Organic food consumption patterns in France: food choices, dietary scores, nutrient intakes & association with adiposity : *results from the Nutrinet-Santé Cohort Study.*

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The organic agriculture challenge

- Challenging the industrialization of the food production system gave rise since the 1970's to so-called "organic", "biological", "biodynamic" and "agro-ecological" productions.

- Such certified organic production has markedly increased during the last decade, representing up to 3-20% (mean 5.1%) of agricultural acreage in European Union countries.
  In 2010, the countries with the largest markets were the United States, Germany and France.

- This has been largely driven by consumer attitudes, with a yearly increase of over 10%.

- These alternative production systems are now being recognized for their lower environmental impact.

The organic agriculture consumers

- Limited but encouraging knowledge is available regarding the high nutritional value and safety of organic food
  (see reports and reviews).

- While the number of consumers of organic food is markedly rising, few small-scale studies have described the profiles of organic consumers (except a “unpublished” large German study in 2008) and little information is available regarding their actual food and nutrient intakes or diet-related health indicators.

- From a diet sustainability and a public health point of view, it is thus crucial to understand and analyze organic product-related consumer profiles.
  We thus studied the organic food consumers in the Nutrinet-Santé study.

Profiles of organic product consumers in a large sample of French adults.

POPULATION - METHODS

The NutriNet-Santé study (1)

A web-based prospective study aiming

- To investigate the relationships between **nutrition** (*nutrients, foods, dietary patterns, physical activity, nutritional status*) and **health outcomes** (*mortality, CVD, cancers, diabetes, obesity, hypertension, depression, cognitive decline, rheumatoid polyarthritis, migraine, quality of life, etc.*).

- To study the role of various **determinants** *(sociological, economic, cultural, psychological, cognitive, food preferences, etc.)* of **dietary behaviours** and nutritional status, and their interactions.

The NutriNet-Santé study (2)

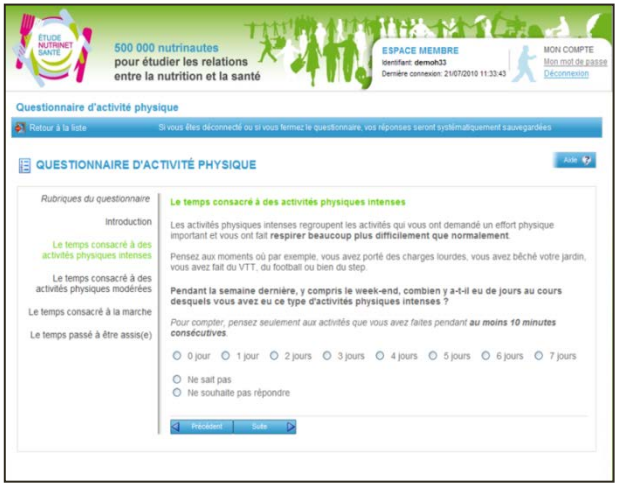
- Web-based prospective cohort study
- Follow-up : > 10 years , Recruitment : 5 years
- Volunteers aged ≥ 18 years
- Dedicated secure HTML interface for web-based questionnaires (www.etude-nutrinet-sante.fr)
- Biochemical samples and clinical examination in a subsample (> 20 000 subjects for blood and urine)
- Registration of health outcomes and validation

To date: 120 000 subjects in the cohort

Baseline questionnaires (yearly update)

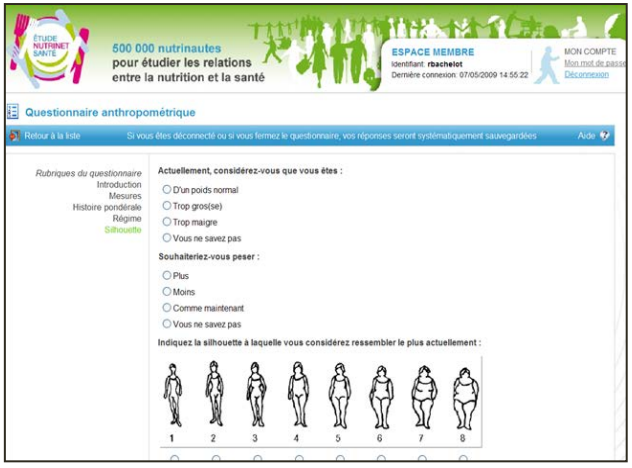
(3 x 24h records)

sedentary behaviour (IPAQ)



Socio-demographic, economic and lifestyle

Anthropometric data and self-perception



Health (personal and family)

Organic product questionnaire (2 months after baseline)

- Frequency questionnaire asking :

  - Opinions about organic products (*prices, quality, taste, impact on health and environment*)

  - Frequency of use/consumption for 18 items

(fruit, vegetables, soya, dairy products, meat and fish, eggs, grains and legumes, bread and cereals, flour, vegetable oils and condiments, ready-to-eat meals, coffee/tea/herbal tea, wine, sweet products, other foods,dietary supplements, textiles and cosmetics):

1) most of the time;
2) occasionally;
3) never (too expensive);
4) never (product not available);
5) never (“I’m not interested in organic products”);
6) never (“I avoid such products”);
7) never (for no specific reason);
8) “I don’t know”.

Dietary data and analyses

- Mean food consumptions : calculated from 3 24-h records (including weighing on a weekday or the weekend).
- Nutrient intake: use of a published nutritional composition table
- Exclusion of under-reporters (method proposed by Black)
- If available data, computation of a score reflecting adherence to French nutritional recommendations (PNNS-GS)

- Profiles of attitude towards organic products were identified using **multiple correspondence analysis** and **cluster analysis (**using Ward's method)

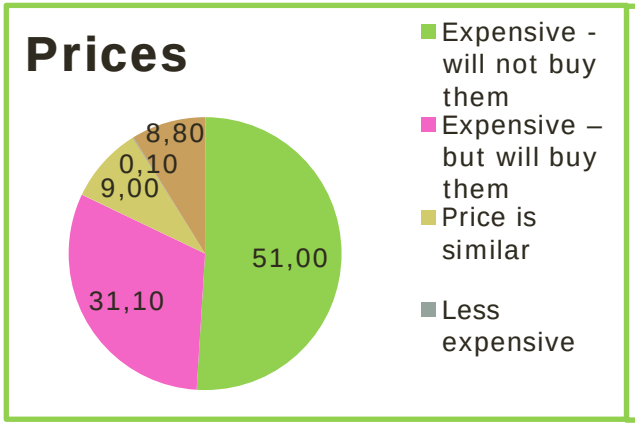
Profiles of organic product consumers in a large sample (n: 54,311) of French adults.

