TDS in Portugal

A harmonized approach - results and challenges

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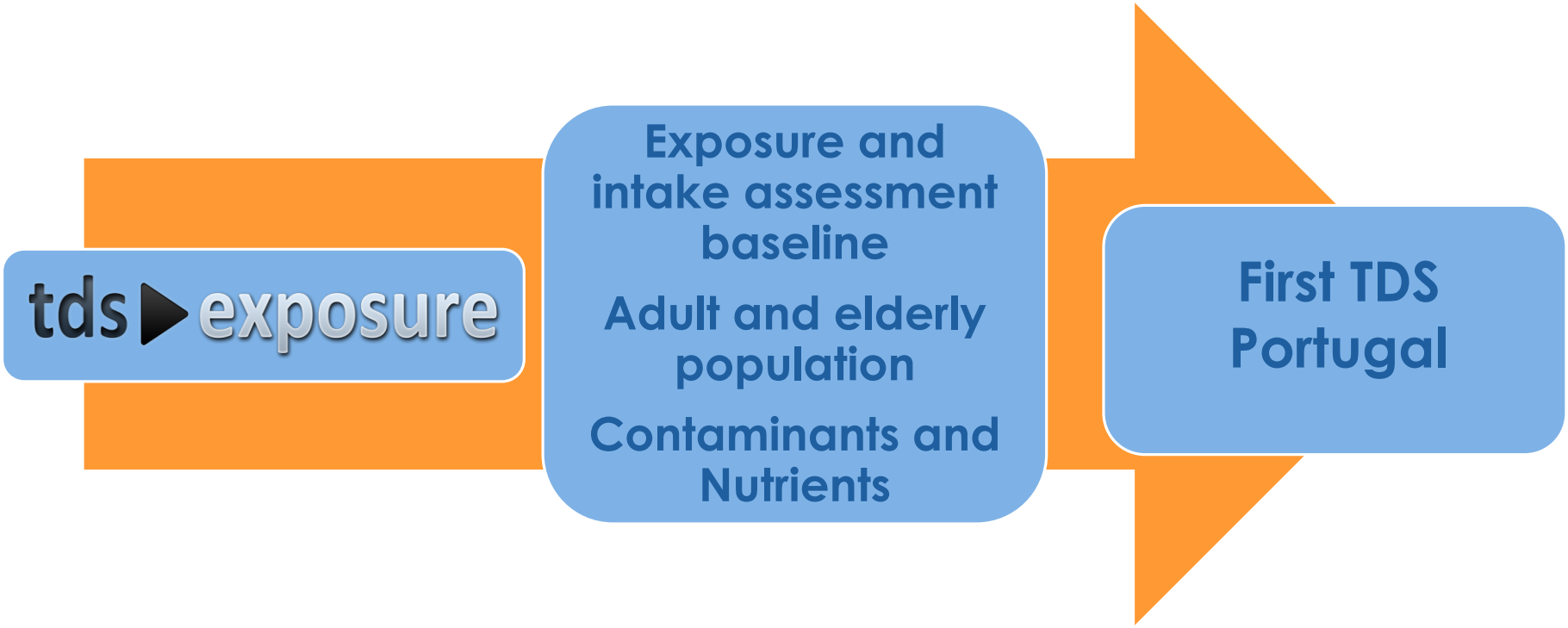
TDS in Portugal

A harmonized approach



Planning phase

Food consumption data source

Definition of the TDS food list and TDS samples

Pooling of TDS food list itens into TDS samples

Sampling plan

Cleansing of the food consumption data Foods – 1070 (45% of the intials)	Mapping to the EFSA FoodEx2 system	Calculation of average food consumption	Selection of foods to be included in the TDS food list

'Portuguese Population's Food Habits and Lifestyles' (AEVPP09)

February-April 2009

Food consumption data source

National Level

18 – 93 years

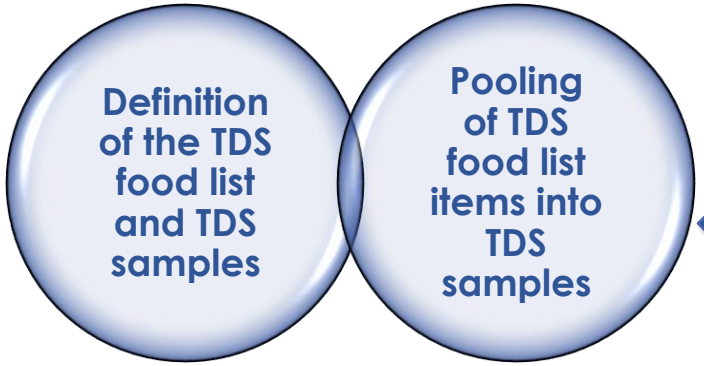
3 529 Individuals

0.033% of the population

one day 24-hour recall

as consumed

The intake of food supplements was not asked



Number of TDS samples by FoodEx2 Groups

FoodEx2 food group number	FoodEx2 Level 1 food Groups	Total Nr of food items	Nr of food items selected for the TDS food list	Nr of TDS Samples	% Consumption covered
1	Additives, flavours, baking and processing aids	2	0	0	-
2	Alcoholic beverages	28	7	2	94
3	Animal and vegetable fats and oils	7	3	2	96.4
4	Coffee, cacao and tea and infusions	12	9	4	99.7
5	Composite dishes	360	191	34	95.6
6	Eggs and egg product	2	1	1	99.9
7	Fish, seafood, amphibians, reptiles and invertebrates	68	41	25	96.9
8	Food products for young population	-	-	-	-
9	Fruit and fruit products	65	15	14	95.6
10	Fruit and vegetable juices and nectars	43	38	2	99.3
11	Grains and grain-based products	158	67	21	95.1
12	Legumes, nuts, oilseeds and spices	21	11	8	96.5
13	Meat and meat products	68	49	11	97.7
14	Milk and dairy products	89	30	6	95.8
15	Products for non-standard diets, food imitates and food supplements	9	4	2	73.3
16	Seasoning, sauces and condiments	22	14	5	94.7
17	Starchy roots or tubers and products thereof, sugar plants	7	1	1	92.6
18	Sugar, confectionery and water-based sweet desserts	23	12	3	96
19	Vegetables and vegetable products	46	22	19	95.7
20	Water and water-based beverages	40	13	4	94.8
	Total	1070	528	164	

The most consumed foods belonged to the FoodEx2 groups

‘Composite dishes’ (6.777 g/kg bw/day)

‘Water and water-based beverages’ (4.741 g/kg bw/day)

‘Milk and dairy products’ (4.287 g/kg bw/day)

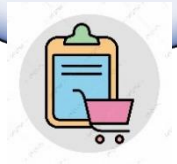
‘Coffee, cacao, tea and infusions’ (2.713 g/kg bw/day)

‘Fruit and fruit products’ (2.660 g/kg bw/day)

Fieldwork phase

Organisation of food collection and sample preparation

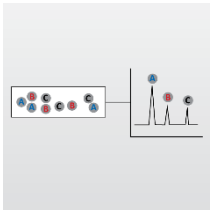
Food collection



Sample reception

Sample treatment and storage

Analytical Phase



Exposure and Intake Assessment Phase

Food collection in numbers

2 years collection

2724 subsamples + ingredients

9 100 € (food itens)

5 600 km (1 750 €)

1.5% territory
5% population

Great Lisbon Area

227 TDS food samples

126 ‘national’
17 ‘regional non-seasonal’
21 were ‘regional seasonal

Analytical Phase

Inorganic contaminants and other elements
(arsenic, mercury, cadmium, lead, cupper, manganese, selenium, zinc, potassium, iron, magnesium, phosphorus, calcium, sodium, Iodine)

Carotenoids
(alpha-carotene, beta-carotene, beta-cryptoxanthin, lycopene, lutein, zeaxanthin)

Mycotoxins
(patulin, Aflatoxin B1, B2, G1, G2, M1 and Ocratoxin A)

Nitrates

Vitamins
(vitamin D, A, E, B1, B2)

Macronutrients
(fat, total sugars, fiber, carbohydrates, energetic value, humidity, ash and protein)

Fatty acids

Exposure and Intake Assessment

Dietary exposure/intake assessment - semiprobabilistic approach.

FoodEx2 food classification system codes - Linkage of occurrence and consumption data.

TDS samples collected in four seasons - mean occurrence value was used.

Exposure/intake evaluation - MCRA software using the OIM model.

Management of left-censored data by substitution.

Exposure / intake assessment

- Upper (UB) and/or lower (LB) bound approach.
- Mean, median (P50) and 95th percentile (P95).
- µg or mg/kg bw/day // µg or mg/day.
- Population group - 'overall population', 'male and female', 'male', 'female'.
- Age group - 'adults and elderly', 'adults', 'elderly'.

Risk characterization

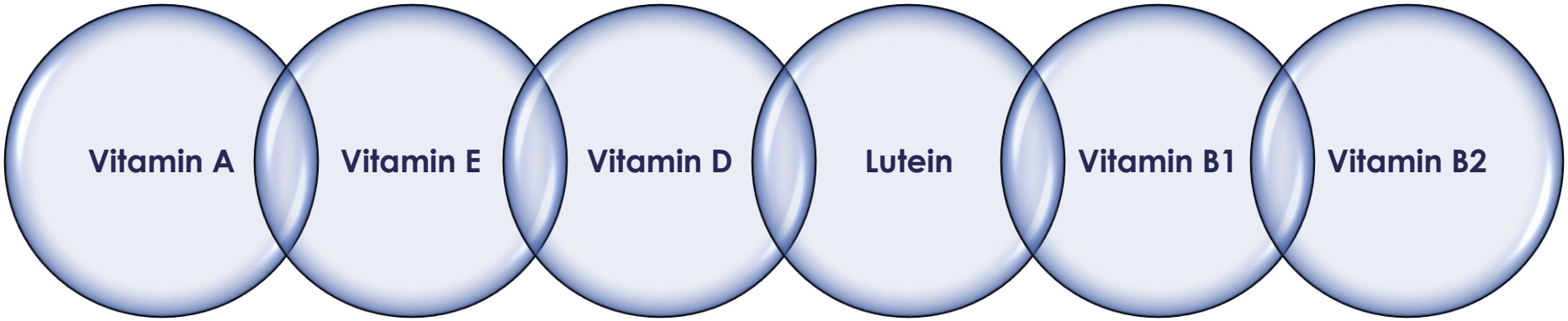
- Exposure - Estimated exposure values compared with the health based guidance value (HBGV) .
- Intake - Estimated intake values compared to the Dietary Reference Value (DRV).

Analytical Determinations // Intake Assessment

Vitamins

Analytical Method

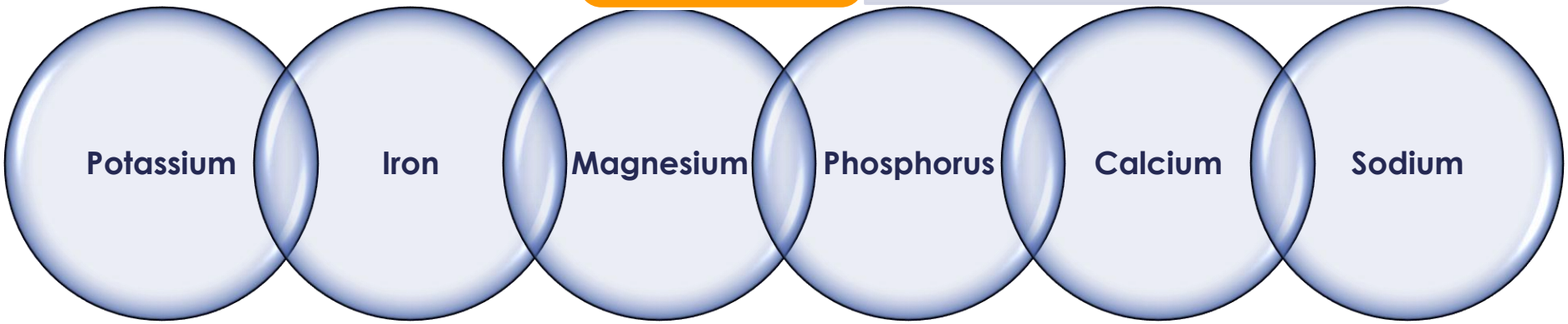
HPLC method, UV/Vis, Fluorescence
ISO/IEC 17025 accredited.



Minerals

Analytical Method

ICP OES // ICP MS
ISO/IEC 17025 accredited.



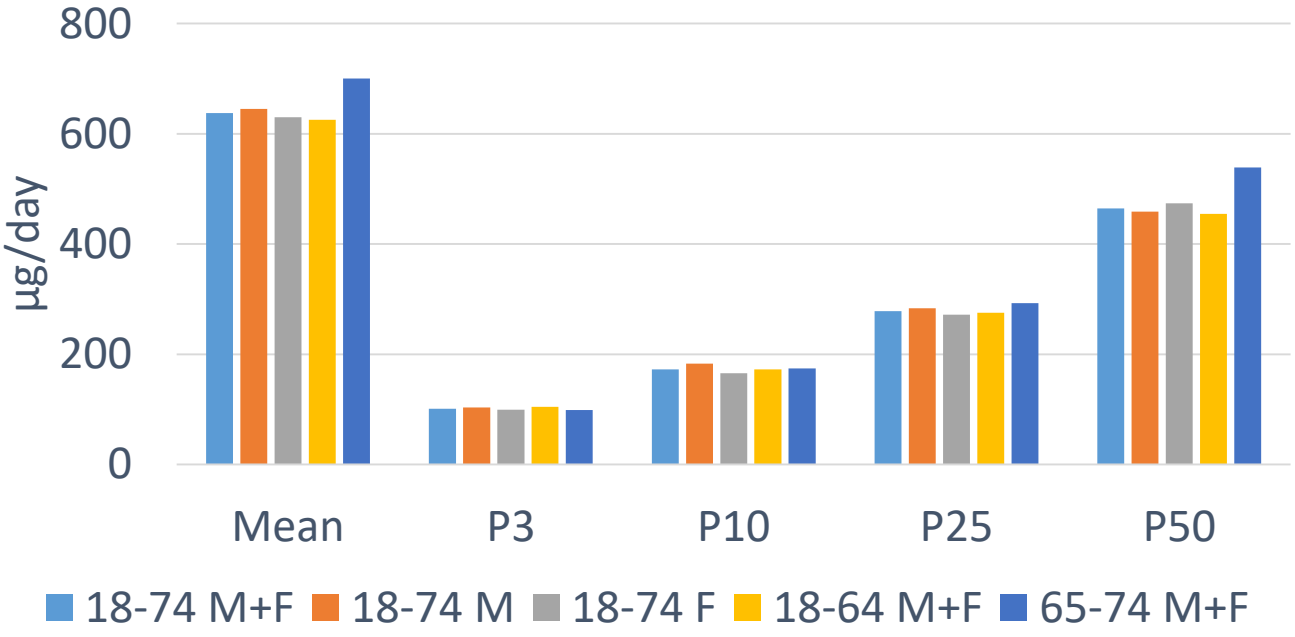
Vitamin A

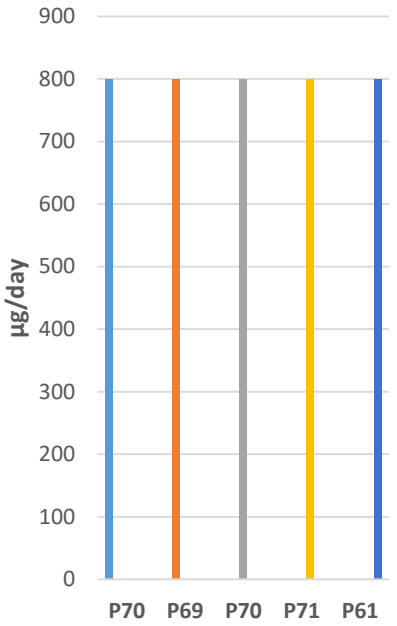
Pre-formed Vit A	Pro Vit A carotenoids
all-trans-retinol	β-carotene/6
13-cis-retinol	α-carotene/12
	β-criptoxanthin/12

