

Risk-benefit approach in food and nutrition as basis for public health policy

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Objective

To determine in what quantities food consumption would:

- Cover the **nutritonal needs** (energy, macronutrients, vitamins, minerals...)
- Reduce the risk of chronic non communicable diseases (cancer, obesity, diabetes...)
- Limit the risk related to food contaminants (trace elements, environmental pollutants...)
- Take into account the eating habits and food preferences

Consumption diversity	34 nutrients of interest	98 contaminants of interest	Eating habits	Chronic non communicable diseases
 1290 food products divided into 32 groups 	 With a defined Population Reference Intake / Adequate Intake Composition data available 	 With or without health-based guidance value Concentration data available 	 Consumtion levels (P5, mean, P95) in the population 	 Relation between food group consumtion and disease risk

→ Optimisation of consumption with a constraints system using linear programing of combined models (Simplex method)

General model

Calculate the optimal consumption X_i for each food group i, that comply with 144 constraints:

• <u>41 nutritional constraints:</u>

PRI or AI $\leq \Sigma_i X_i \cdot C_{i,nut} \leq USL$

- <u>39 toxicological constraints:</u> $\frac{\Sigma_{i} Xi C_{i,conta}}{BW} \leq HBGV \text{ or P50}$
- <u>3 constraints for « disease prevention »:</u> X_i ≤ Max consumption epidemio (red meat, delicatessen meats, sugar-sweetened beverages)
- <u>61 constraints on eating habits:</u> $P5 \le X_i \le P95$



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Optimisation criteria

Disease prevention	 Minimize consumption of red meat, delicatessen meats, sugar- sweetened beverages Maximize consumption of fruits and vegetables, wholegrain bread and bread products, and other wholegrain starches
Contaminant exposure	 Minimize the exposure to food contaminants
Eating habits	 Minimize deviations from current consumptions



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Eating habits	 Minimize deviations from current consumptions
In case of no solution	 Minimize the breach of the toxicological constraints Minimize the breach of the nutritional constraints



Simplex theory

The algorithm helps determine a target value by successive iterations on one or more variables, taking into account the constraints imposed.

The algorithm searches for the only optimal solution in the domain of possible ones corresponding to a polyhedron with N dimensions defined by the constraints.

Dantzig, 1963: « An optimal solution of a linear problem is necessary locted on a vertex of the polyhedron defined by the constraints. »





A compromise for vitamin D

- Except for vitamin D, the nutrient requirements of the population are covered, notably for Mg and vitamin C, for which the prevalence of inadequacy is high → the reference intakes are compatible
- The PRI for vitamin D is not possible to reach, taking into account the concentration of vitamin D but also the contamination levels of the main contributors, and the eating habits of the population → need for specific management measures for vitamin D such as:
 - Supplementation with medical control
 - Exposure to sunlight within the limits of skin cancer prevention recommendation

• Food fortification as public health policy





A compromise for contaminants

- Exposure levels generally lower than the HBGV and the current exposure (dioxins, PCBs, pesticides, PFAAs...)
- Except for CrVI (~110% current exposure) and lindane (~110% HBGV but exposure lowered)
- Exposure still associated with a health risk:
 - Men and women: inorganic arsenic, lead, acrylamide
 - Women only: nickel

 \rightarrow Efforts to reduce the level of food contamination should be continued, particularly for those contaminants





Results for adults – consumptions (g/day)