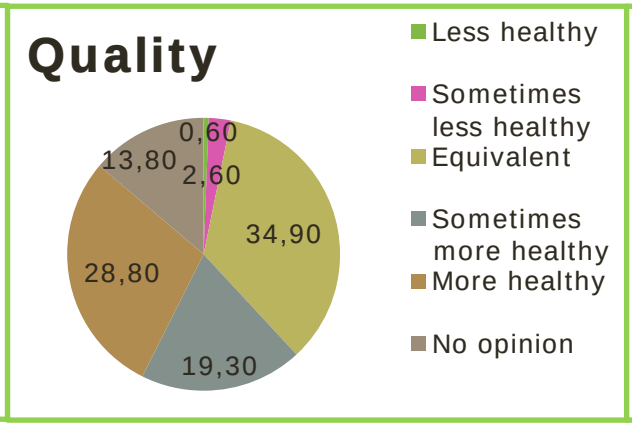
RESULTS (2012)

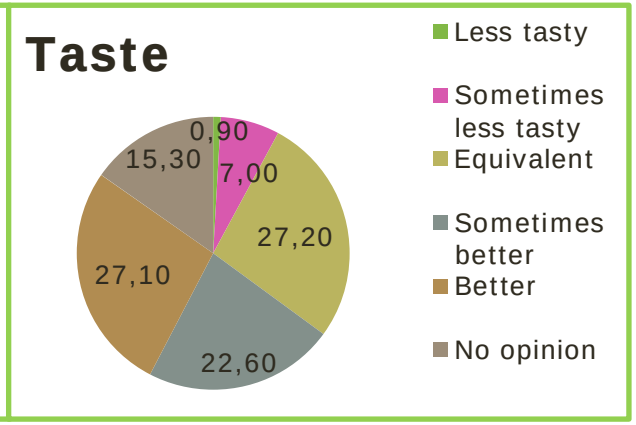
Population

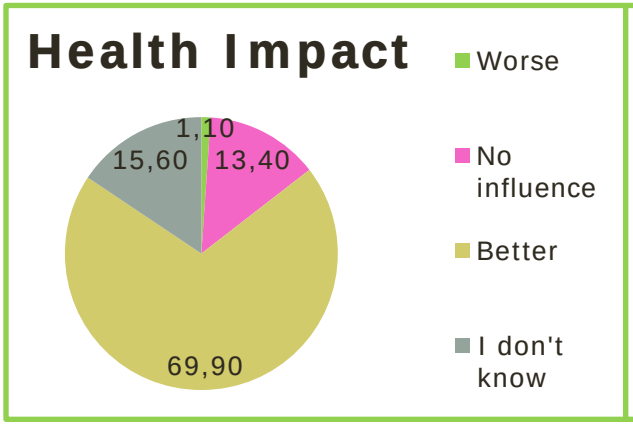
- 54,311 subjects (77% women)
- High level of education (64,5% post-secondary graduate)