EFSA
AR (P50) – 490-570 µg/day
PRI (P97.5) – 650-750 µg/day

Reg 1169/20 11
NRV - 800 µg/day

Vitamin A intake



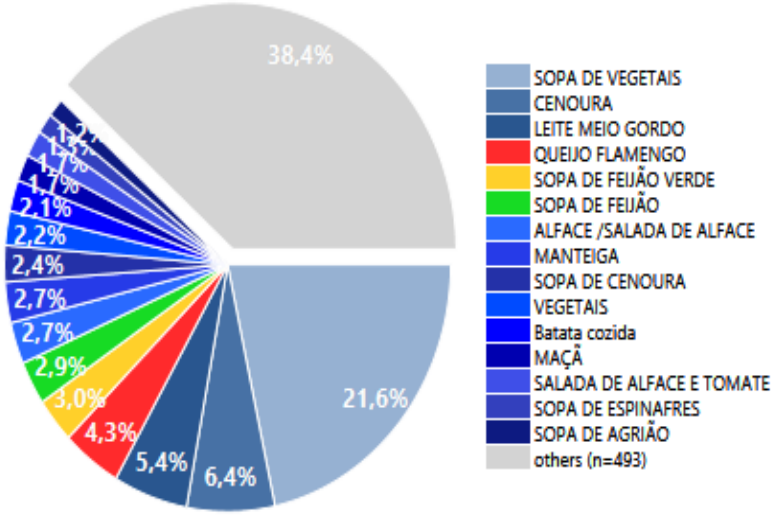


- Tolerable upper intake level (EFSA) – 3000 µg/day
  - Exceeded by 0.1% of the population

Vitamin A

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

F

M

Vegetable Soup
Carrot
Milk
"Flamengo" cheese
Green beans soup
Carrot soup
Beans soup

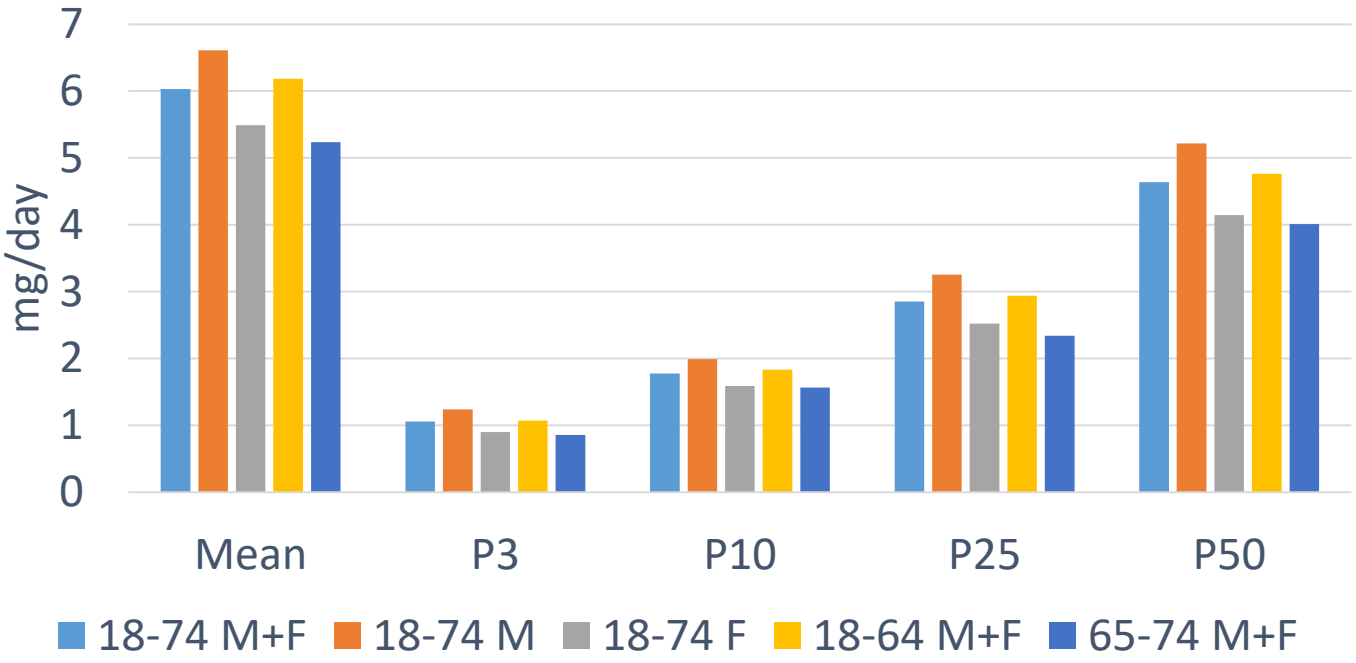
Vitamin E

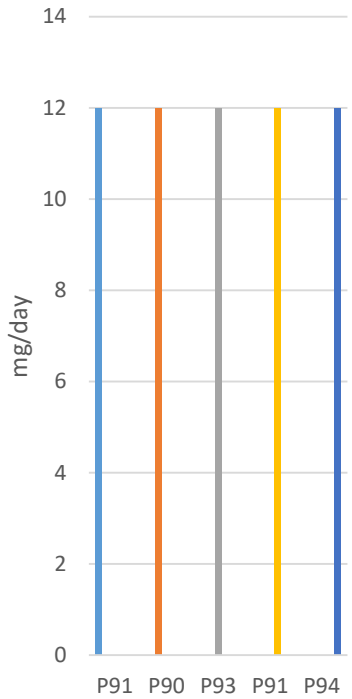
dl-a-tocopherol

EFSA
AI (P97.5) – 11-13 mg/day

Reg 1169/20 11
NRV - 12 mg/day

Vitamin E intake



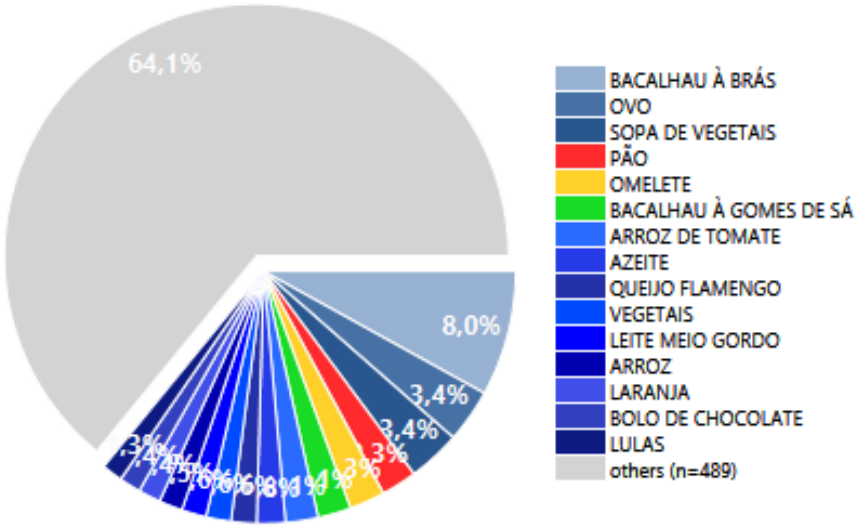


- Tolerable upper intake level (EFSA) – 300 mg/day
  - Exceeded by 0.0% of the population

Vitamin E

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

F

M

Codfish "à Brás" (+fried potatoes+eggs)
Eggs
Vegetable soup
Bread
Olive oil
Tomato rice
Omelette

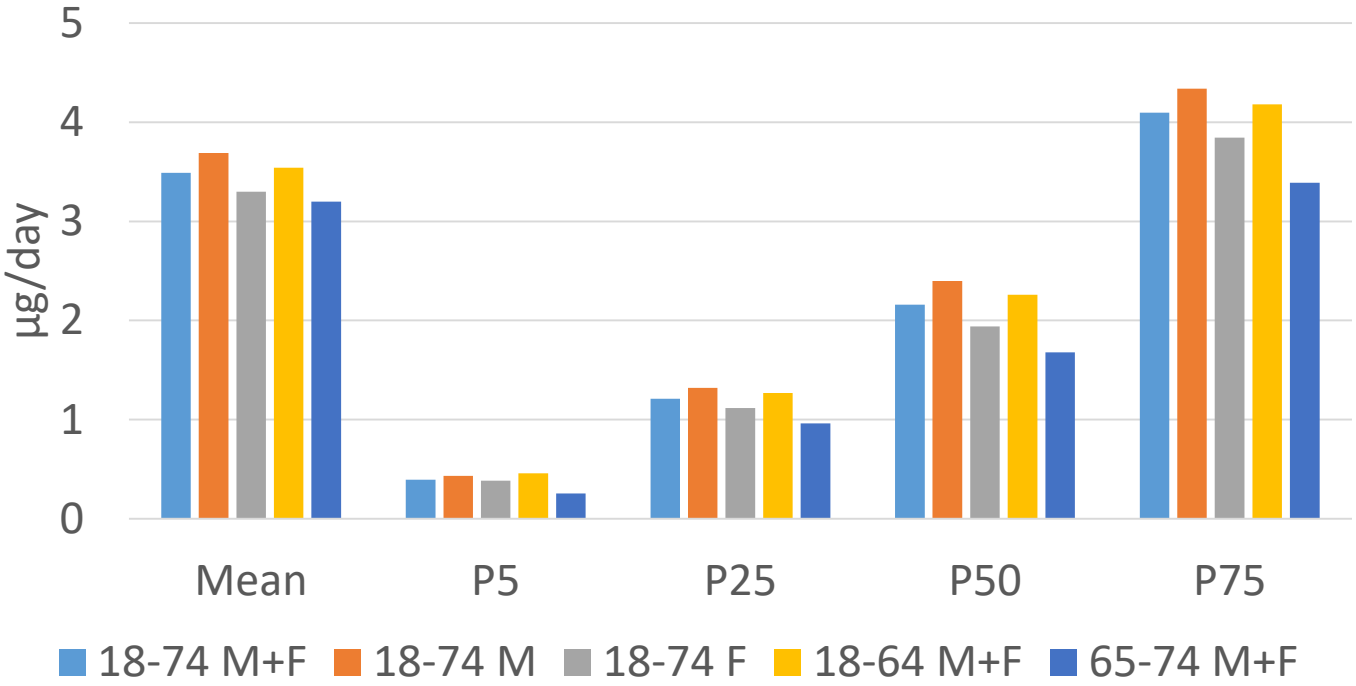
Vitamin D

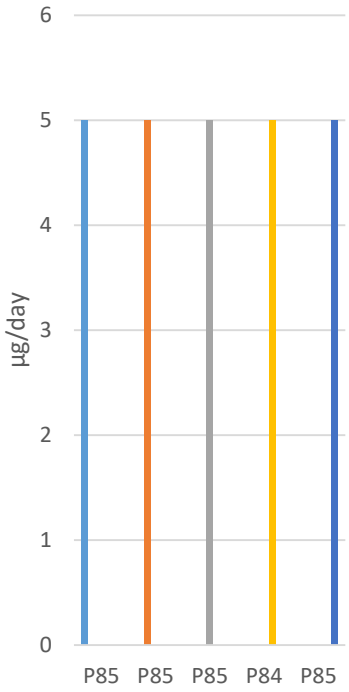
D_3 – cholecalciferol
D_2 - ergocalciferol

EFSA
AI (P97.5) – 15 µg/day

Reg 1169/20 11
NRV - 5 µg/day

Vitamin D intake



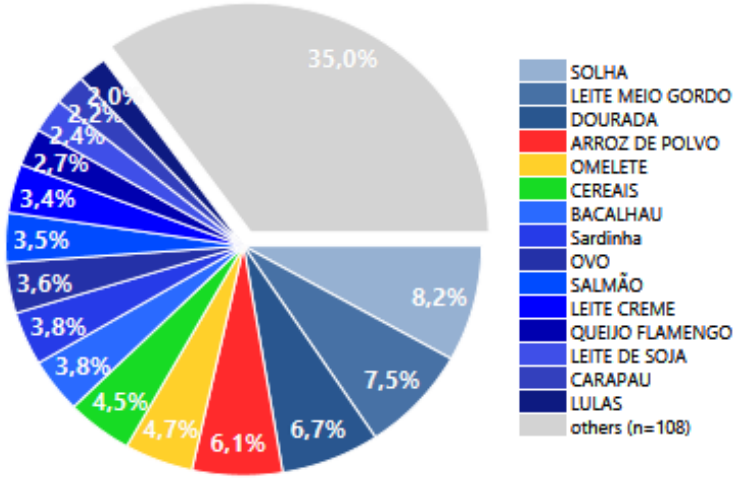


- Tolerable upper intake level (EFSA) – 100 µg/dia
  - Exceeded by 0.0% of the population

Vitamin D

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

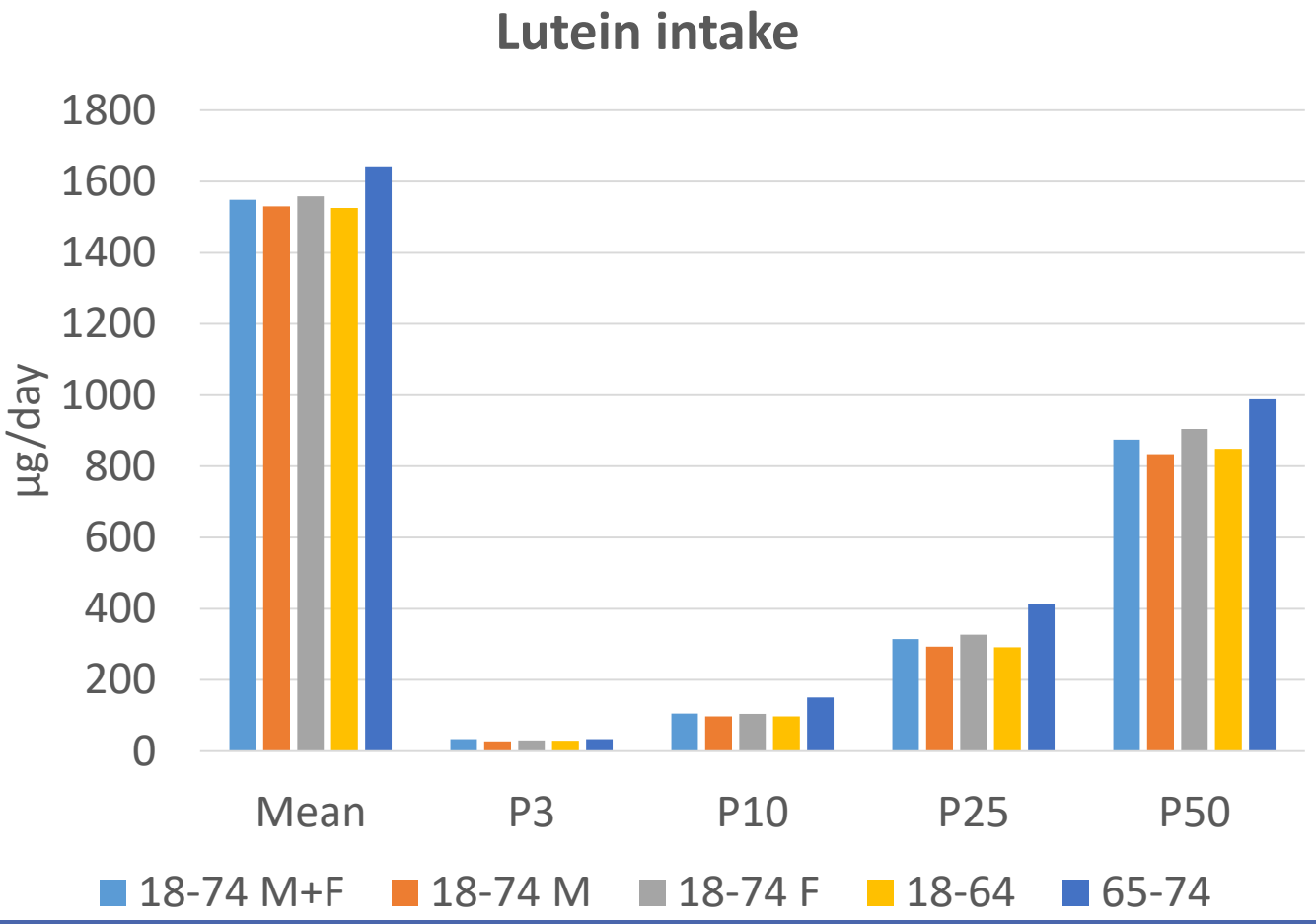
F

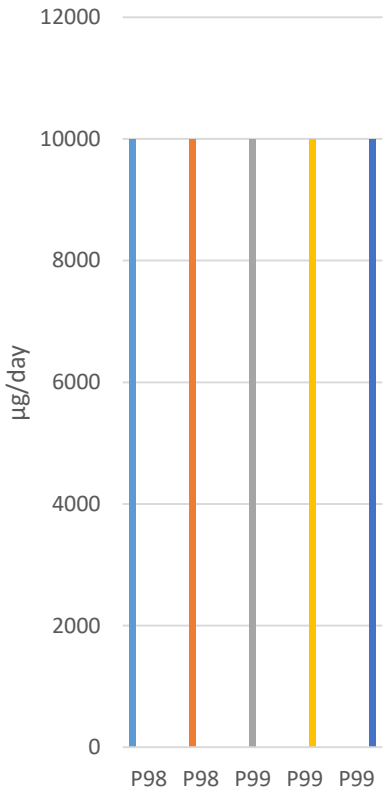
M

Plaice
Gilthead seabream
Milk
Octopus rice
Omelette
Beakfast cereals
(fortified)

