Teaching, Social Security and Care.

Volume B : Food consumption survey

Method

- Food unit : all the people who depend on a single center for most of their food
- Weighing for one week of the year all the food :
 - ✓ consumed or used in the preparation of their meals,
 - ✓ as purchased or in edible state

Result

Foods weighed as purchased or in edible state

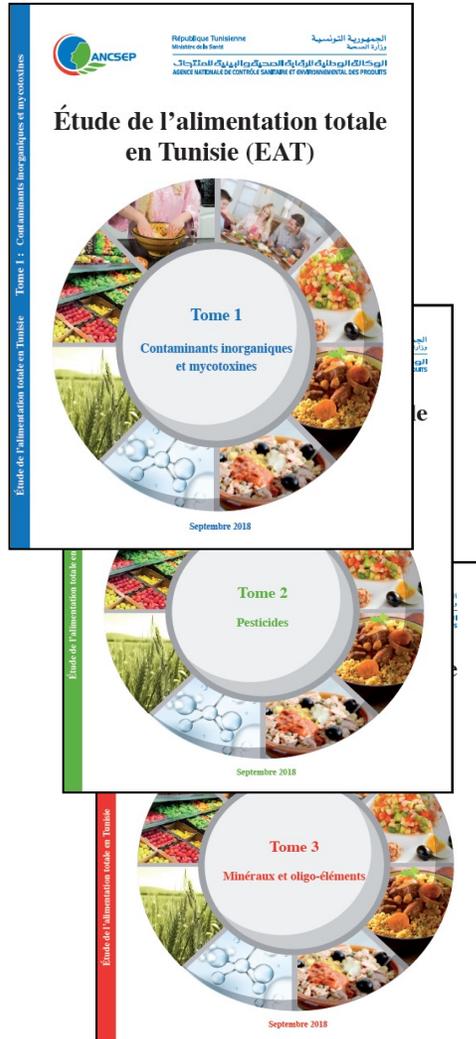
- Reported to the people who actually consumed it (*ration count*)
- Converted through a food composition table into their nutrient equivalents: calories, protein, vitamins, minerals, calcium , iron

Volume B



Food consumption survey

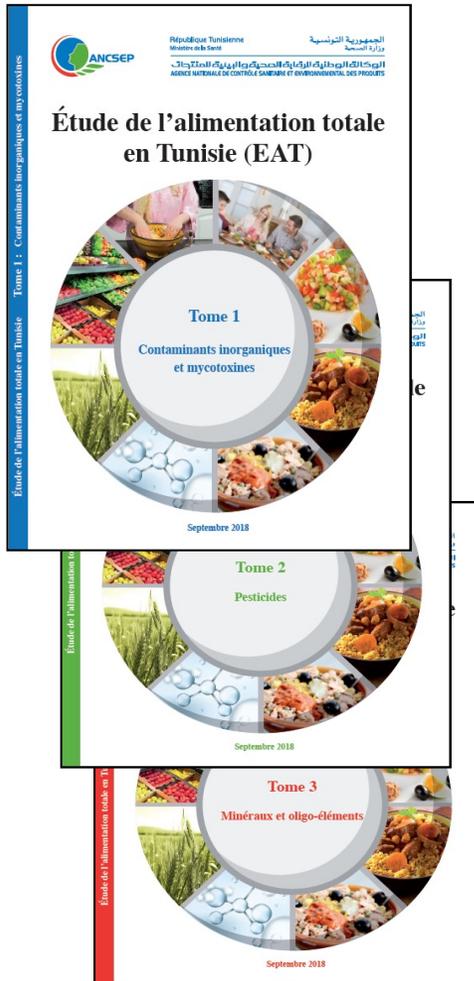
Food consumption data used for the Tunisian TDS



In 2009 Tunisia carried out its first TDS :

- Need of food consumption data in order :
 - ✓ identify foods to be tested,
 - ✓ Estimate the exposure.
- Available data :
 - ✓ no food consumption survey at individual level,
 - ✓ raw data of the Food consumption survey of the National Household Budget, Consumption and Standard of Living Survey.

Raw food consumption data of the NSI



Subsample of 420 households (food unit) from the food consumption survey of the NIS :

- ✓ The households composition (*number of individuals, age, sex, weight and height*),
- ✓ Consumption in g / week per household of food "as purchased",
- ✓ Edible factors.