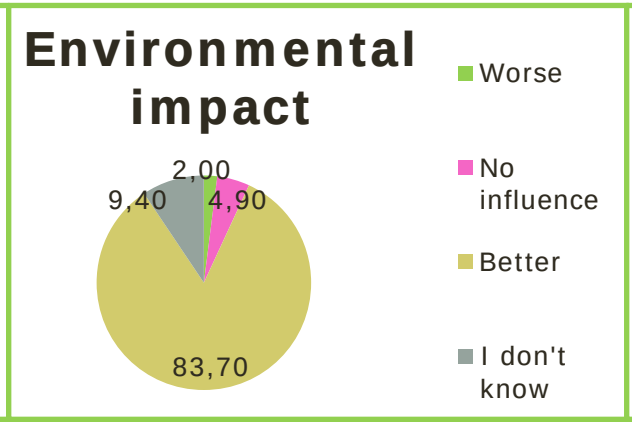
- Opinions about organic products

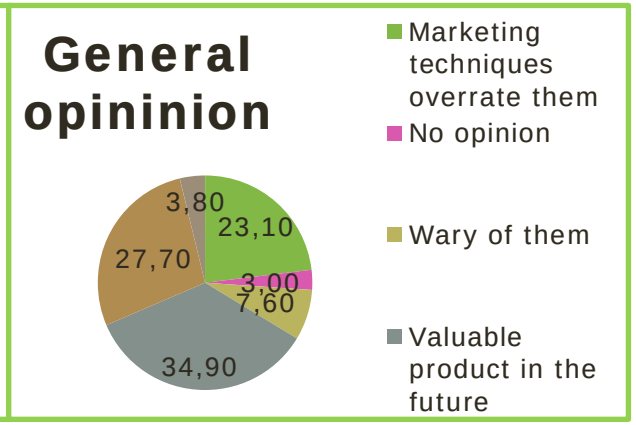








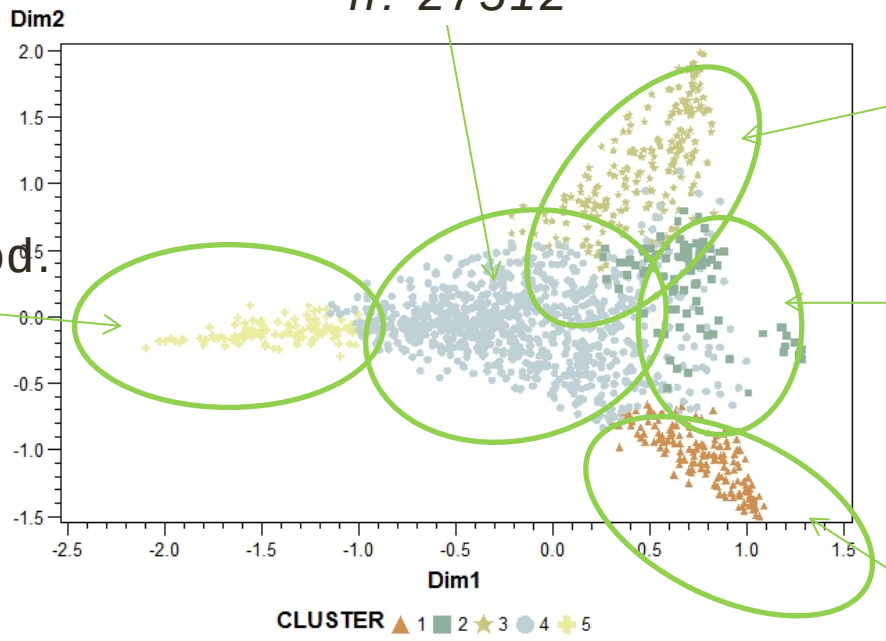




Consumers clustering

- 5 clusters

Occasional Org. Prod. consumers
n: 27512



Regular Org. Prod. Consumers
n: 7606

NC:Too expensive
n: 4484

NC: Avoiding Org. Prod.
n: 5700

NC: No interest in Org. Prod.
n: 9009

Description of clusters

Lifestyle

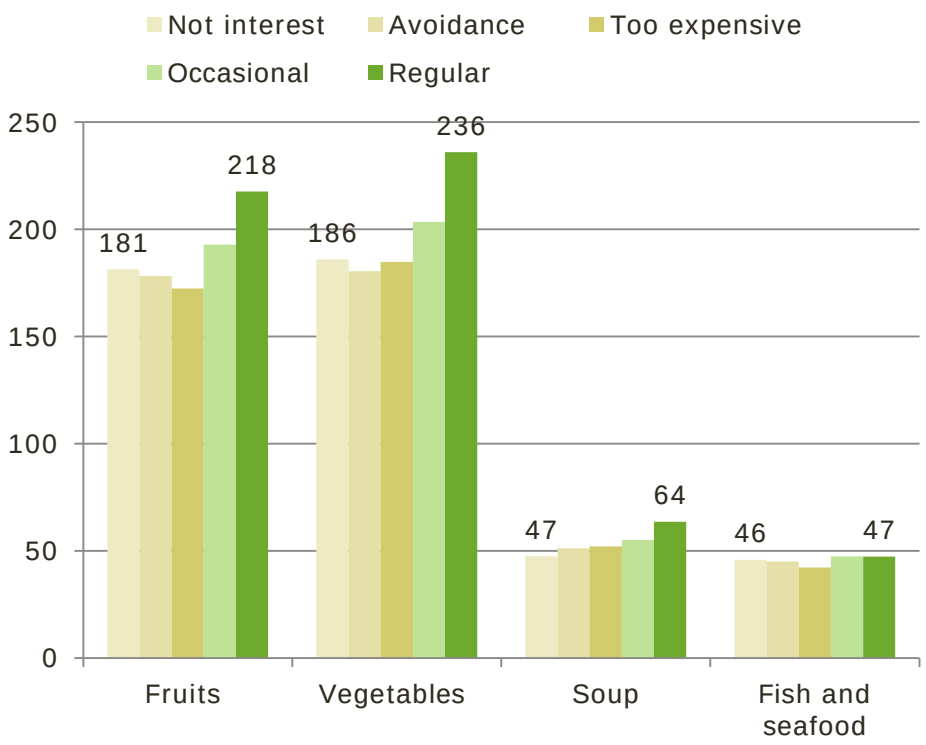
***Regular consumption** of organic food is associated with :*

- Less report of restrictive diet
- Higher education level
- No smoking
- Higher level of physical activity

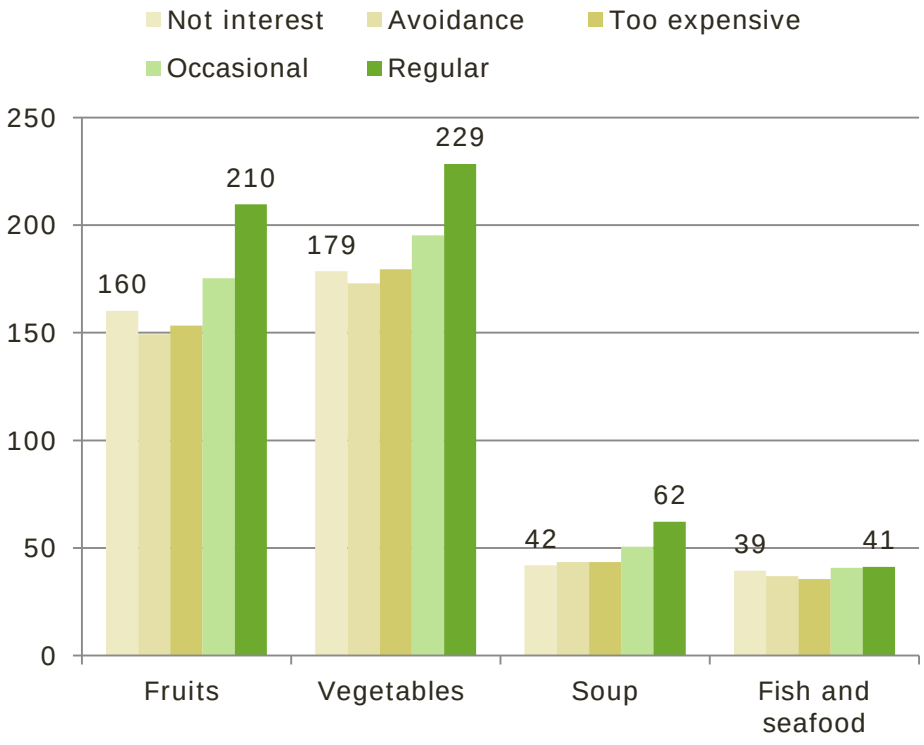
→ healthier life-style profiles

Food consumption* (1)

Men

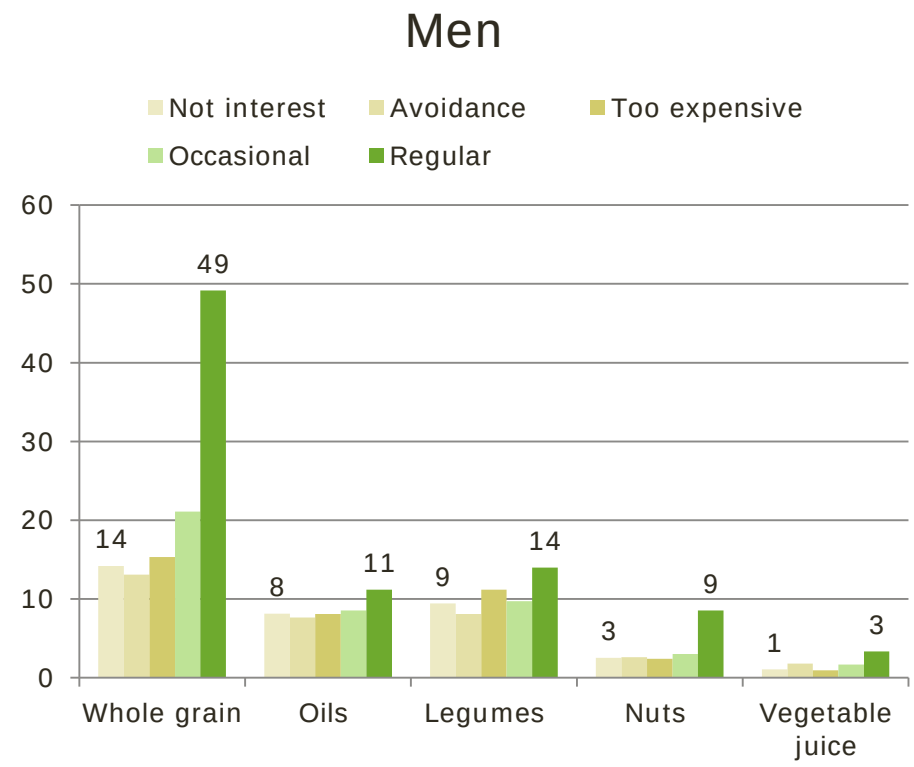


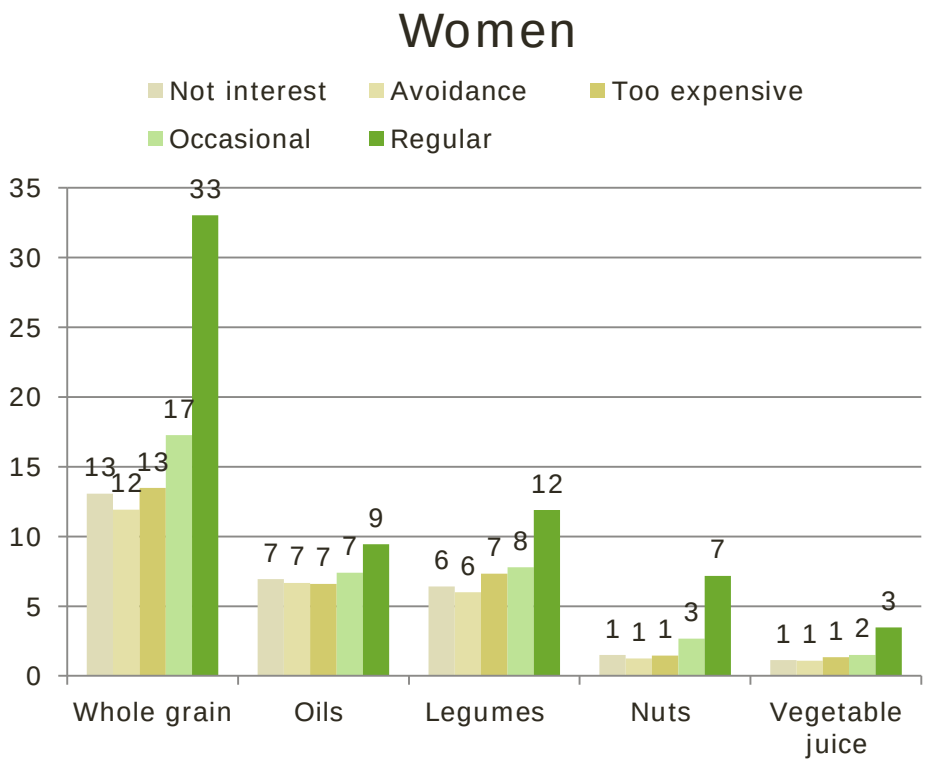
Women



*Values are mean consumption (g/d)