Lutein

NRV to be recommended according to several studies - 10 mg/day

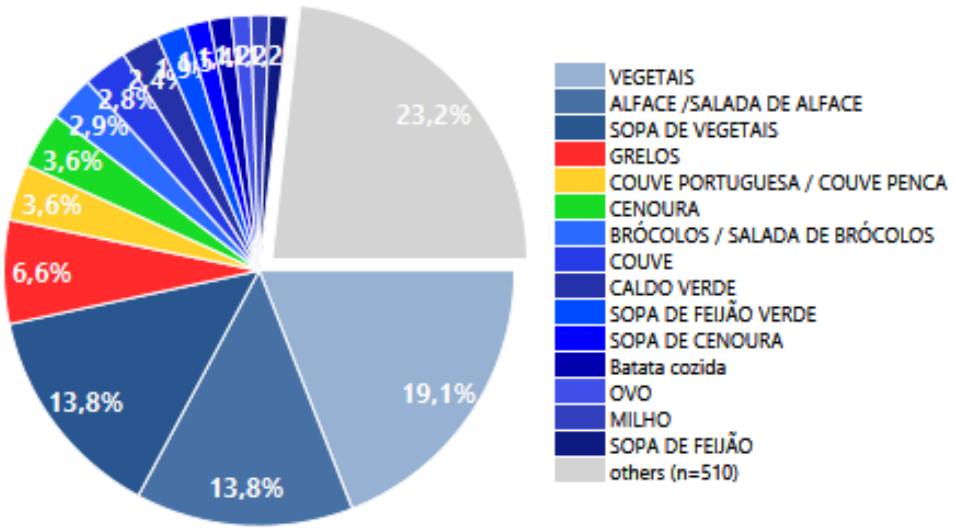




Lutein

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

F

M

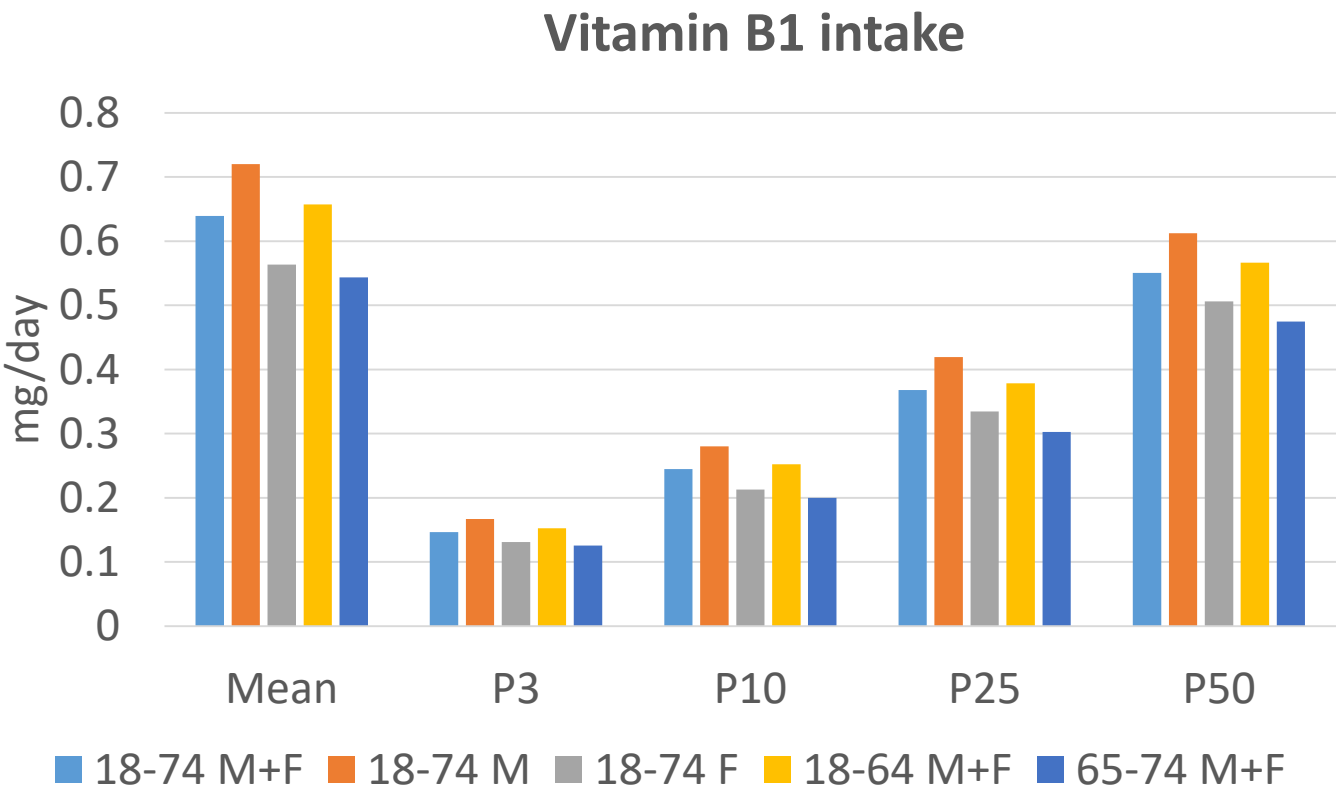
Mixed vegetables
Lettuce
Vegetable soup
Rapini
Portuguese cabbage