Etude de l'alimentation totale en Tunisie. Tome 3 : Minéraux et oligoéléments

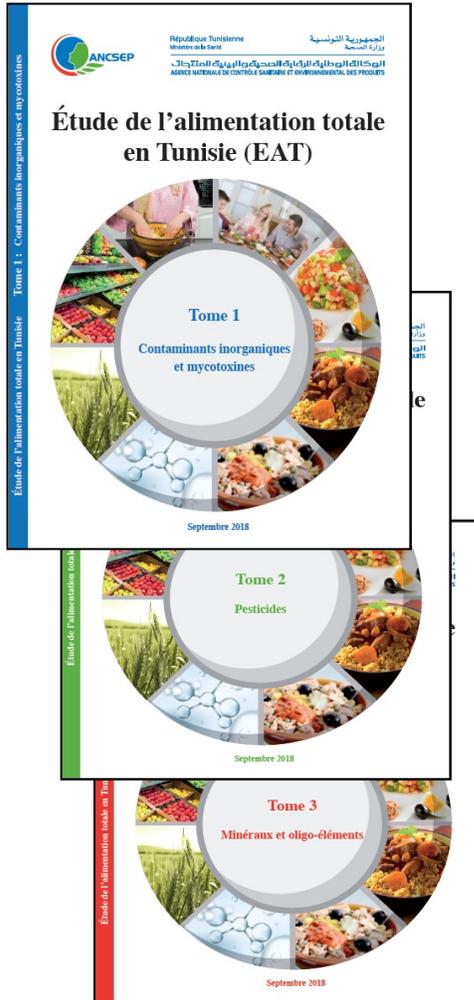
Agence Nationale de Contrôle Sanitaire et Environnemental des Produits ()

Etude de l'alimentation totale en Tunisie. Tome 2 : Pesticides
Agence Nationale de Contrôle Sanitaire et Environnemental des Produits (Février 2019)

Etude de l'alimentation totale en Tunisie. Tome 1 : Contaminant inorganiques et mycotoxines

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Data treatment from "as purchased" to "as consumed"



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As purchased

Edible factors



Without inedible part

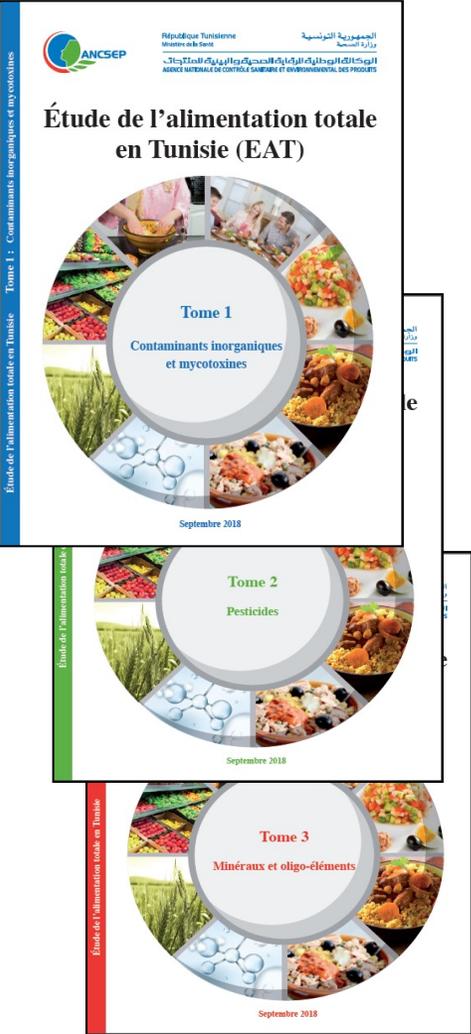
Yield factors



As consumed

Data treatment from household to AME

Table 1 : Conversion Factors for the AME transformation [FAO / WHO / UNU, 2004].