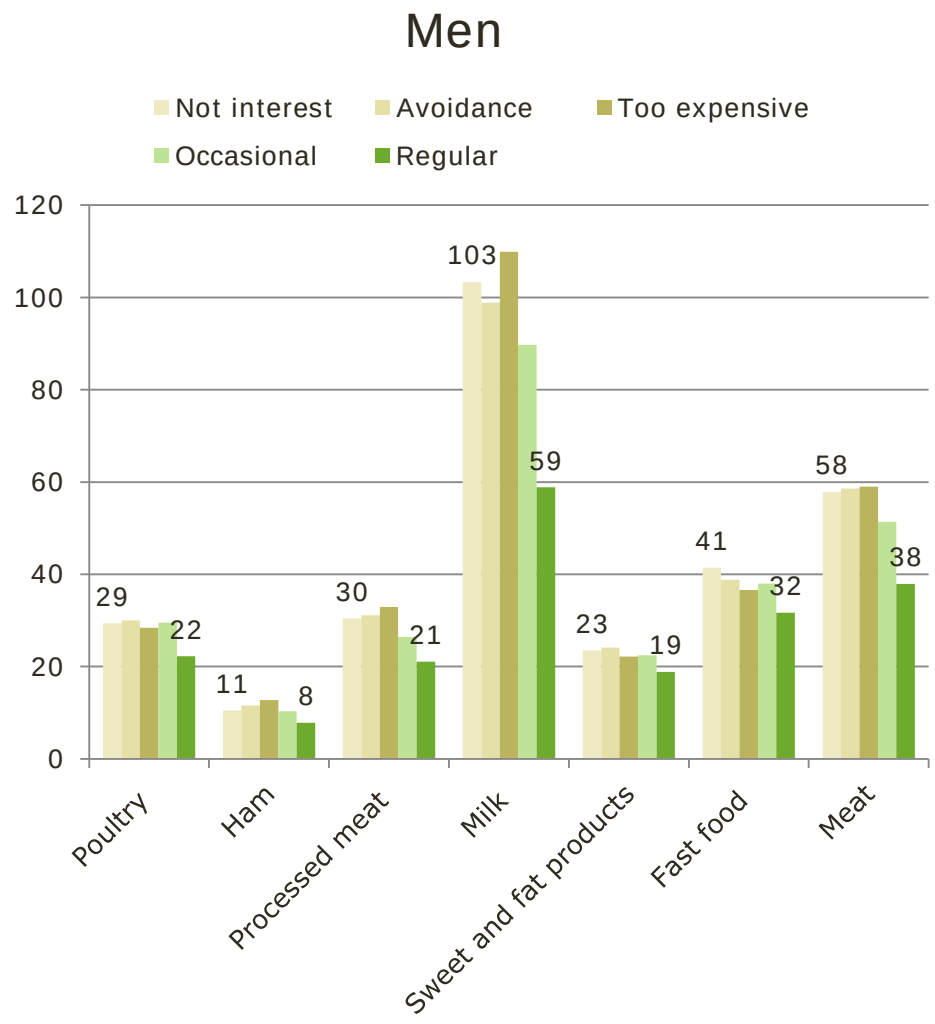
Food consumption* (2)

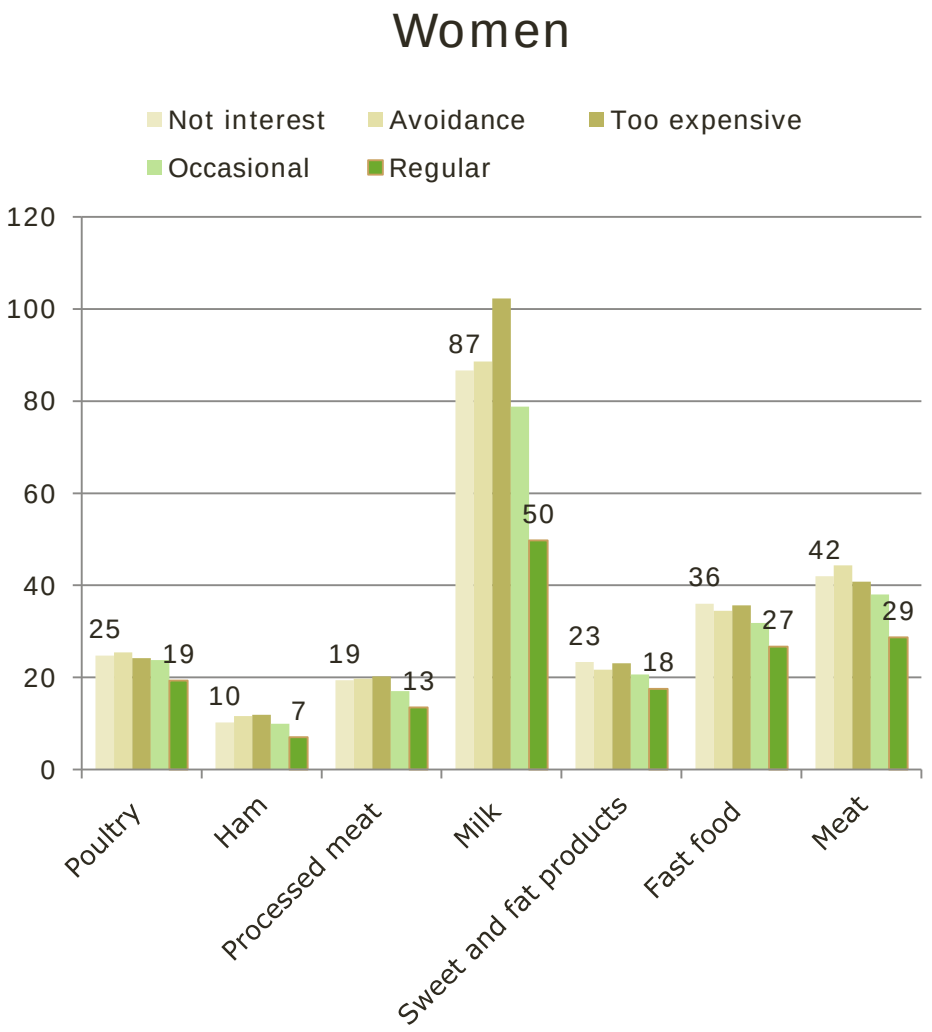




*Values are mean consumption (g/d)