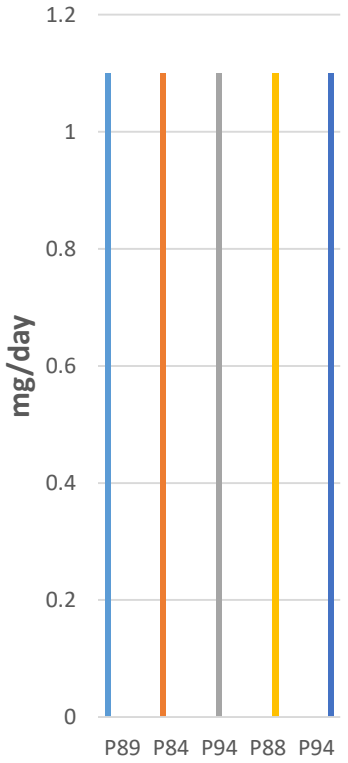
Vitamin B1

Thiamin

EFSA
AR (P50) – 0.60 mg/day
PRI (P97.5) – 0.84 mg/day

Reg 1169/20 11
NRV – 1.1 mg/day

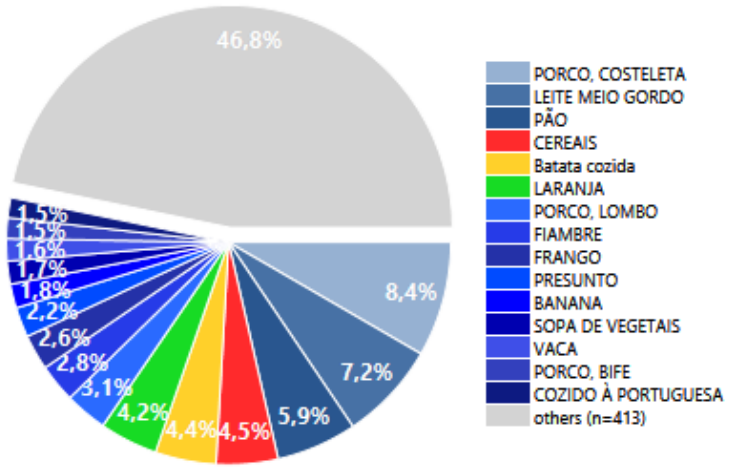




Vitamin B1

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

F

M

Pork chop
Milk
Bread
Breakfast cereals
Potatoes
Orange

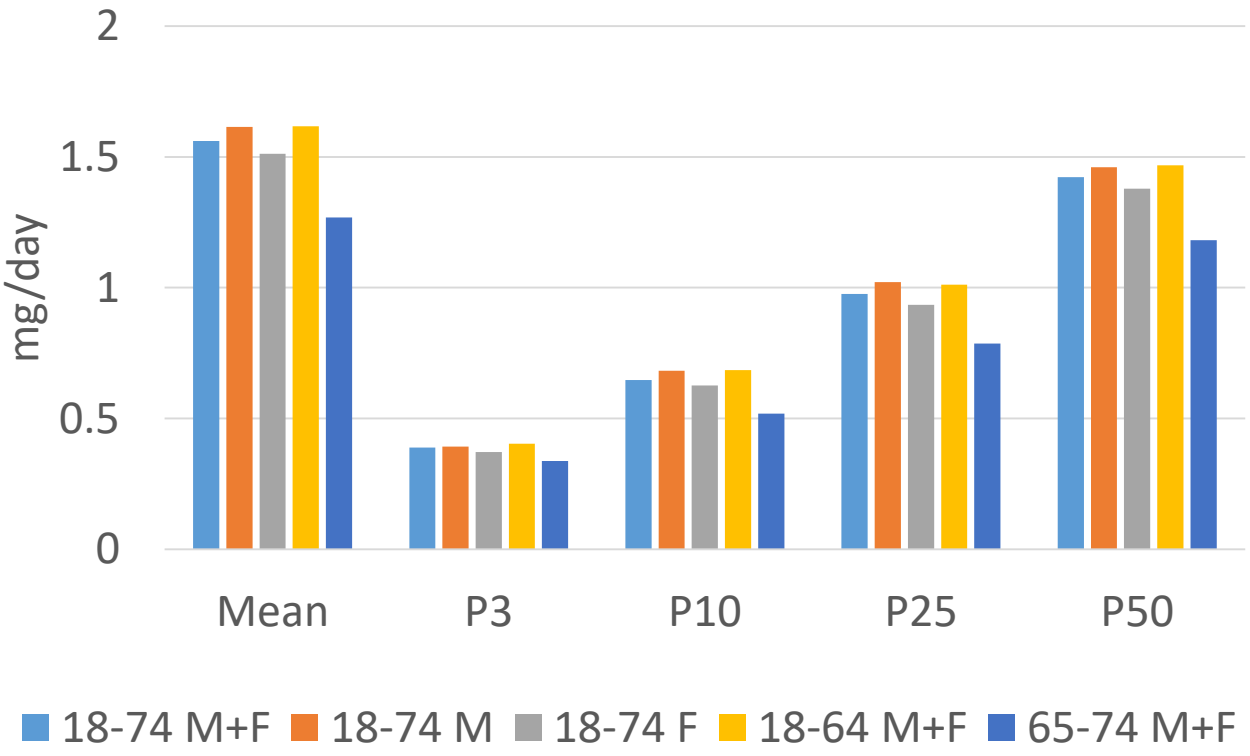
Vitamin B2

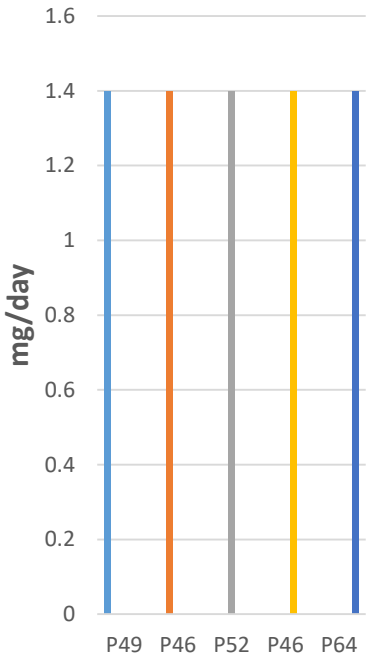
Riboflavin

EFSA
AR (P50) – 1.3 mg/day
PRI (P97.5) – 1.6 mg/day

Reg 1169/20 11
NRV – 1.4 mg/day

Vitamin B2 intake

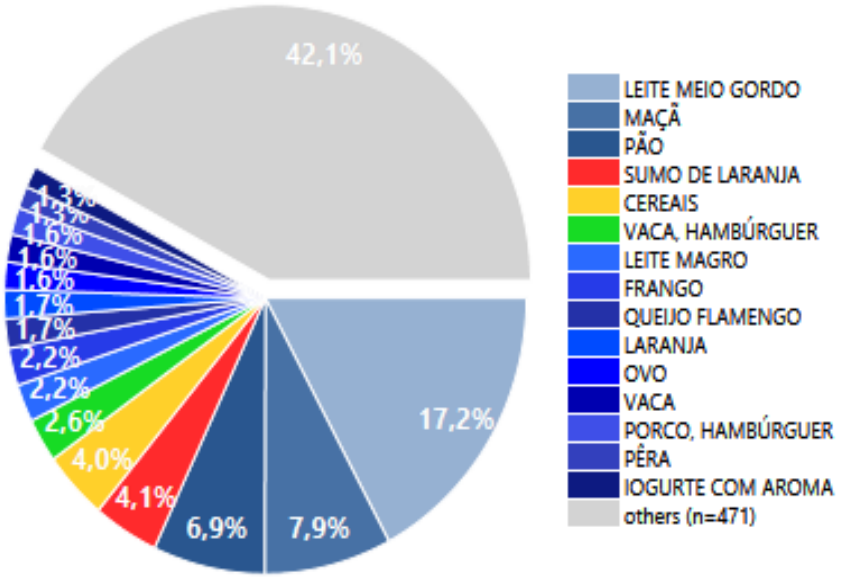




Vitamin B2

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

F

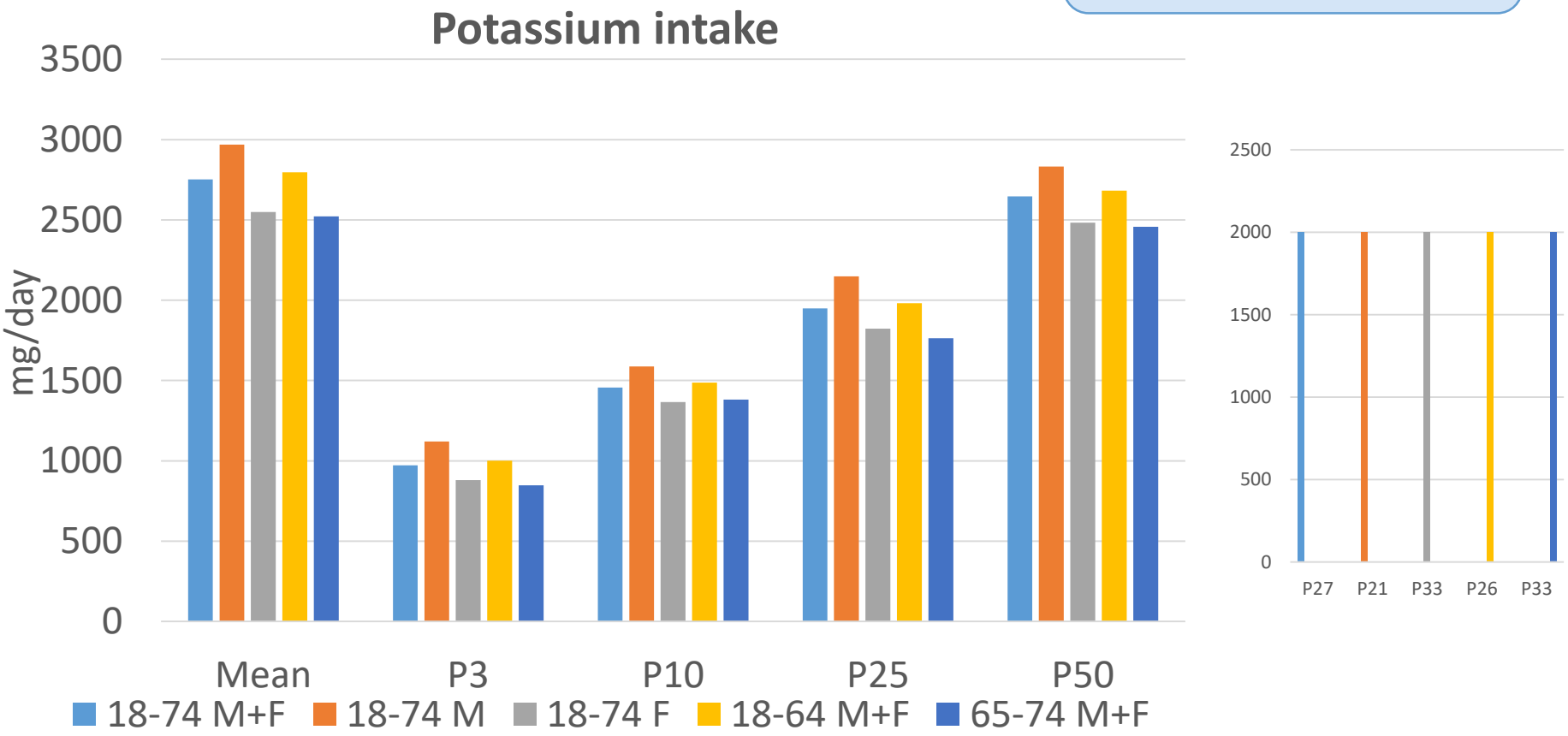
M

Milk
Apple
Bread
Orange juice
Breakfast cereals
Hamburguer, beef

Potassium

EFSA
AI (P97.5) – 3500 mg/day

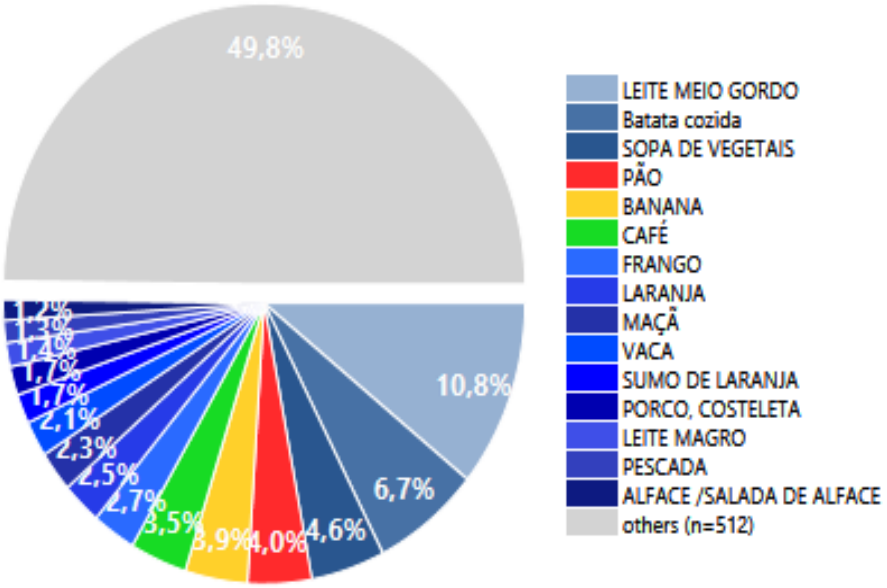
Reg 1169/20 11
NRV – 2000 mg/day



Potassium

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

F

M

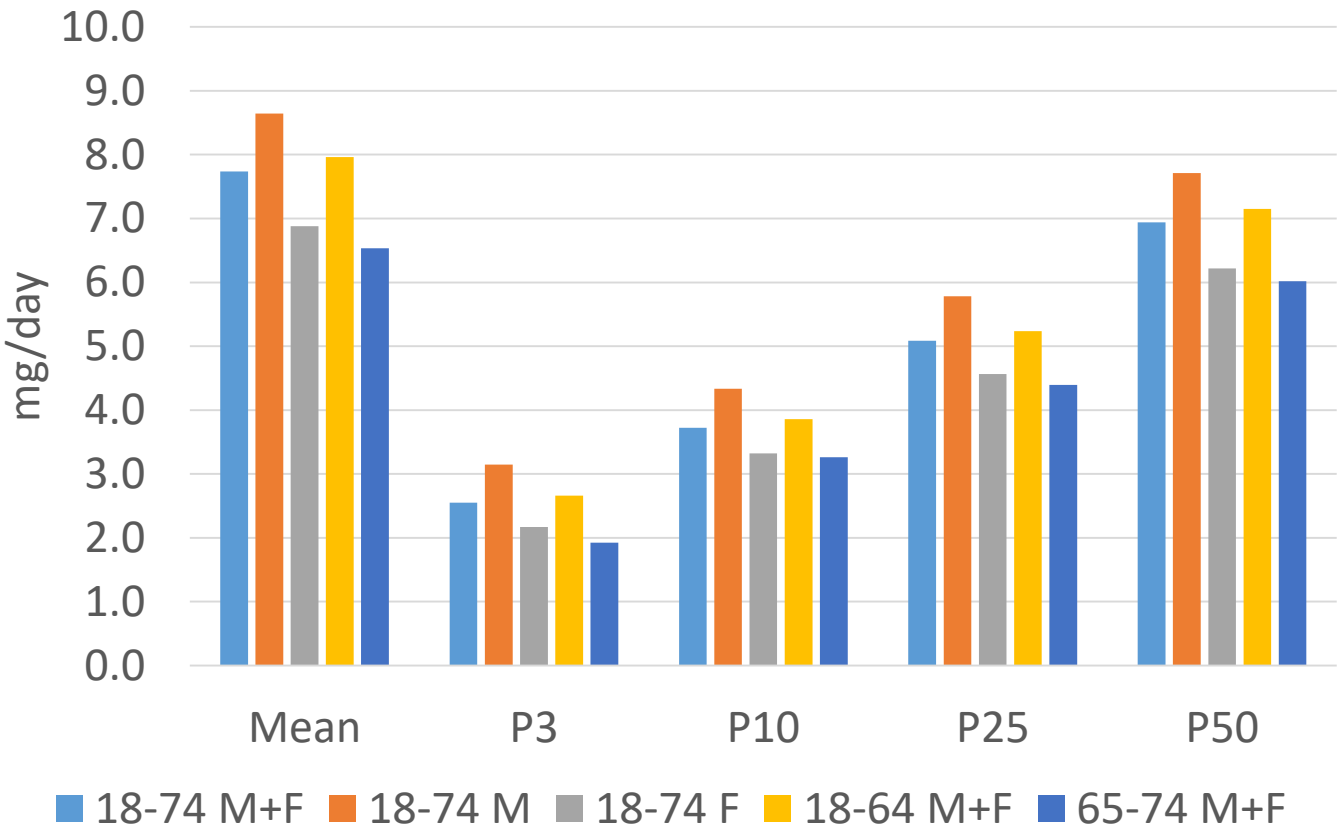
Milk
Potatoes
Vegetable soup
Bread
Banana
Coffee

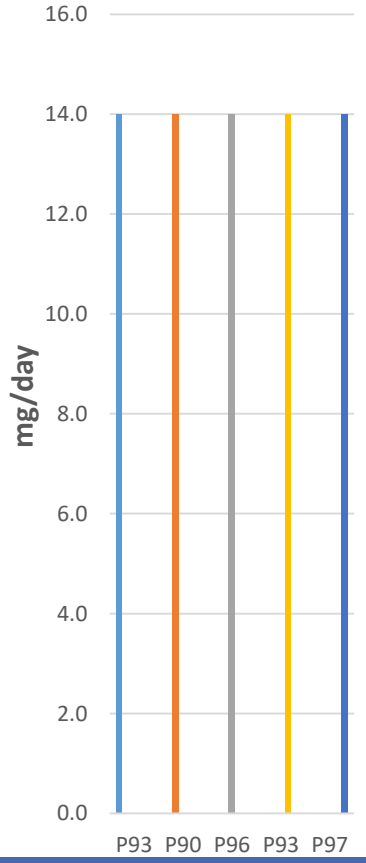
Iron

EFSA
AR (P50) – 7 mg/day
PRI (P97.5) – 16 mg/day

Reg 1169/20 11
NRV – 14 mg/day

Iron intake

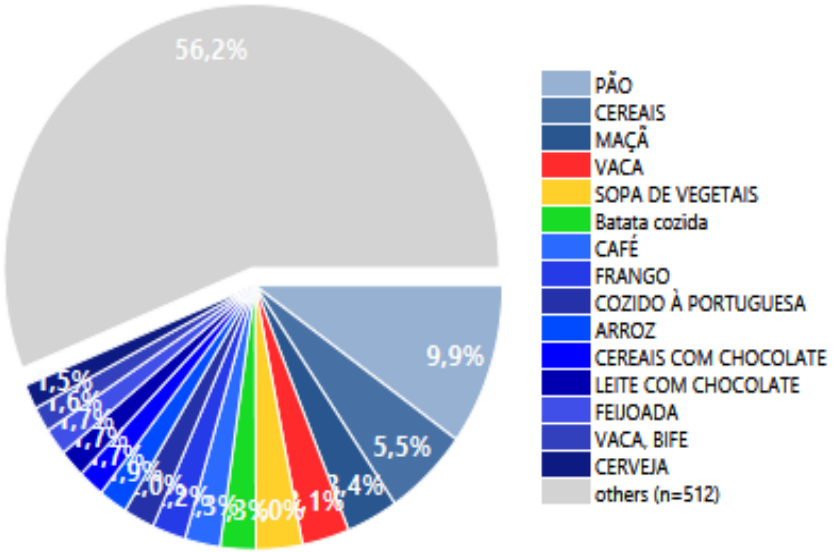




Iron

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

F

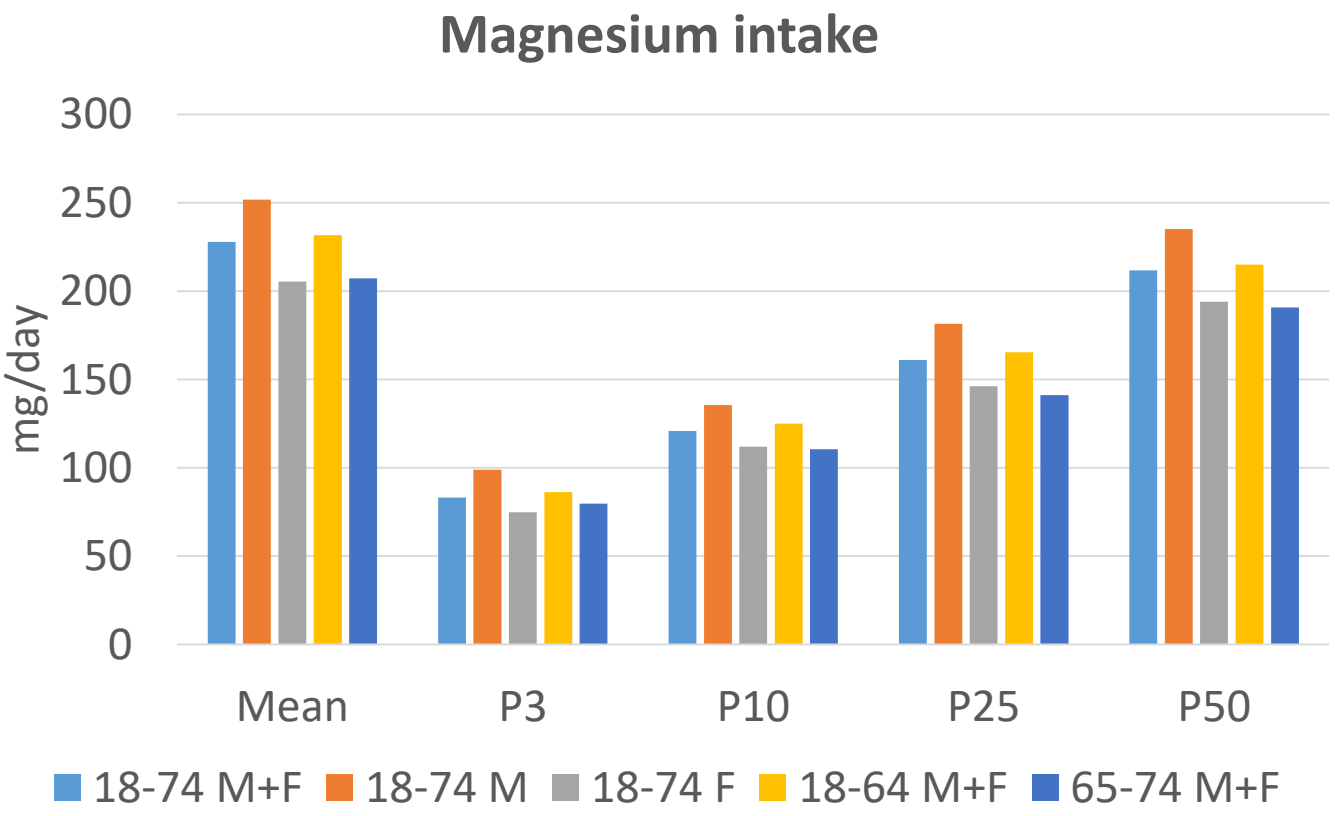
M

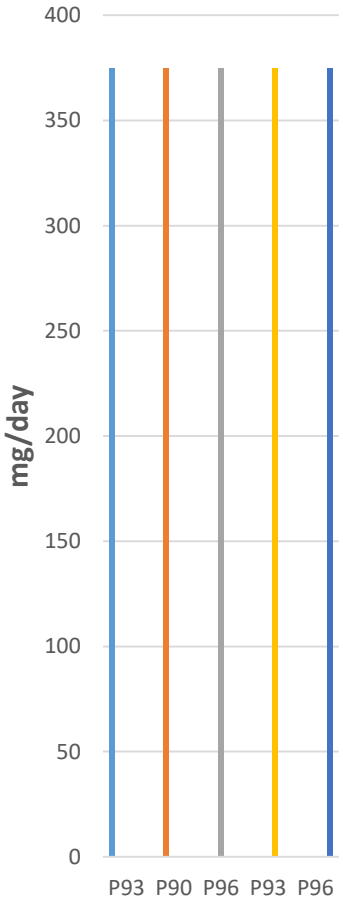
Bread
Breakfast cereals
Apple
Beef
Vegetable soup