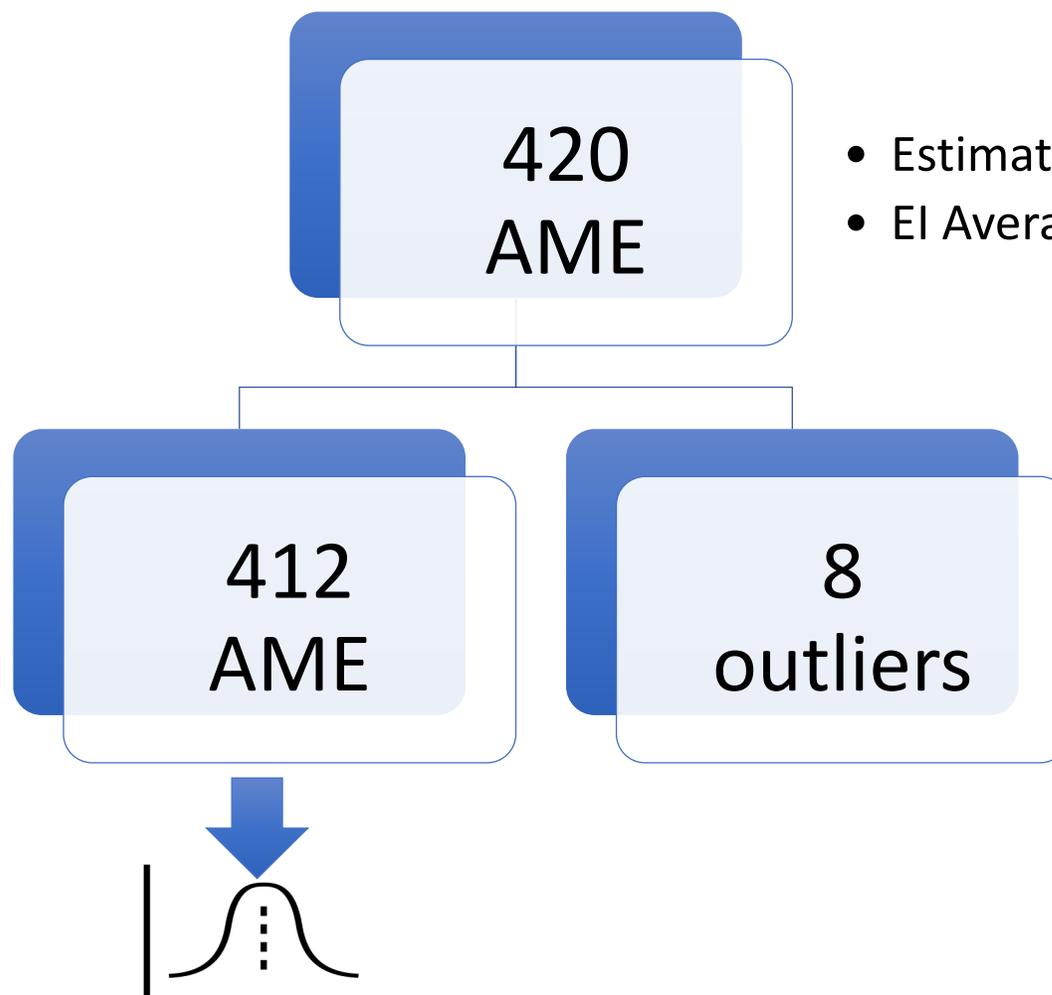
Age	Male	Female
0 to 1 year	0,225	0,225
2 to 3 years	0,450	0,450
4 to 6 years	0,620	0,620
7 to 10 years	0,690	0,690
11 to 14 years	0,860	0,760
15 to 18 years	1,030	0,760
19 to 25 years	1,000	0,760
26 to 50 years	1,000	0,760
> = 51 years	0,790	0,660

Identification & elimination of outliers



Etude de l'alimentation totale en Tunisie. Tome 1, 2 et 3 (ANCSEP, 2018-19)

< Mean EI
+ 3 SD
(5959.53
kcal / day)

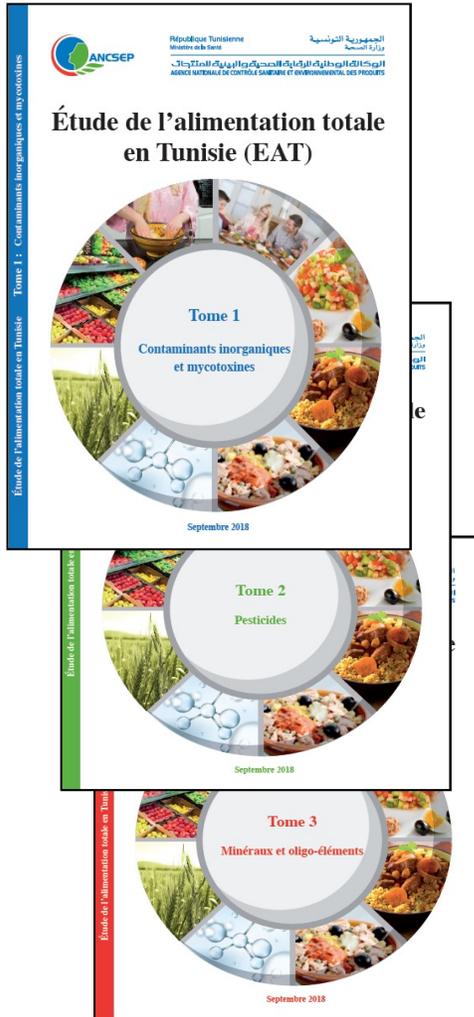


- Estimation of Energy Intakes (EI)
- EI Average = 2745 ± 52 kcal / day

> Mean EI + 3 SD (5959.53
kcal / day)
EI: 6210.99 to 9645.13
kcal / day

consumption distribution

Food consumption data of the Tunisian TDS



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Table 2: Consumption data used to estimate the exposure of the Tunisian adult population

Food item	% consumer	Average (g/AME/day)	% total intake	Maximum (g/AME/day)	Median g/AME/day)	Standard deviation (g/AME/day)	P 5 g/AME/day)	P 95 (g/AME/day)
Citrus fruits	42,96%	25,65	0,88%	638,96	0	60,96	0	108,25
Soft drink	48,06%	44,95	1,55%	426,44	0	67,76	0	168,86
coffee	72,57%	69,87	2,41%	525,63	41,395	82,45	0	230,49
Industrial canned tomato	97,57%	29,32	1,01%	128,7	27,125	16,01	9,1275	60,75
Corete	8,01%	3,19	0,11%	91,74	0	11,98	0	34,54
Whole wheat couscous	13,83%	62,27	2,15%	2004,81	0	244,99	0	358,06
Dattes	11,65%	3,35	0,12%	83,24	0	11,75	0	25,08

Thank you

Questions?

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