Food consumption* (3)





*Values are mean consumption (g/d)

Food consumption (4) : conclusion

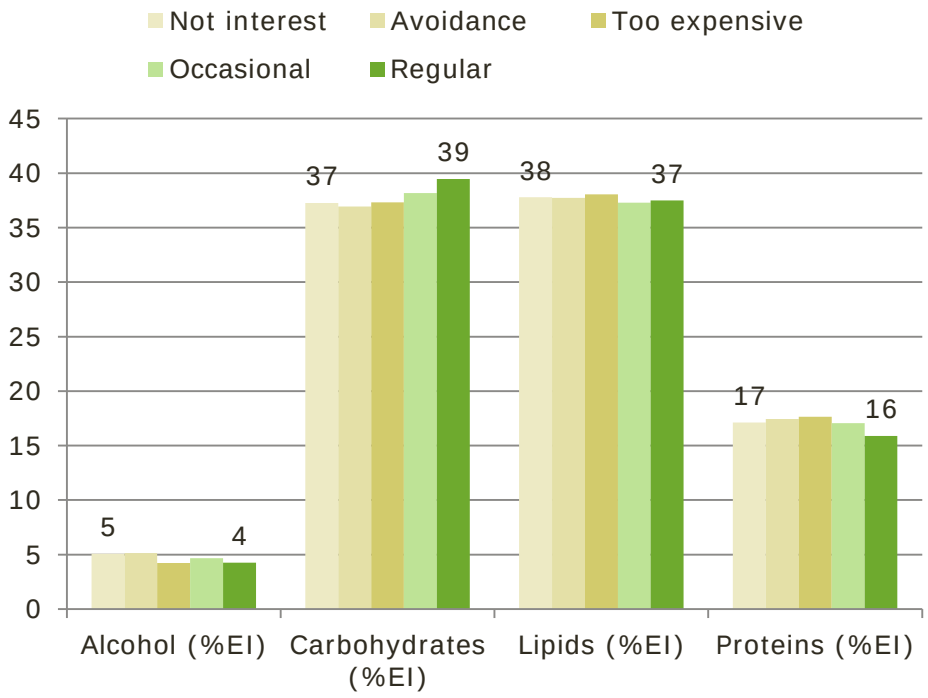
Compared to participants in cluster 1 (no interest OP):

- those in cluster 2 & 3 (not OP) showed comparable food consumptions
- those in cluster 5 (RCOP) showed higher consumption of healthy foods :
  fruit (+20% in men, +31% in women), ($p < 0.0001$)
  vegetables (+27% in men, +28% in women),
  legumes (+ 49% in men, + 85% in women),
  vegetable oils (+38% in men, +36% in women),
  whole grains (+247% in men, +153% in women) and
  nuts (+239% in men, +381% in women)

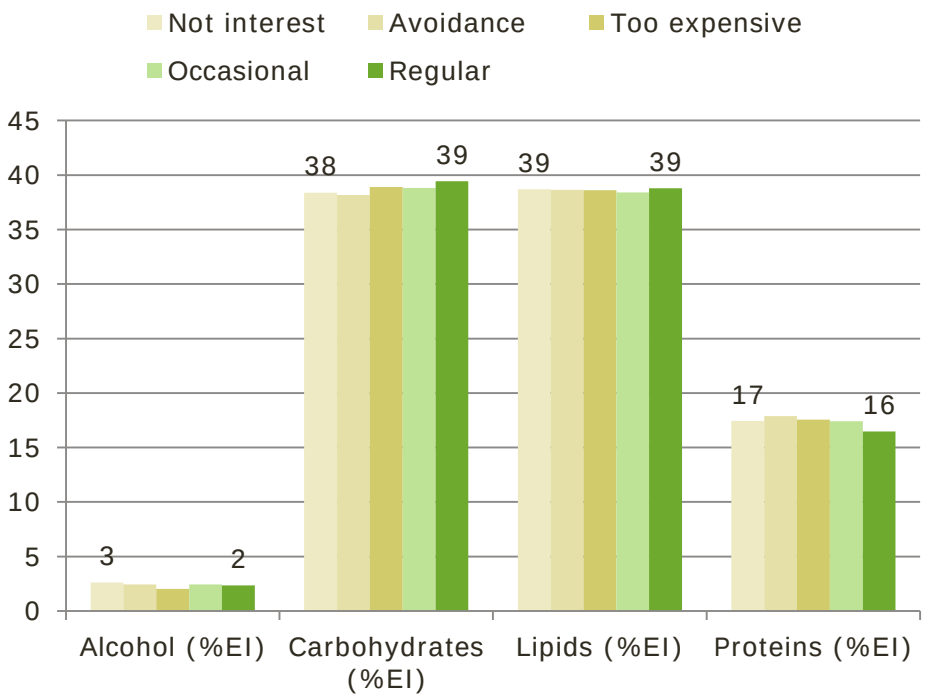
  and lower consumption of : ($p < 0.0001$)
  sweet soft drinks (-34% in men, -46% in women)
  alcoholic beverages (-18% in men, -8% in women),
  animal products including processed meat (-31% in both genders)
  fresh meat (-34% in men, -32% in women),
  milk (-43% in both genders) and
  fast foods (- 22% in men, - 25% women).
- those in cluster 4 (OCOP) showed profiles intermediate between never-consumers and RCOP.

Nutrient intakes (1)