Magnesium

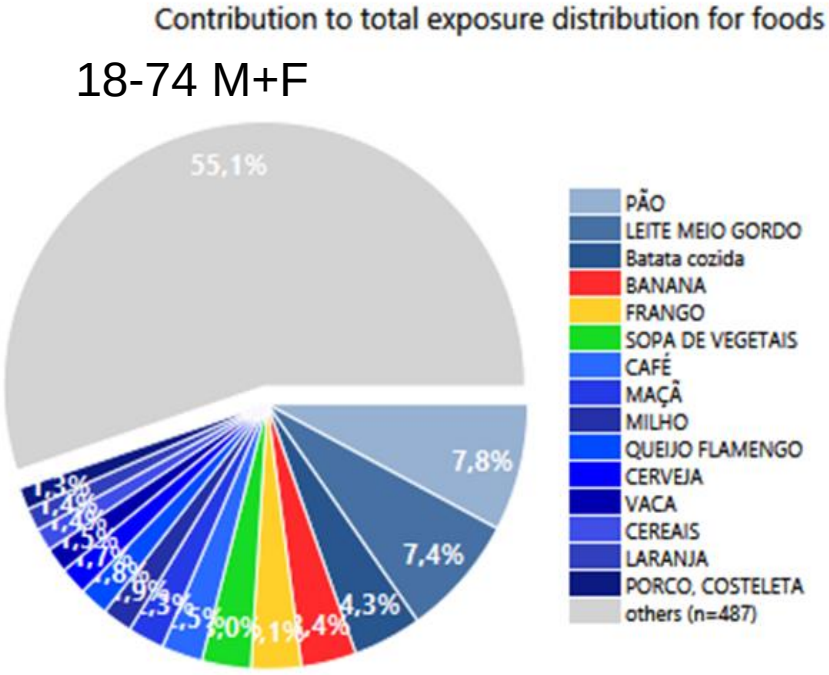
EFSA
AI (P97.5) – 300 mg/day

Reg 1169/20 11
NRV – 375 mg/day





Magnesium

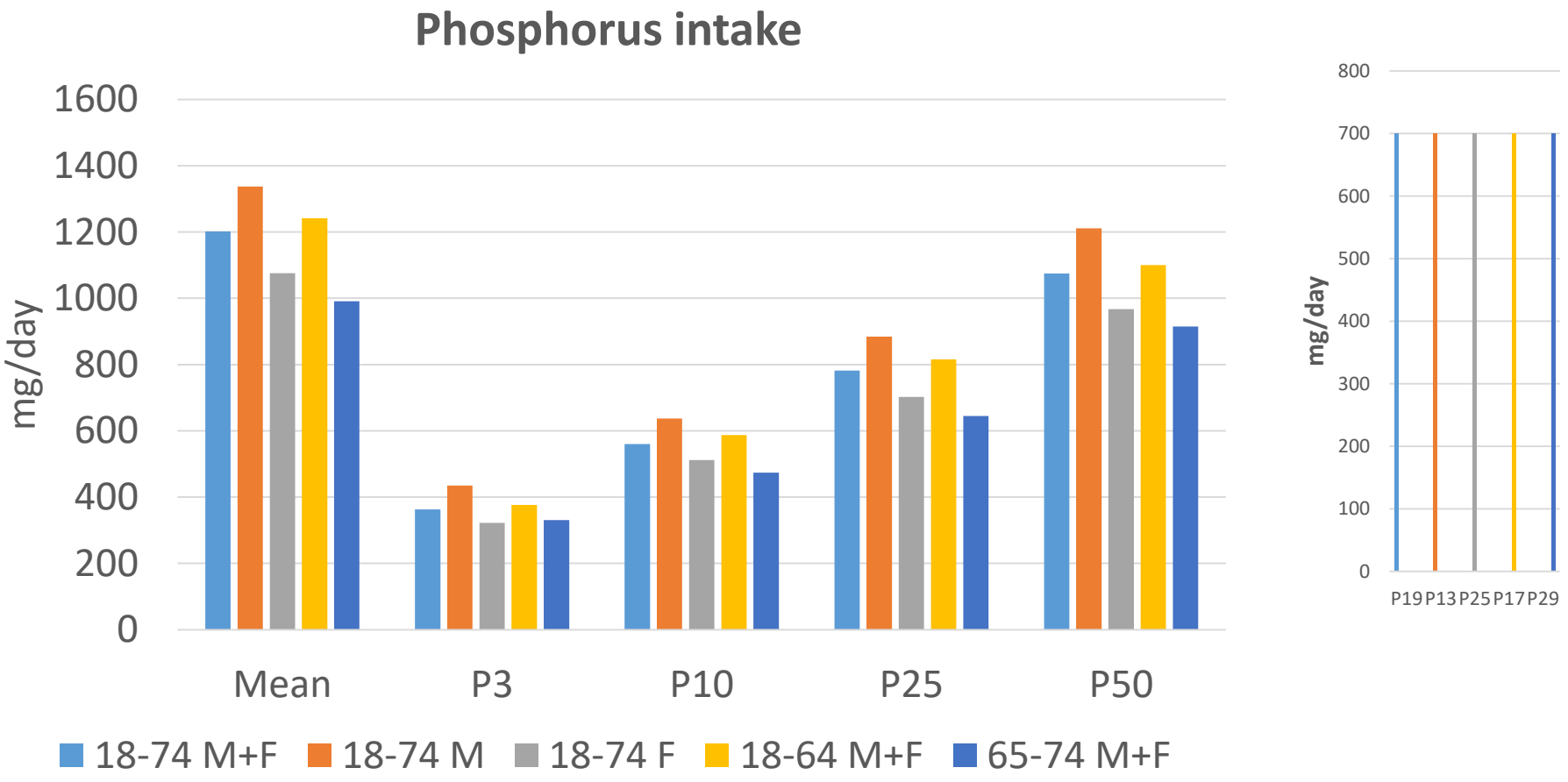


Bread
Milk
Potatoes
Banana
Chicken
Vegetable soup

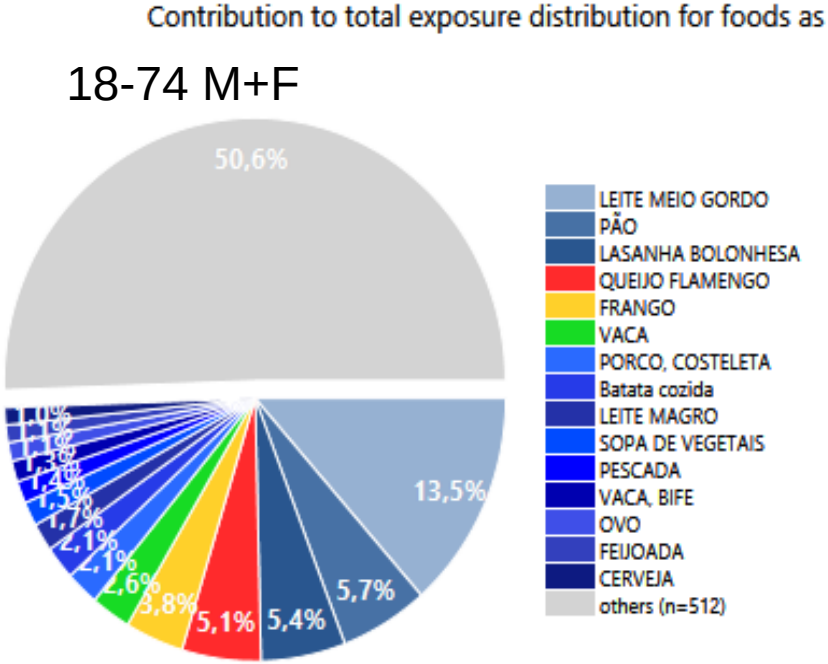
Phosphorus

EFSA
AI (P97.5) – 550 mg/day

Reg 1169/20 11
NRV – 700 mg/day



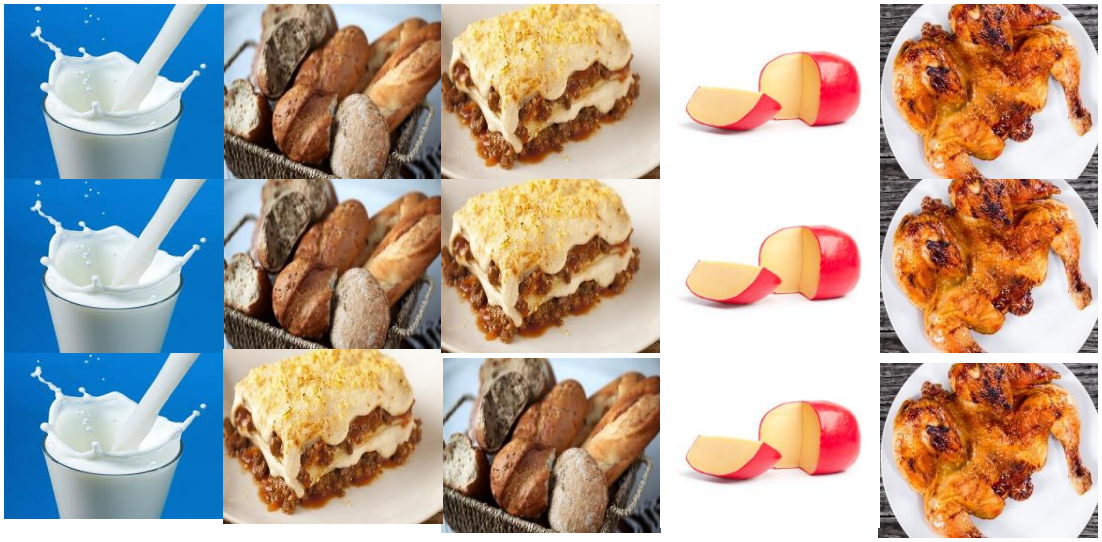
Phosphorus



M+F

F

M

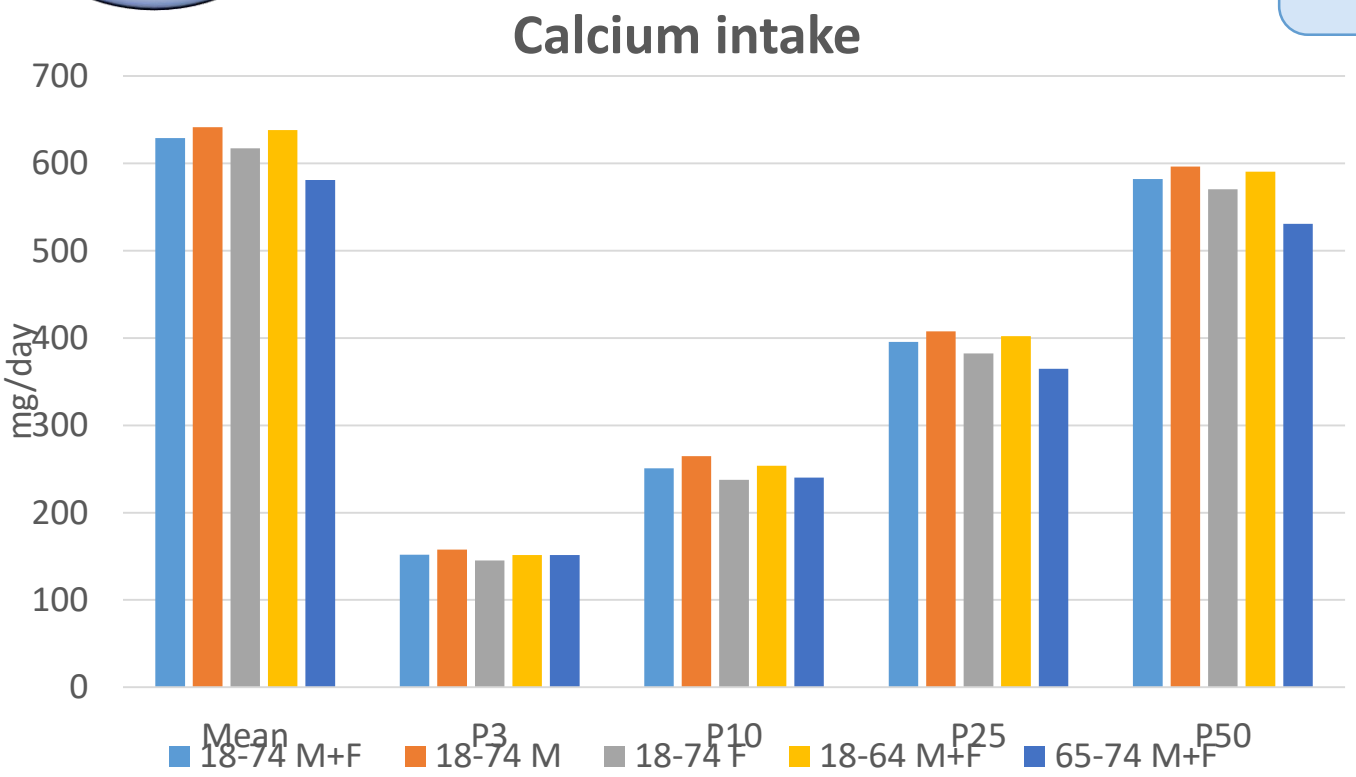


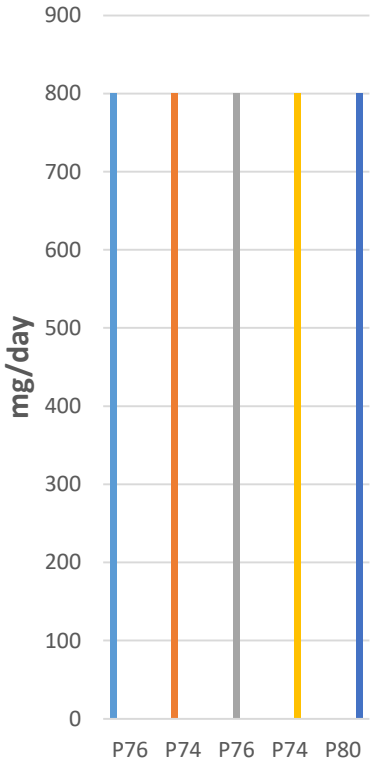
Milk
Bread
Potatoes
Lasagna bolognese
"Flamengo" cheese
Chicken

Calcium

EFSA
AR (P50) – 860 mg/day
PRI (P97.5) – 1000 mg/day

Reg 1169/20 11
NRV – 800 mg/day



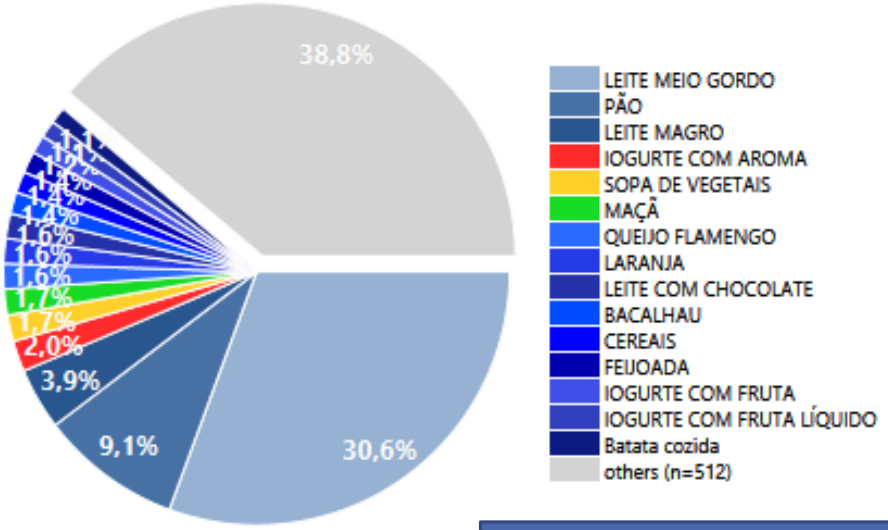


- Tolerable upper intake level (EFSA) – 2500 mg/dia
  - Exceeded by 0.06% of the population

Calcium

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

F

M

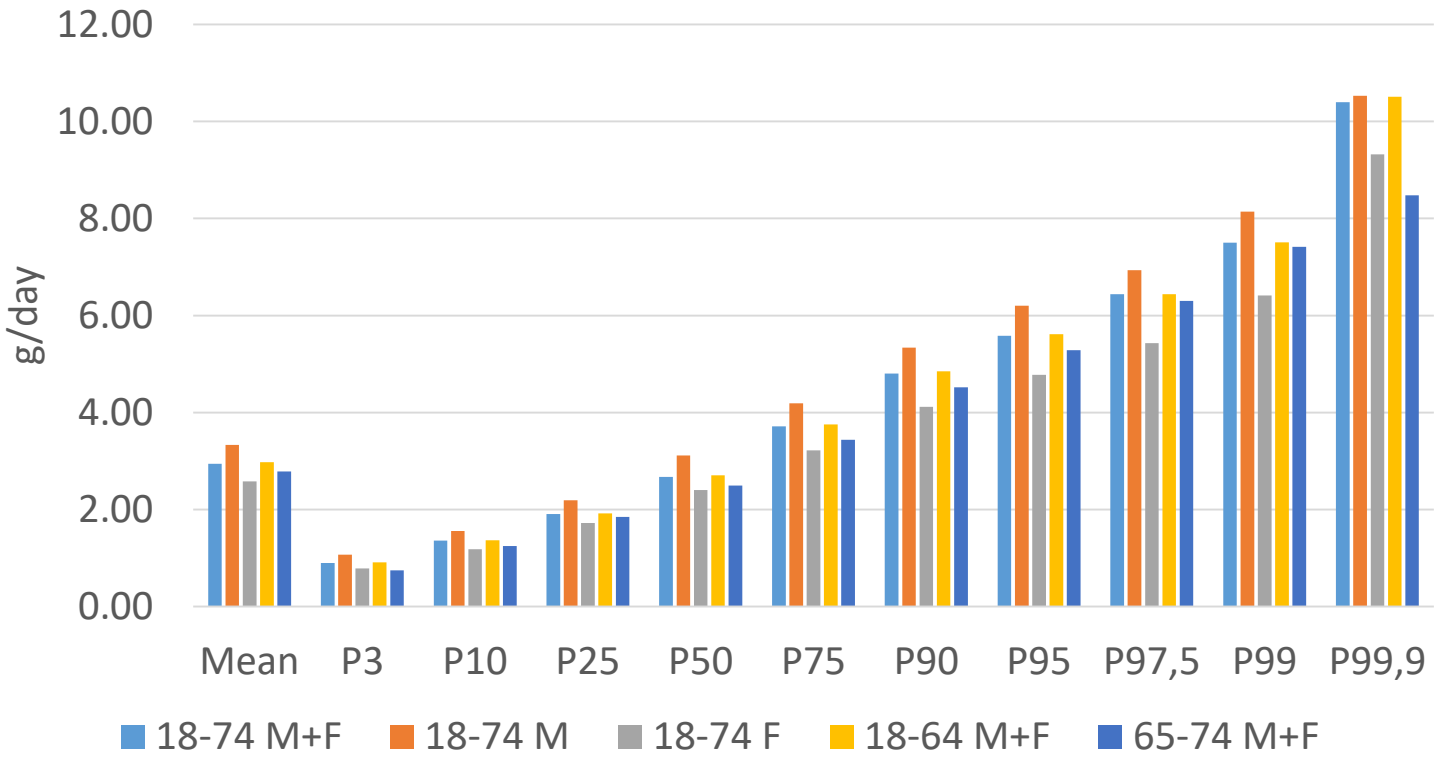
Milk
Bread
Yogurt
Beans stew
(+ vegetables + pork meat)
Vegetable soup
Apple
"Flamengo" cheese