Food group	Men	Women	Food group	Men	Women
Vegetables	285	282	Milk	0	341
Fresh fruits	376	332	Plain fresh dairy products	122	36
Dried fruits	2.9	0.6	Sweetened fresh dairy prod.	0	47
Purees & cooked fruit	5.5	12	Sweetened dairy desserts	15	16
Oilseeds	8.6	4.6	Cheeses	81	24
Refined bread and bread prod.	0	0	Butter & reduced-fat butter	0	4.2
Plain wholegrain bread and bread products	70	60	Vegetable oils rich in ALA	21	16
Starch-based, sweet/fatty processed products	31	15	Vegetable oils poor in ALA & margarines	0.4	0
Starch-based, savoury/fatty processed products	16	20	Sauces, fresh creams & condiments	4.4	30
Other refined starches	14	14	Sweet or sweet & fatty products	28	55
Other plain wholegrain starches	243	179	Poultry	122	25
Pulses	50	32	Red meat	71	57
Drinking water	1002	806	Delicatessen meats	0	0
Sugar-sweetened beverages	0	0	Fatty fish	22	16
Fruit juice	263	28	Other fish & seafood	7	55
Salt	<0.1	<0.1	Eggs	46	12 - di 1585
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Food groups to be increased...

- Consumption of fruits and vegetables
- Fish twice a week, among which one portion of fish rich in EPA+DHA (salmon, herring...)
- Regularly consume legumes (lentils, chickpeas...)
- Favour plain wholegrain cereal products (bran bread, wholegrain rice & pasta...)
- Favour consumption of vegetable oils rish in alpha-linolenic acid (rapeseed, walnut...)











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... or decreased

- Delicatessen meats (ham, sausages...) < 25 g/day
- Meat excluding poultry (beef, pork...) < 500 g/week •
- Less than 1 glass/day of sugar-sweetened beverages • (sodas, fruit juices...)



Advantages and limitations of the risk-benefit method

Advantages	 Global and transposable method Allow to define objective and science-based dietary patterns Take into account many parameters Allow to identify public heath issues
Limitations	 Nutrient bioavailability in the food products are not taken into account Need a lot of data Uncertainties from databases and from the reference values used
Perspectives	 Extend the method for different subgroups of the population and different dietary patterns (need a lot of data) Weight the criteria for the optimisation



From Risks-Benefits results to food-based dietary guidelines





- Enjoy eating: opt for variety, take the time to eat and savour
- When possible, favour the « home made »
- Be careful of quantity and portion size you eat
- Well eating is also take into account environment by favouring local production, seasonal products, and if possible, organic foods





Increase fish consumption



Twice a week, among which one portion of fish rich in EPA+DHA

- It is recommended to eat fish twice a week, including fatty fish (sardines, mackerel, herring, salmon) because fatty fish are rich in omega 3
- A large selection of fish is available. They can be consumed in all forms: fresh, frozen or canned
- Fish has many nutritional qualities. But some fish may contain pollutants, so it is recommended to vary the species



Decrease sugary drinks...

... but also fatty, sweet, salted and ultra-processed foods



Less than 1 glass/day of sugar-sweetened beverages (sodas, fruit juices...) It is recommended to limit sugary drinks, fatty, sweet, salted and ultraprocessed foods

- Water is the only drink recommended. Fruit juices, sugary drinks and sodas, even light drinks, so-called "energizing" drinks should be limited as much as possible; in any case, not more than one drink per day
- Sugary breakfast cereals, cakes, chocolate, [...] and some commercially prepared meals often contain a lot of sugar, fat or salt. In addition to being fat, sweet or salty, these products are often ultra-processed, that is, they contain many additives (colours, preservatives, flavours...). The exact impact on human health is not yet known. As a precaution, choose foods without additives or with the shortest list of additives. Whenever possible, opt for home-made products using fresh, unprepared canned or frozen foods such as plain vegetables or natural fish fillets.

Conclusions

- The approach developed is **global** and integrates both the **benefits and risks** linked to food consumption
- The use of a mathematical algorithm makes it possible to integrate many parameters and not to limit to observed dietary patterns, in a search of objectivity
- Public health policies need an integrative approach combining scientific data, but also social, environmental or economical aspects
- In the future, the tool could evolve and incorporate other interesting criteria such as the environmental impact





Thank you for your attention

https://www.anses.fr/en/system/files/NUT2012SA0103Ra-1EN.pdf