Men



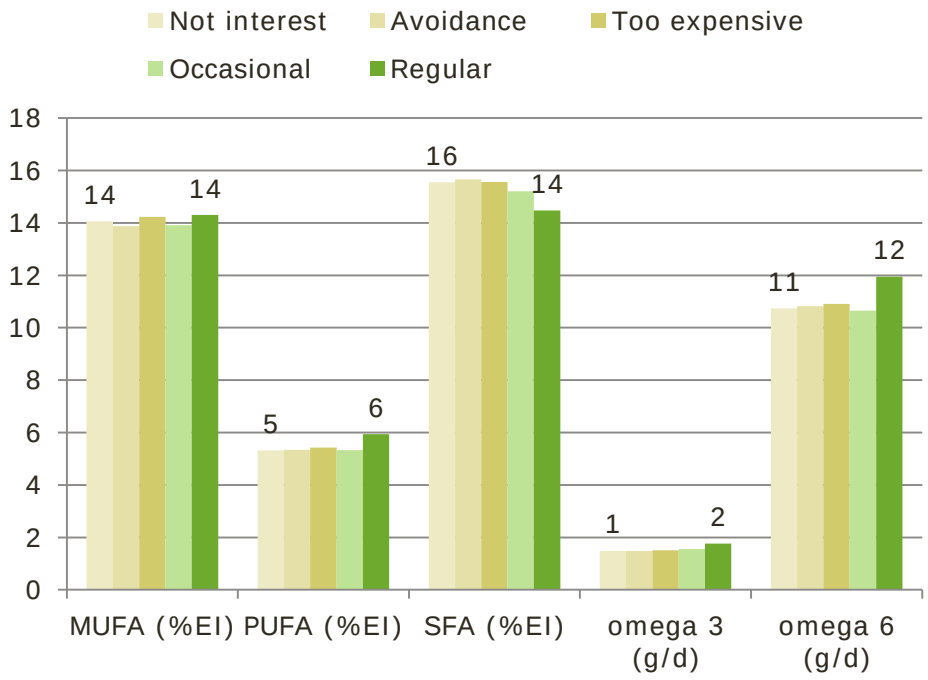
Women



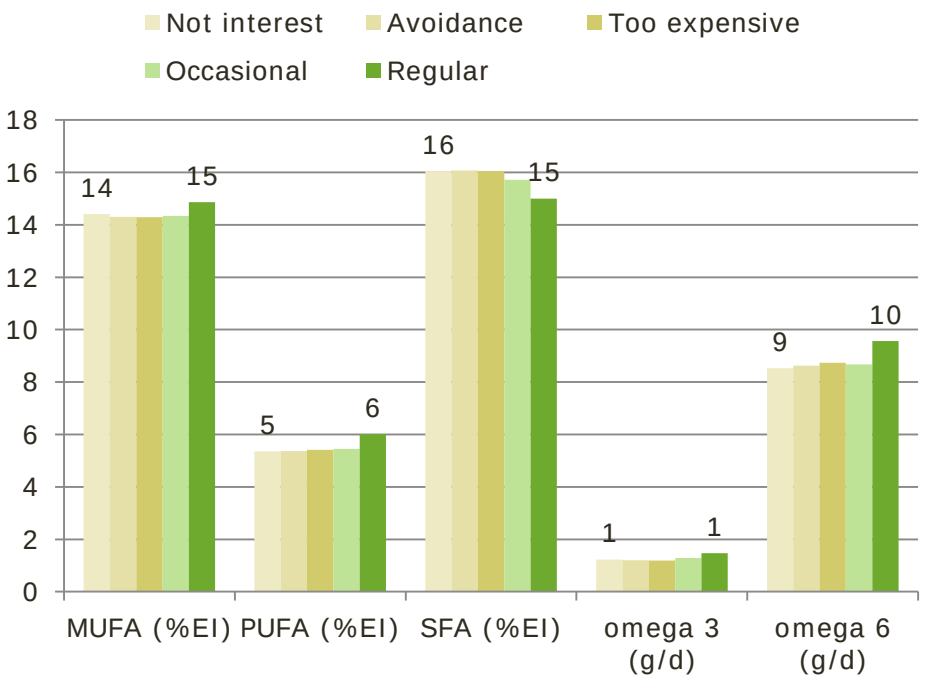
- No marked differences in total EI (kcal/d: 2200 men, 1740 women) and EI from macronutrients

Nutrient intakes (2)

Men

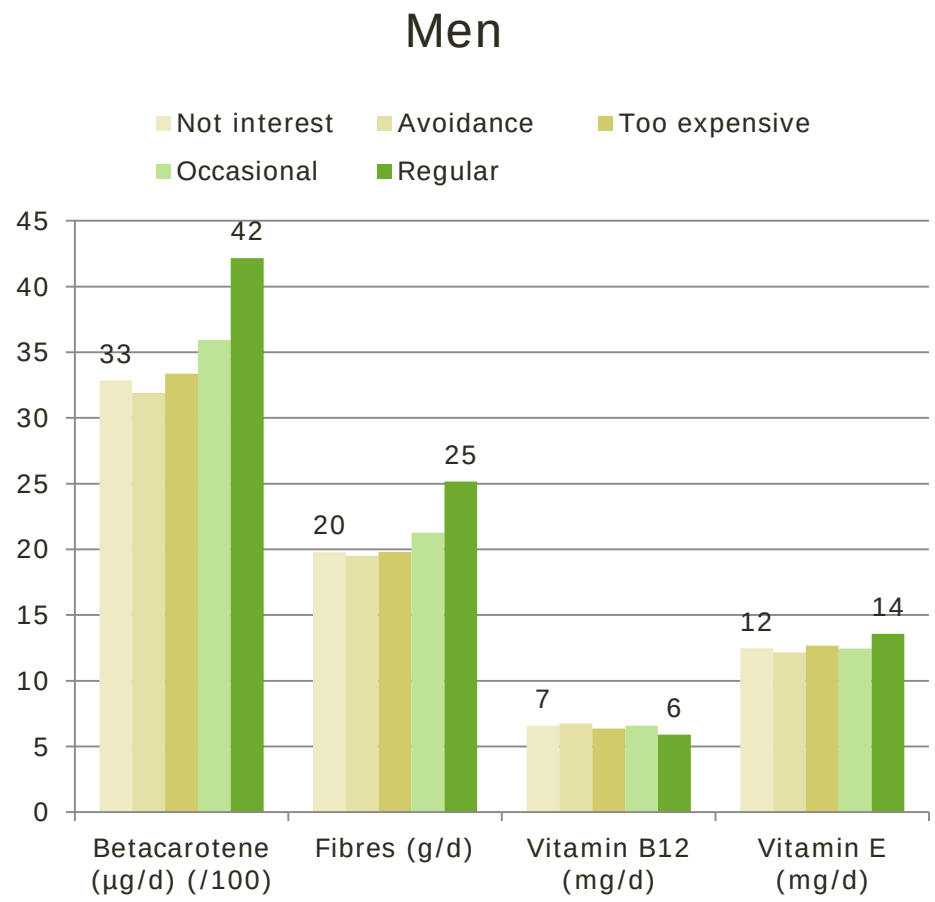


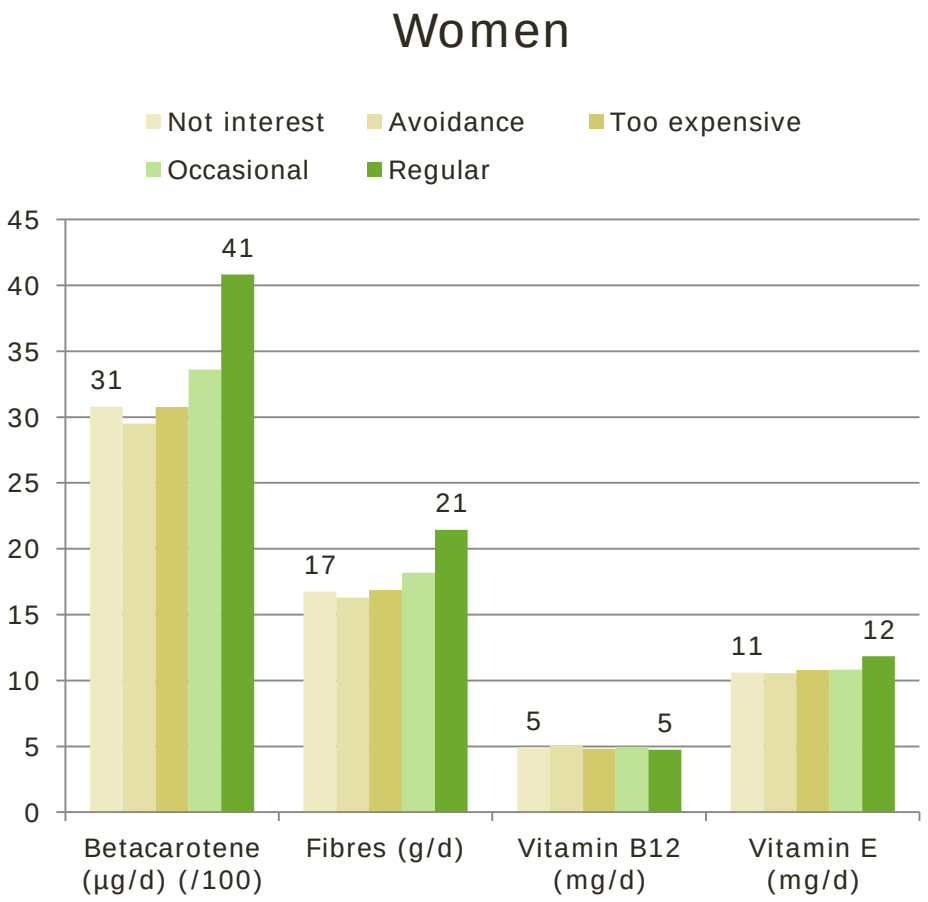
Women



- Differences in %EI for: SFA, tot PUFAs, n-3 & n-6 PUFAs

Nutrient intakes (3)