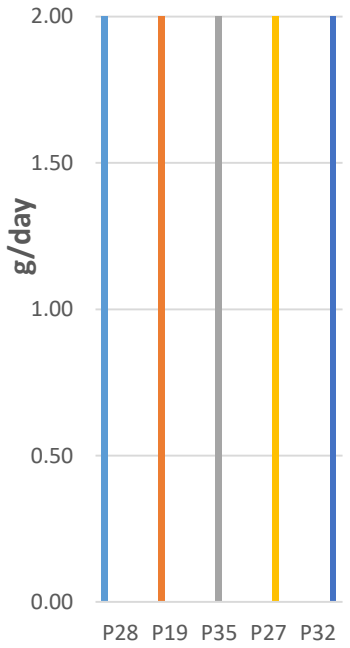
Sodium

EFSA
Safe and adequate intake: 2 g/day

Reg 1169/20 11
NRV – 2.5 g/day

Sodium intake



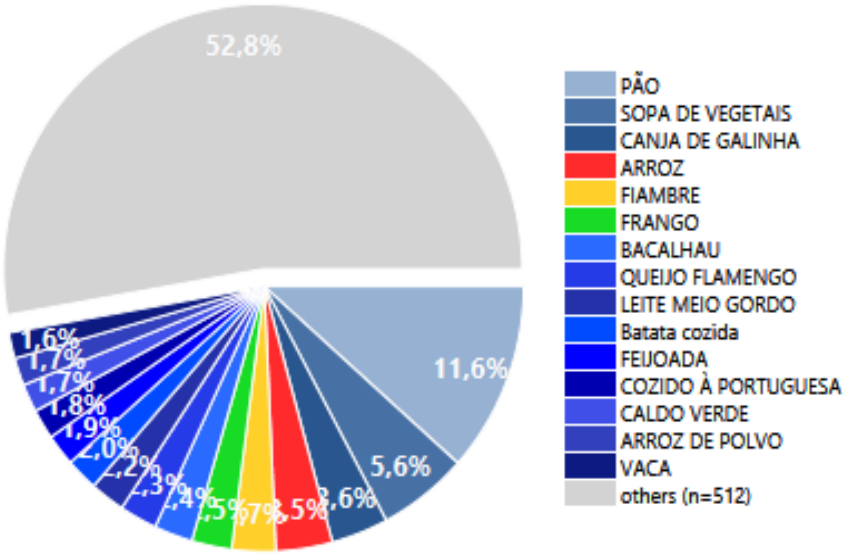


- Safe and adequate intake (EFSA) – 2 g/dia
  - Exceeded by 72% of the population

Sodium

Contribution to total exposure distribution for foods as eaten

18-74 M+F



M+F

F

M

Bread
Vegetable soup
Chicken soup
Rice
Cooked ham
Chicken

Vitamins and Minerals intake evaluation

Inadequacy (< AR//0.67 AI)

Vit. A	Vit. E	Vit. D	Vit. B_1	Vit. B_2
52-58%	78-83%	95%	45%	42%

K	Fe	Mg	P	Ca
38%	51%	45%	3%	80%

Population exceeding the safe and adequate intake

Na
72%

TDS vs Consumption Survey/FCompositionD

	A (µg/day)	E (mg/day)	D (µg/day)	B_1(mg/day)	B_2(mg/day)
TDS - P50	464✓	4.6✓	2.2✓	0.55✓	1.4✓
Cons Survey - P50	701✓	9.0✓	3.7✓	1.3✓	1.5✓

	K (mg/day)	Fe (mg/day)	Mg (mg/day)	P (mg/day)	Ca (mg/day)
TDS - P50	2646✓	6.9✓	212✓	1075✓	582✓
Cons Survey - P50	3057✓	11✓	279✓	1236✓	733✓

	Na (g/100 g)
TDS - P50	2.67✓
Cons Survey - P50	3.01✓

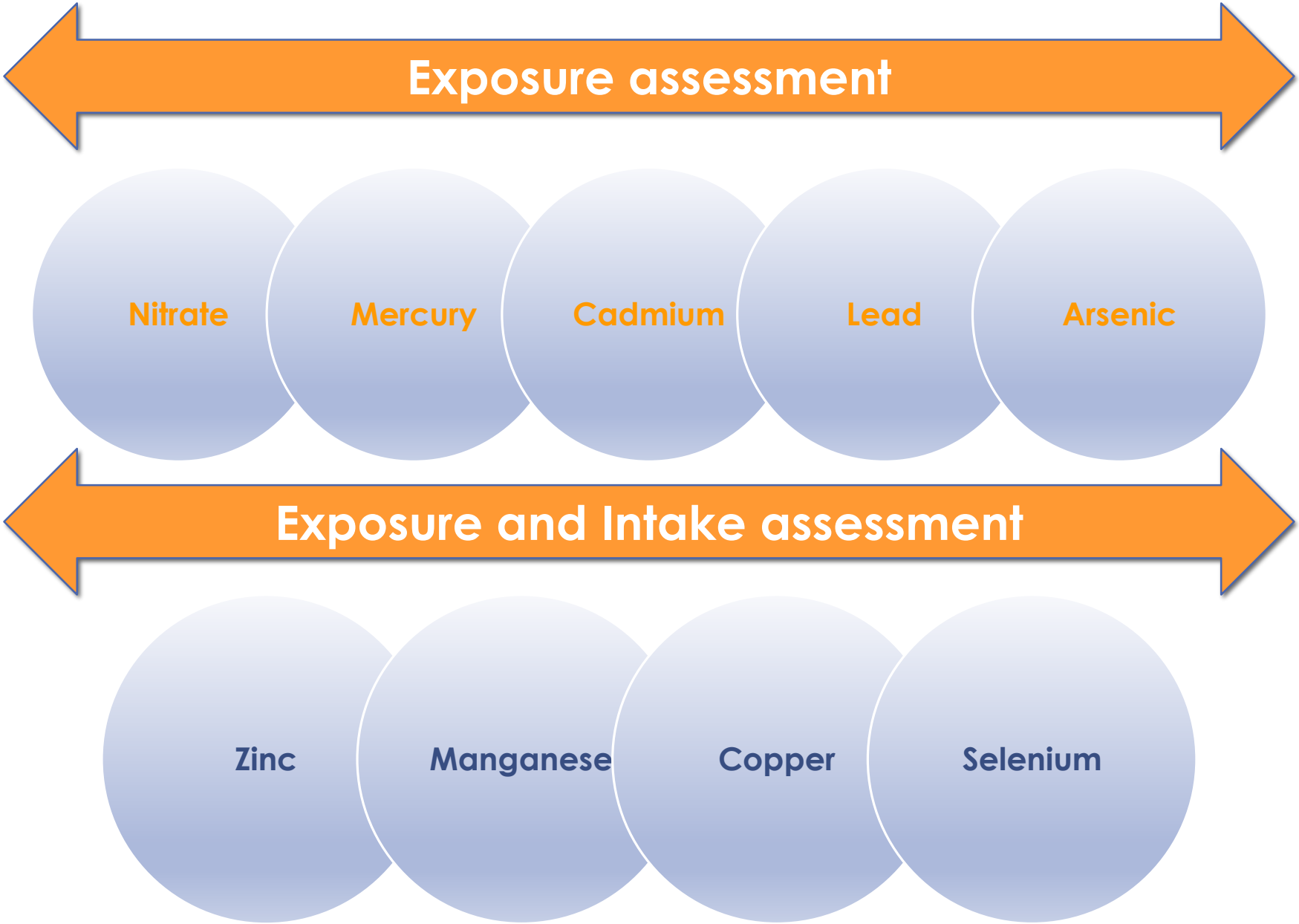
Results Summary – Nutrients

- TDS – Nutrients – intake baseline

  - ✓ At least 50% of the studied population presents adequate intake for vitamin A, vitamin B_1, vitamin B_2, and for the minerals potassium, iron, phosphorus and magnesium.

  - ✓ 72% of the population exceeds the safe and adequate intake for sodium.

  - ✓ Vitamins E and D and Ca low intakes can be of heath concern.


Exposure assessment
Nitrate
Mercury
Cadmium
Lead
Arsenic
Exposure and Intake assessment
Zinc
Manganese
Copper
Selenium

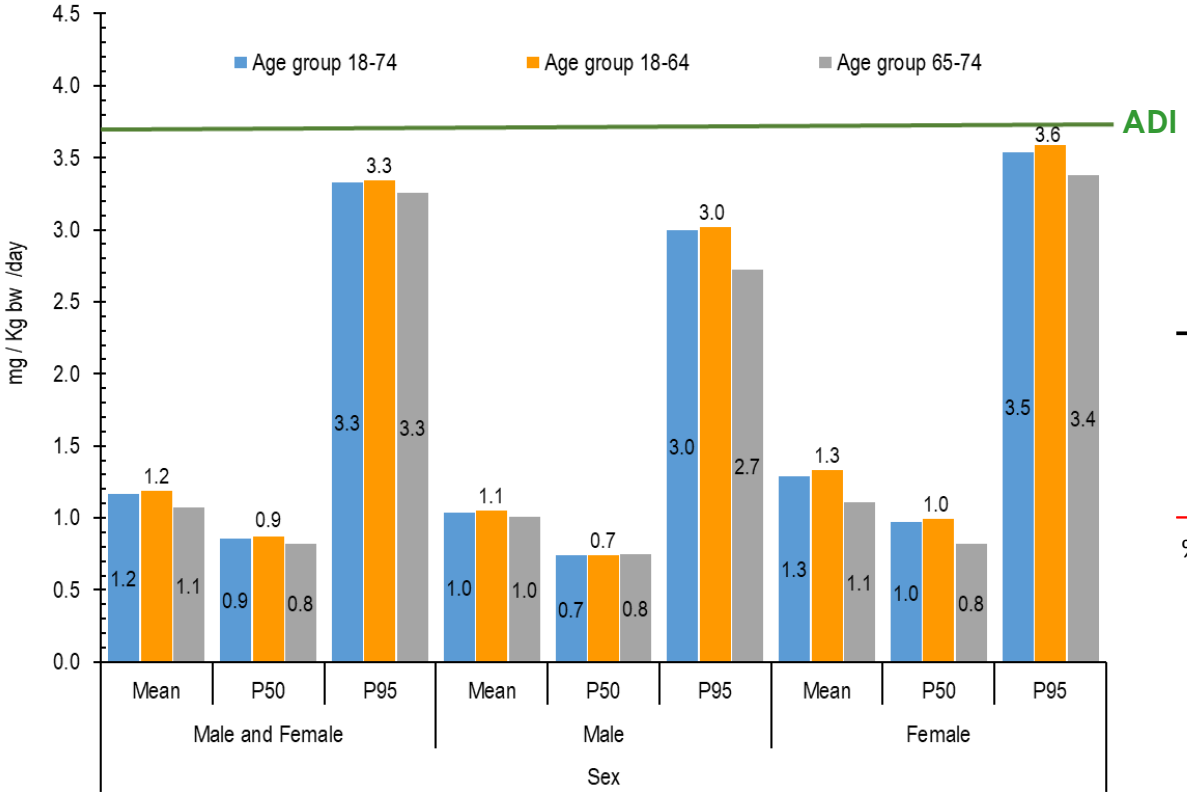
Nitrate

Analytical Method

- Ultra Violet (UV) detection high-performance liquid chromatography method (HPLC), ISO/IEC 17025 accredited.

Risk Characterization

- Admissible Daily Intake (ADI) – 3.7 mg / Kg bw / day [1]



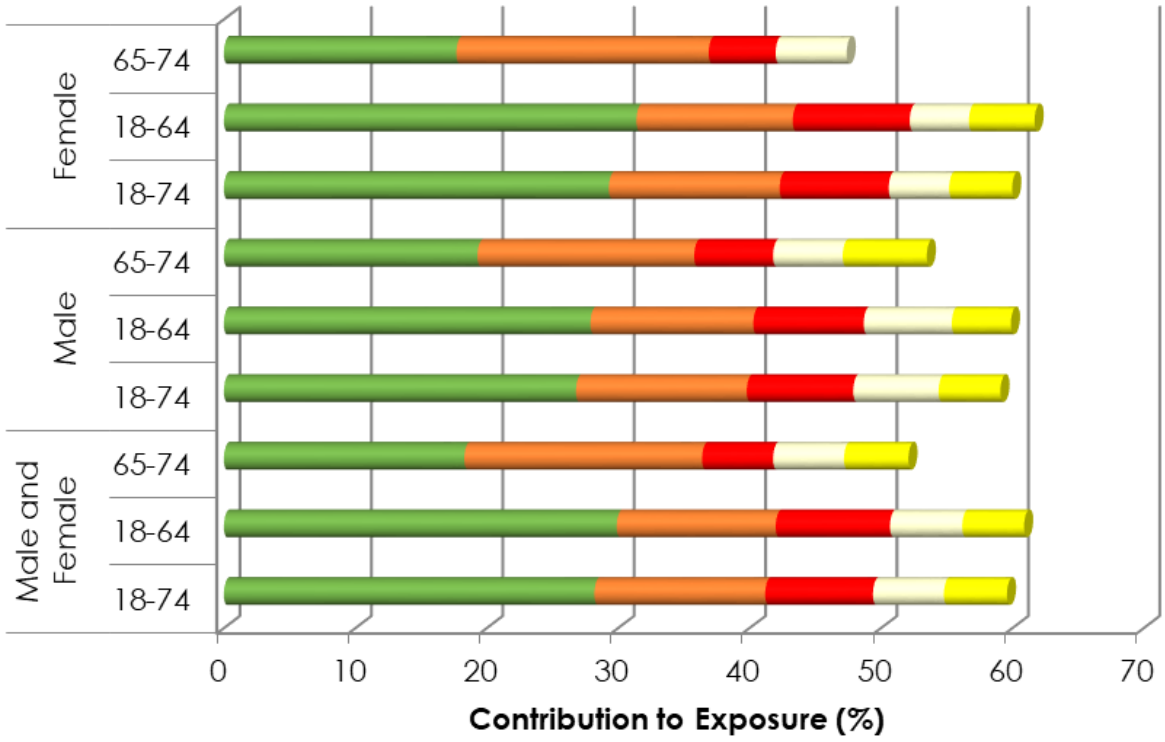
Sex	% of ADI		
	M+F		
Age group	18-74	18-64	65-74
Mean Exposure	32	32	29
P50	23	24	22
P95	90	90	88
% of individuals above the ADI	3.2	3.2	2.7

1 - EFSA Journal 2017;15(6):4787

Nitrate

Top five contributors

- Lettuce, vegetable soup, lettuce and tomato salad, boiled potatoes and banana



https://doi.org/10.1016/j.foodchem.2022.133152

Total Mercury

Analytical Method

- Direct mercury analyser DMA-80 (Milestone Inc., Shelton, CT, USA) method, ISO/IEC 17025 accredited.