- Differences for fibres, beta-carotene,vitamin E, vitamin C

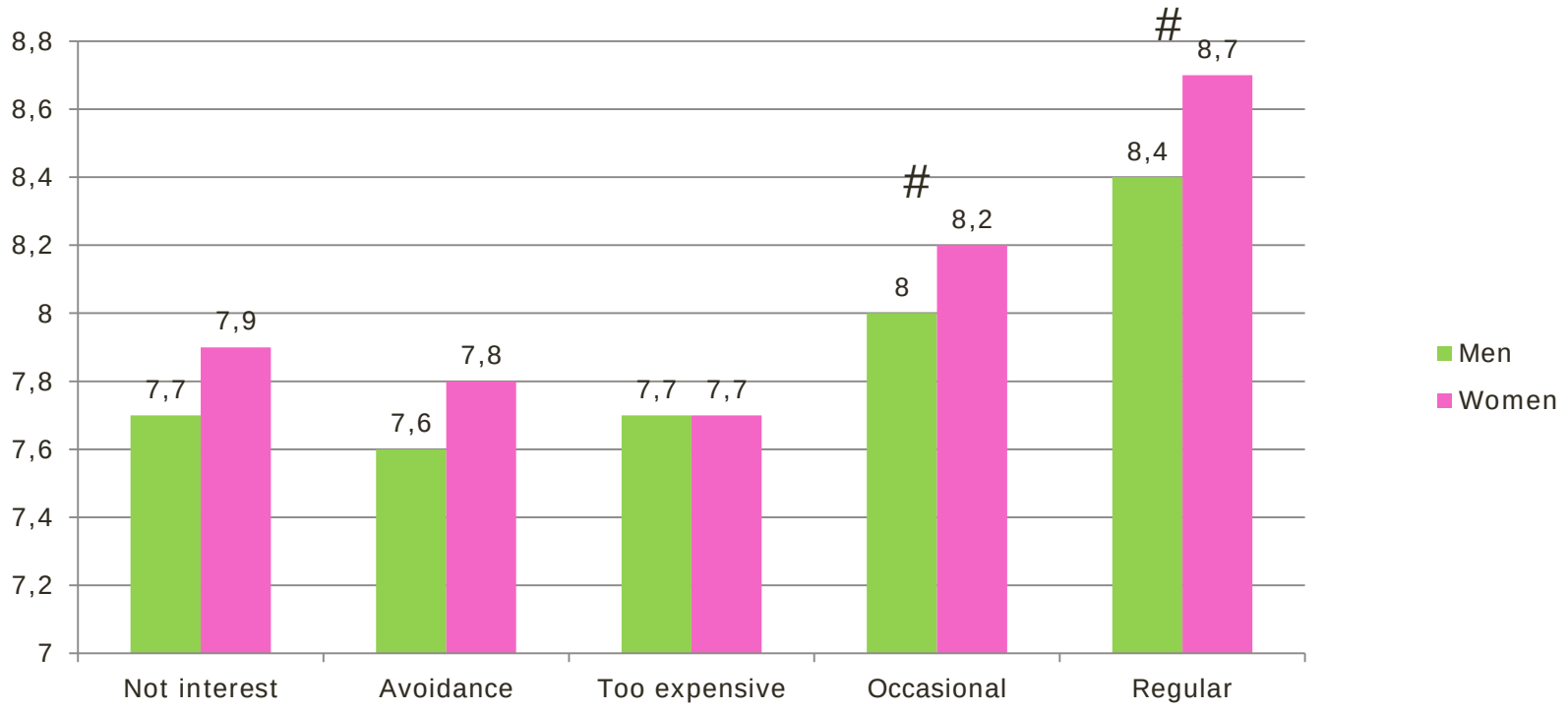
*Values are adjusted for EI

Nutrient intakes : conclusion

Compared to participants in cluster 1 (no interest OP):

- those in cluster 2 & 3 (not OP) showed comparable energy & nutrient intakes
- those in cluster 5 (RCOP) showed comparable daily energy intakes but higher daily intakes of: ($p < 0.0001$)
  polyunsaturated fatty acids (+12% in both genders),
  n-3 PUFA (+19% in men, +20% in women),
  fibers (+27% in men, +28% in women),
  beta-carotene (+28% in men,+-33% in women),
  folic acid (+15% in men, +17% in women),
  vitamin C (+10% in men, + 13% in women),
  iron (+20% in men, +18% in women),
  magnesium (+18% in both genders),
  and
  lower daily intakes of : ($p < 0.0001$)
  alcohol (-17% in men, -11% in women)
  and cholesterol (-12% in men, -10% in women).
- those in cluster 4 (OCOP) showed profiles intermediate between never-consumers and RCOP.

Adherence to nutritional guidelines*



The more frequent organic food consumption , the higher the adherence to Nutritional Guidelines (cf PNNS)

* This score includes 12 components for a maximum of 13.5 points :
- 8 refer to food serving recommendations (fruit and vegetables, starchy foods, whole grain products, dairy products, meat, eggs and fish, seafood, vegetable fat, water and soda),
- 4 refer to moderation in consumption (added fat, salt, sweets, alcohol)

Association between cluster and corpulence among men*

* Values are odds ratios (polytomous logistic regression) adjusted for age, physical activity, education, smoking, energy intake, restrictive diet and mPNNS-GS.

Overweight, BMI 25-29.9; Obesity, BMI > 30

P-values for Wald test of the global effect between clusters <0.0001 (#)

Association between cluster and corpulence among women*

* Values are odds ratios (polytomous logistic regression) adjusted for age, physical activity, education, smoking, energy intake, restrictive diet and mPNNS-GS.

Overweight, BMI 25-29.9; Obesity, BMI > 30

P-values for Wald test of the global effect between clusters <0.0001 (#)

Conclusions :

Regular consumers of organic products exhibit
- specific socio-demographic characteristics (higher education level),
- with a better dietary pattern (more plant food-based one) fitting food-based and nutritional recommendations
- and a better compliance with the sustainable diet concept (more plant foods, better nutrition, to minimize land/energy/water uses and environmental impacts).

- They are markedly less overweight and obese.

The relationship between organic food intake and health markers will be further studied longitudinally in this cohort (10 years) during the BioNutrinet study.