Risk Characterization

- Tolerable weekly intake (TWI) for **inorganic mercury** of 4 µg/kg b.w.[1];
- TWI for **methylmercury** of 1.3 µg/kg b.w.[1]

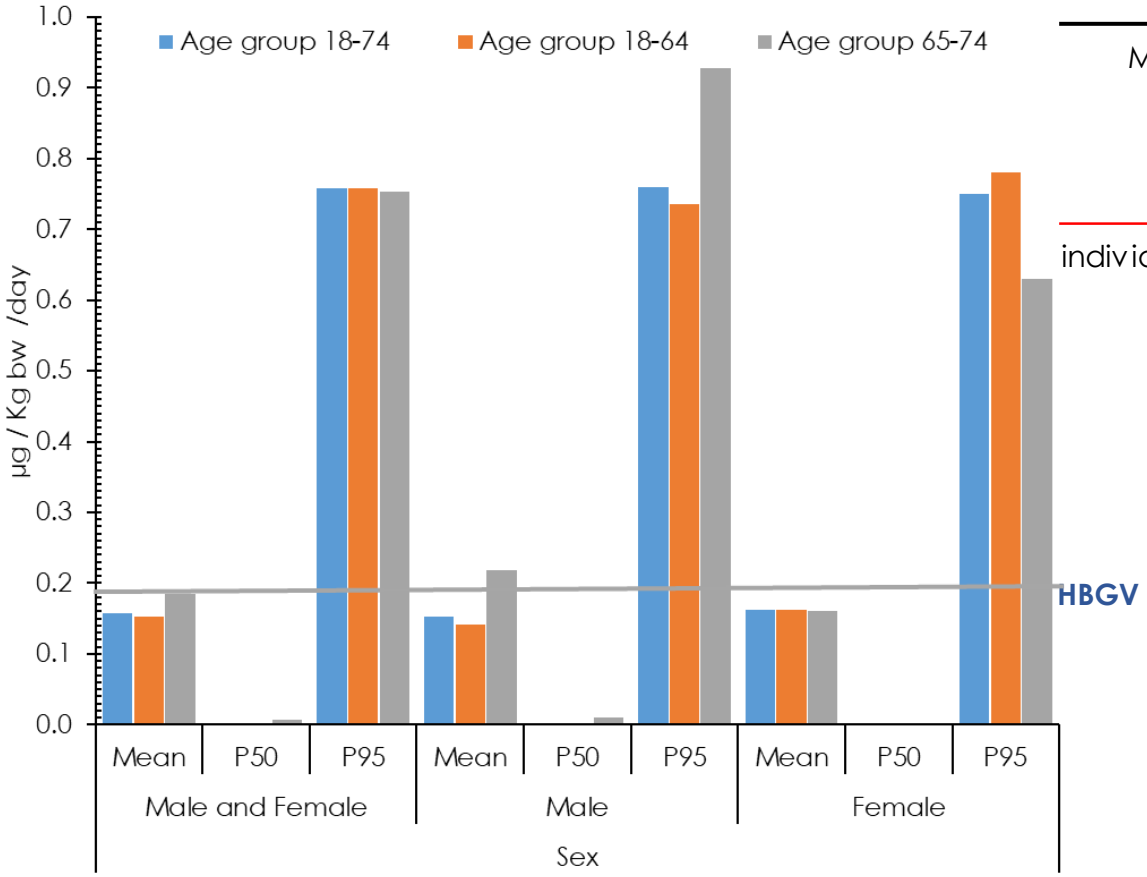
EFSA CONTAM Panel conservative approach[1]

- Fish – 100% of total mercury is methylmercury and 20% is inorganic mercury;
- Seafood - 80% of total mercury is methylmercury and 50% is inorganic mercury;
- Samples other than fish and/or seafood - logical zero for methylmercury and 100% of inorganic mercury.

1 - EFSA Journal 2012;10(12):2985

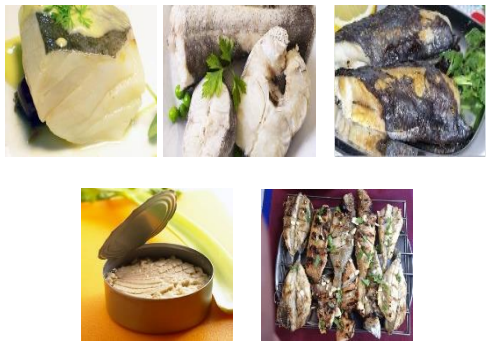
Methylmercury

TWI (Methyl Mercury) – 1.3 µg / Kg bw
UB approach



Sex	% of HBGV M+F		
Age group	18-74	18-64	65-74
Mean Exposure	85	82	99
P50	0	0	0
P95	408	408	406
individuals above the HBGV	26.4	25.3	32.1

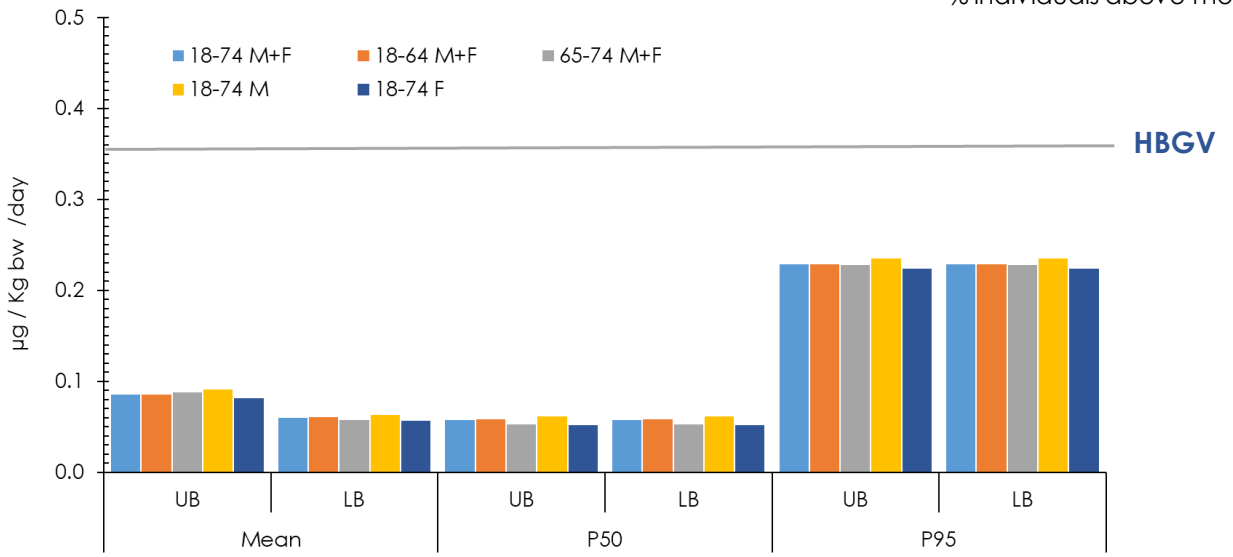
Top five contributors



Inorganic Mercury

TWI (Inorganic Mercury) – 4 µg / Kg bw
UB approach

UB Aproach	% of HBGV				
Sex	M+F			M	F
Age group	18-74	18-64	65-74	18-74	18-74
Mean Exposure	15	15	15	16	14
P50	10	10	9	11	9
P95	40	40	40	41	39
% individuals above the HBGV	1.1	0.9	2.0	1.2	1.1



Top five contributors





Cadmium

Analytical Method

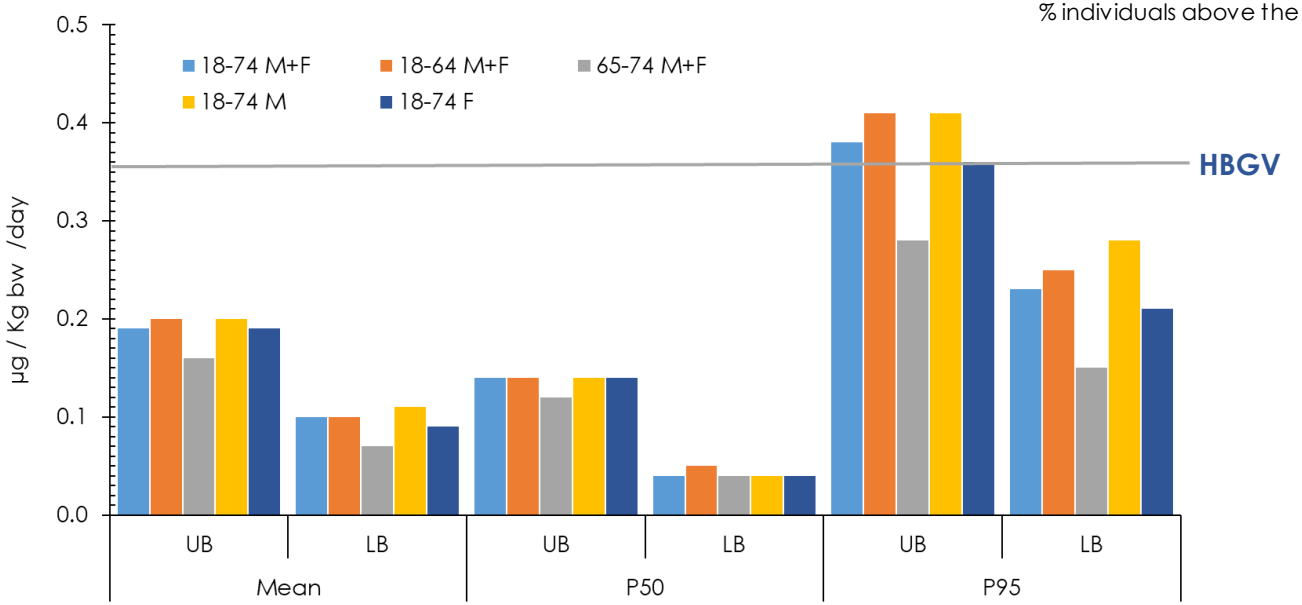
- A quadrupole inductively coupled plasma mass spectrometry (ICP-MS; Thermo Elemental, X-series 2, UK), ISO/IEC 17025 accredited.

Risk Characterization

- TWI – 2.5 µg / Kg bw [1]

[1]EFSA Journal 2012;10(1):2551

UB Aproach	% of HBGV				
Sex	M+F			M	F
Age group	18-74	18-64	65-74	18-74	18-74
Mean Exposure	54	56	44	55	53
P50	39	40	35	39	40
P95	105	115	79	114	101
% individuals above the HBGV	5.4	5.8	3.0	5.6	5.2



Top five contributors

Lead

Analytical Method

- ICP-MS, ISO/IEC 17025 accredited.

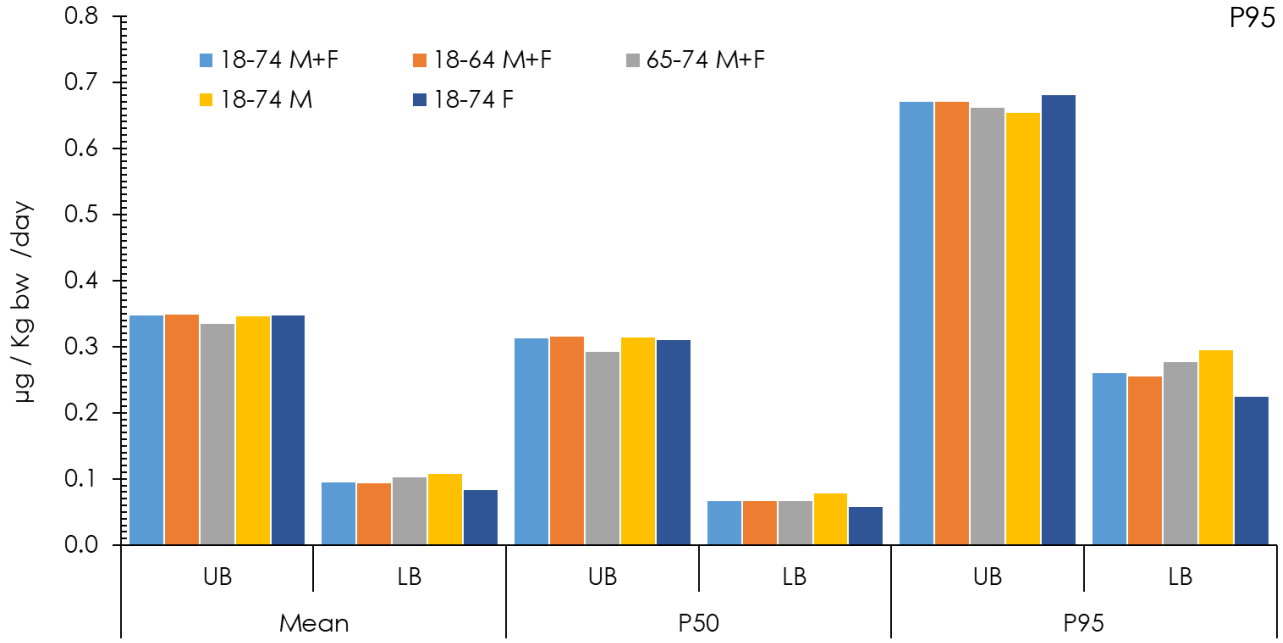
Risk Characterization

Calculation of Margin of exposure (MOE) with:

- $BMDL_{10}$ - 0.63 (nephrotoxicity adults)[1]
- $BMDL_{01}$ – 1.5 (cardiovascular effects adults)[1]

[1]EFSA Journal 2012;10(1):2551

overall population	MOE 0.63		MOE 1.5	
	LB	UB	LB	UB
Mean	7	2	16	4
P50	10	2	23	5
P95	2	0.9	6	2



Top five contributors

Arsenic

Analytical Method

- ICP-MS, ISO/IEC 17025 accredited.

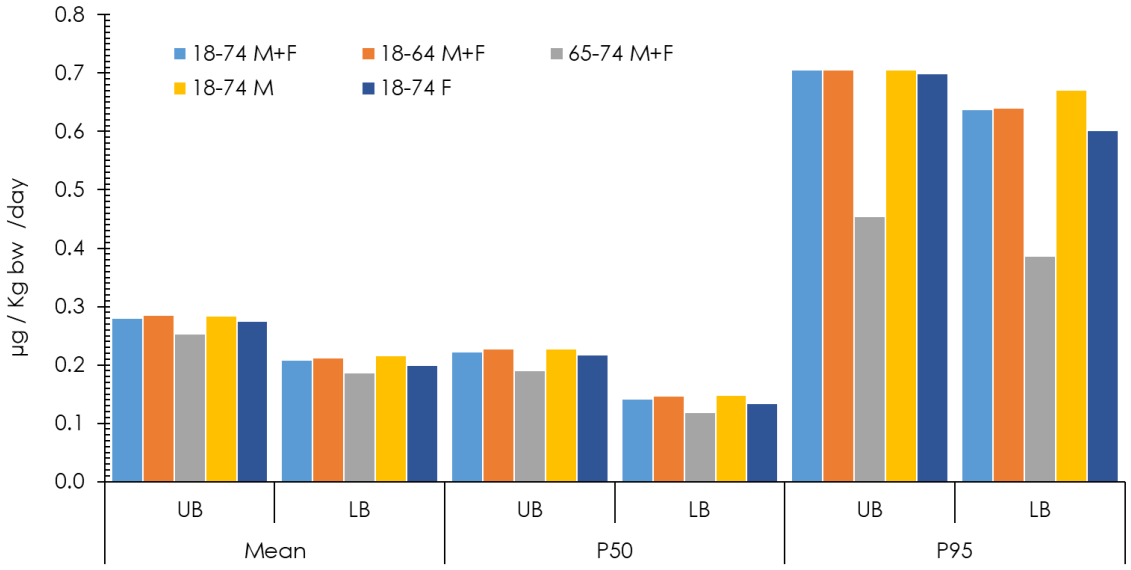
Risk Characterization

- **inorganic arsenic** (BMDL01) values between 0.3 and 8 µg/kg b.w. for cancer of the lung, skin and bladder, as well as skin lesions[1]

1 - EFSA Journal 2009; 7(10):1351

EFSA CONTAM Panel assumptions[1]

- Fish samples – 0.03 mg/kg of inorganic arsenic;
- Seafood – 0.1 mg/kg of inorganic arsenic;
- Other than fish and/or seafood - 70% of the occurrence value as Inorganic arsenic.



overall population	MOE 0.3		MOE 8	
	LB	UB	LB	UB
Mean	1	1	39	29
P50	2	1	57	36
P95	0.5	0.4	13	11

Top five contributors

Zinc

Analytical Method

- ICP-MS, ISO/IEC 17025 accredited.

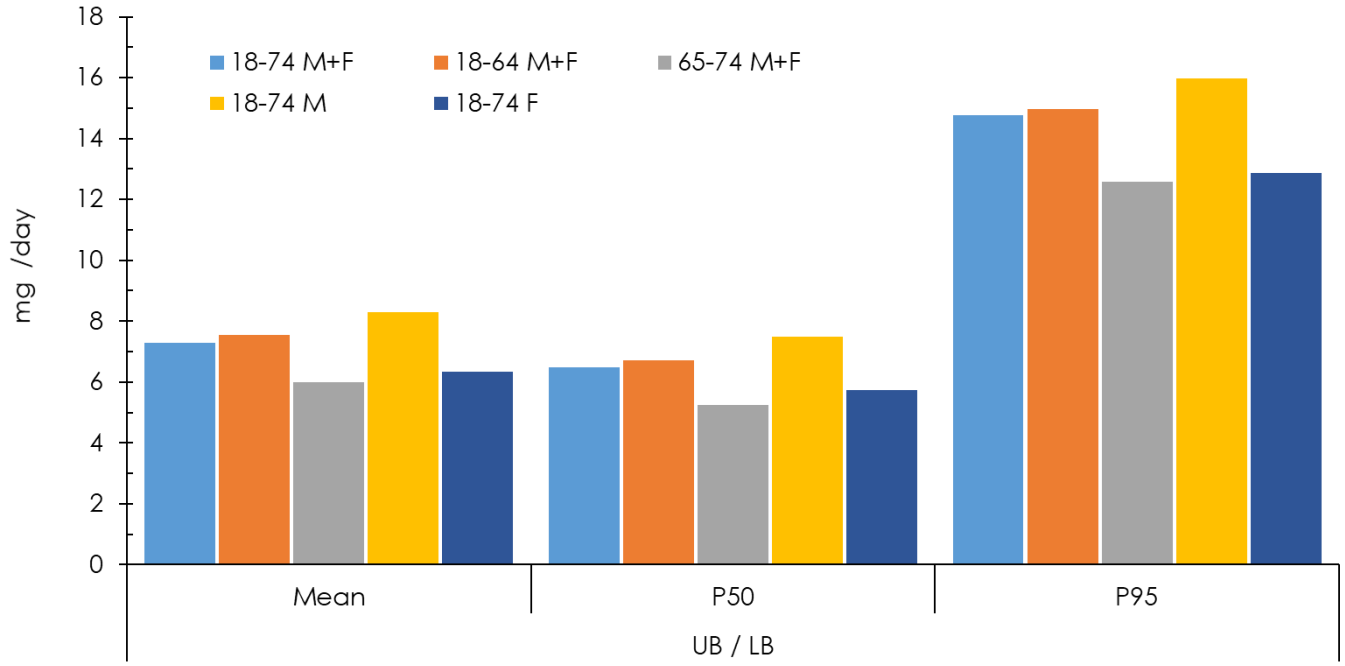
Risk Characterization

- **UL** - 25 mg/day
- **PRI** – 9.4 mg/day Adults Male
- **PRI** – 6.2 mg/day Adults Female

Top five contributors







Manganese

Analytical Method

- ICP-MS, ISO/IEC 17025 accredited.

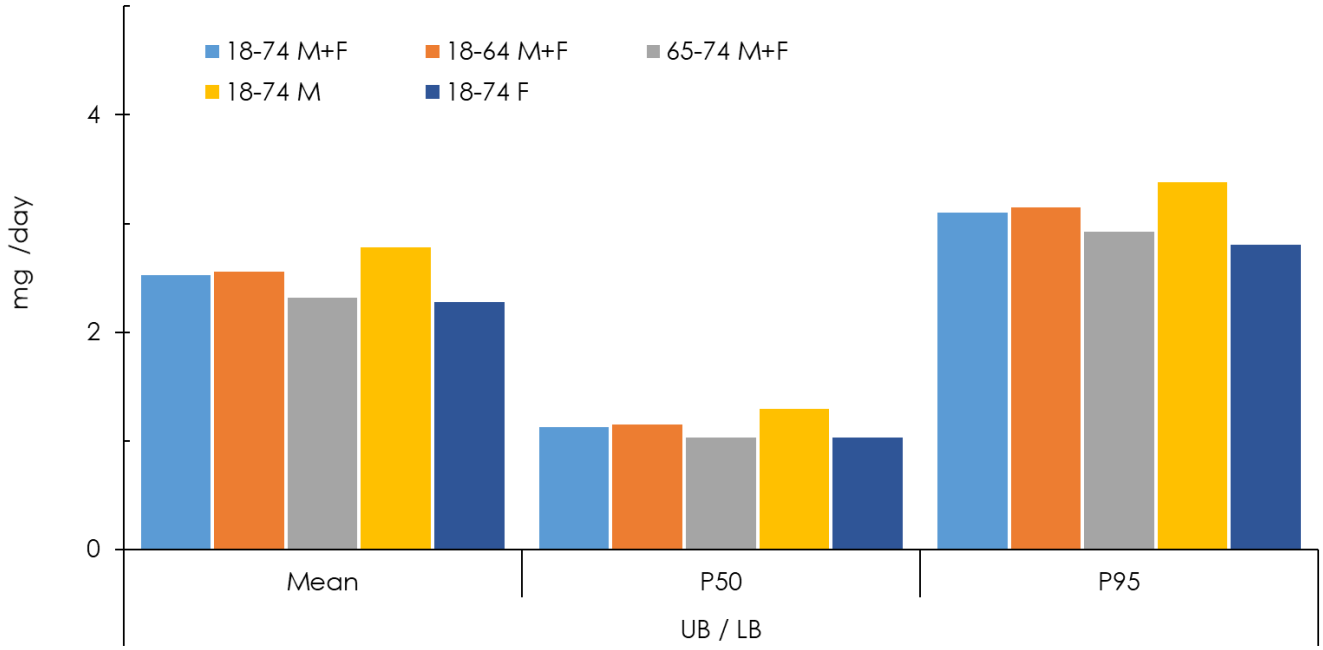
Risk Characterization

- **UL** - 11 mg/day
- **AI** – 3 mg/day

Top five contributors







Copper

Analytical Method

- ICP-MS, ISO/IEC 17025 accredited.

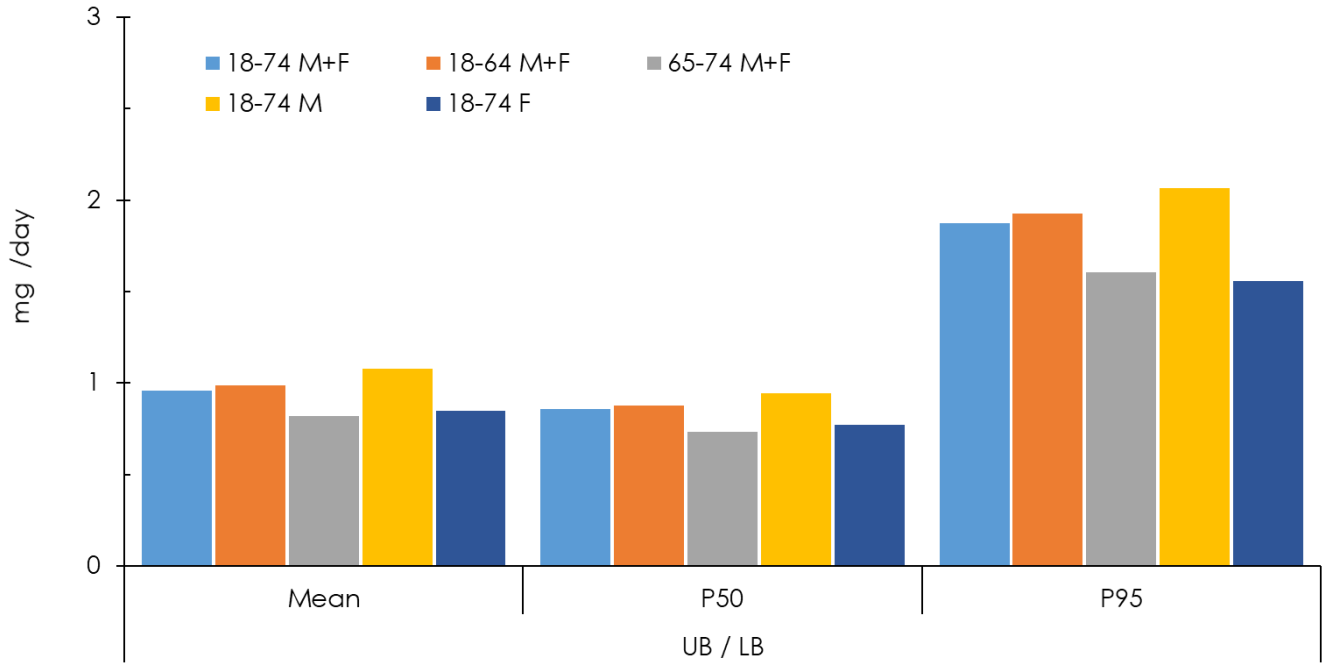
Risk Characterization

- **UL** - 5 mg/day
- **AI** – 1.6 mg/day Adults Male
- **AI** – 1.3 mg/day Adults Female

Top five contributors







Selenium

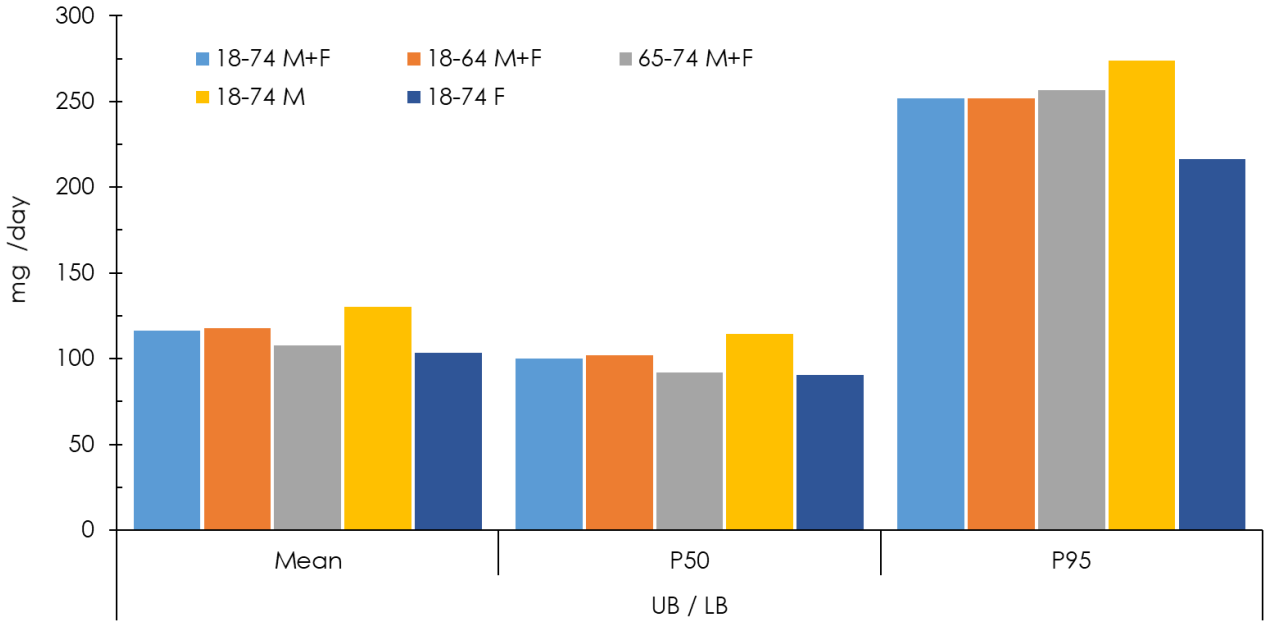
Analytical Method

- ICP-MS, ISO/IEC 17025 accredited.

Risk Characterization

- **UL** - 300 µg/day
- **AI** – 70 µg/day Adults Male

Top five contributors



Results Summary - Contaminants

Contaminant	HBGV		Units	Mean / P50	P95 (%) or MOE<1
Nitrate	ADI	3.7	mg/kg bw/day	√	√
Methyl Mercury	TWI	1.3	µg/kg bw/day	√	408
Inorganic Mercury	TWI	4	µg/kg bw	√	√
Cadmium	TWI	2.5	µg/kg bw/day	√	105
Lead	BMD	0.63	µg/day	√	0.95
Inorganic Arsenic	BMD	0.3	µg/day	√	0.4

- TDS – Contaminants – exposure baseline
  - ✓ None of the contaminants studied showed health concern at the mean and P50.
  - ✓ Methyl mercury and cadmium presented exposure values that exceed the Health Based Guidance Value at P95.
  - ✓ For lead and inorganic arsenic the MOE indicates that the possibility of an effect cannot be excluded.

Results Summary – Contaminants/Nutrients

Contaminant	HBGV	Value (mg/day)	Mean/ P50 / P95	Exposure Exceedance (%)
Zinc	UL	25	√	0.50
Manganese	UL	11	√	0.22
Copper	UL	5	√	0.21
Selenium	UL	0.3	√	2.50

- TDS – Contaminants/Nutrients – exposure baseline
  - ✓ None of the elements studied showed health concern at mean, P50 and P95.
  - ✓ Tolerable upper intake level values (UL) were exceeded by small percentages of the population.

Results Summary – Contaminants/Nutrients

Nutrient	NRV	Value (mg/day)	Population achieving DRV (%)
Zinc	PRI Males	9.4	33
	PRI Females	6.2	43
Manganese	AI	3	28
Copper	AI Males	1.6	12.8
	AI Females	1.3	10.8
Selenium	AI	0.07	73

- TDS – Contaminants/Nutrients – intake baseline
  - ✓ Considering the elements as nutrients, zinc and selenium seems to show less health concern than copper and manganese.

Final Considerations

- **Achievements:**
  - Capacity to accomplish a TDS at national level using an internationally harmonised methodology;
  - Assessment of Portuguese population's baseline dietary exposure and the risk of exceeding the health based guidance values.

- **Started (with little success):**
  - Promotion of TDS as public health tool at country level fostering the vision of a wider food/diet surveillance system that would include periodic food consumption surveys and TDSs.

- **Major challenge**
  - Not having a TDS dedicated team – delay in the analysis of the results for exposure/intake assessment, risk characterization and publication.

Future work

- Finish the publication of results;
- Further investigate the differences between intake results obtained by the TDS and FC Survey;
- Disseminate the TDS results among risk managers, policies makers researchers to inform new recommendations and research needs (prioritization of substances for further actions, focus on nutrients where AR is higher than P50);
- Raise awareness of political decision makers on the importance of TDS as a public health tool and the need of its inclusion in regular monitoring system – Concerted action WHO, EFSA, FAO, other international organisations (?) member states?
- Amplify Cost-effectiveness – articulate with the update of the food composition database (new analytical values).

Publications

Food Chemistry 363 (2021) 130258

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

The first harmonised total diet study in Portugal: Planning, sample collection and sample preparation

Elsa Vasco, M. Graça Dias *, Luísa Oliveira

Food and Nutrition Department, National Institute of Health Doutor Ricardo Jorge, IP (INSA), Av. Padre Cruz, 1649-016 Lisboa, Portugal

https://doi.org/10.1016/j.foodchem.2021.130258

Food Chemistry 392 (2022) 133152

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The first harmonised total diet study in Portugal: Nitrate occurrence and exposure assessment

Elsa Vasco *, M. Graça Dias, Luísa Oliveira

Food and Nutrition Department, National Institute of Health Doctor Ricardo Jorge, IP (INSA), Portugal

https://doi.org/10.1016/j.foodchem.2022.133152

Under drafting:

M. Graça Dias, Elsa Vasco, Luísa Oliveira. The first harmonised total diet study in Portugal: Vitamin D occurrence and exposure.

Elsa Vasco, M. Graça Dias, Luísa Oliveira. The first harmonised total diet study in Portugal: Mercury, Cadmium, Arsenic and Lead exposure.

Elsa Vasco, M. Graça Dias, Luísa Oliveira. The first harmonised total diet study in Portugal: Zinc, Selenium, Manganese and Cupper exposure and intake.

Thank you very much for your attention!

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