German National Nutrition Survey II, 2008

Survey on 13.074 men and women, 18 - 80 years

Fachhochschule Münster University of Applied Sciences

- Assessement based on the consumption of 10 relevant food groups :

- **0rganic food buyers compared to non-buyers:**

→non-smoker and more physically active

→ more favourable food choice

→ with good knowledge of nutrition

→ more often of normal weight (less often overweight or obese)

→→ buyers of organic food adhere to a healthier lifestyle.

Source: Hoffmann I & Spiller A (2010): Data Interpretation Based on the German National Nutrition Survey II (NVS II): An Integrative Analysis of Behavioural and Lifestyle-Related Factors for Organic Food Consumption. http://orgprints.org/18055/

Sustainable diet

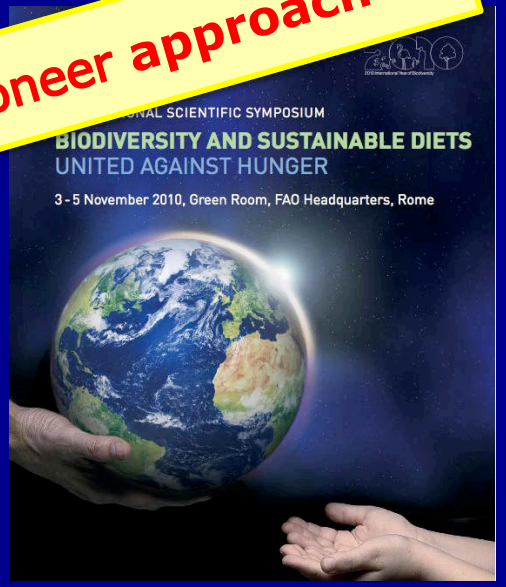
DEFINITION OF SUSTAINABLE DIETS

“ Sustainable Diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations.
Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources. “

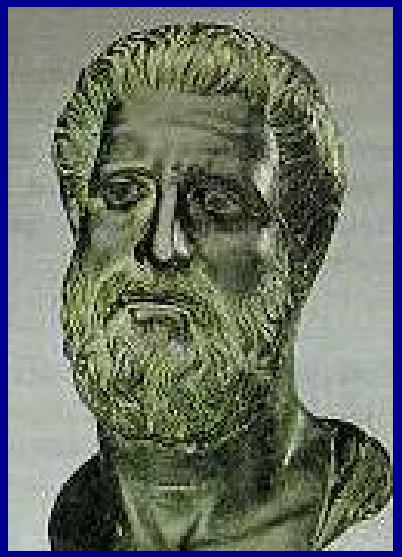
INTERNATIONAL SCIENTIFIC SYMPOSIUM
BIODIVERSITY AND SUSTAINABLE
UNITED AGAINST HUNGER

3-5 NOVEMBER ... ADQUARTERS, ROMA

Organic agriculture aims and achievements : a pioneer approach !



Hippocrates, 400 BC

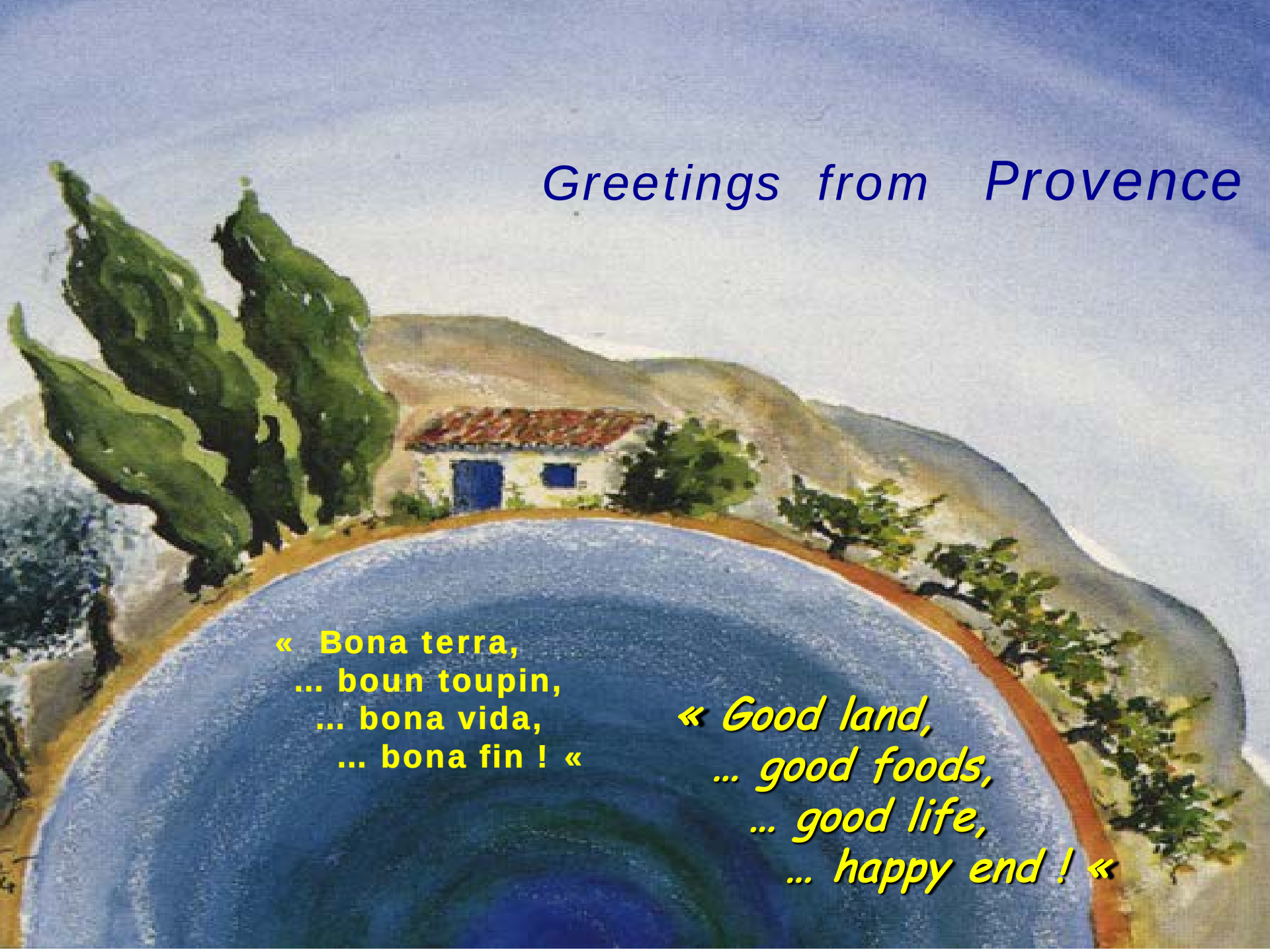


"Should your diet be your first medicine "

" Positive health requires a knowledge of man's primary constitution (today's "genetics") and of the powers of various foods, both those natural to them and those resulting from human skill (today's processed food).

But eating alone is not enough for health. There must also be exercise, of which the effects must likewise be known …

…The combination of these two things makes regimen, when proper attention is given to the season of the year, the changes of the winds, the age of the individual and the situation of his home. "


Greetings from Provence
« Bona terra,
... boun toupin,
... bona vida,
... bona fin ! «
« Good land,
... good foods,
... good life,
... happy end ! «

Description of clusters

	Men					Women				
	Not interested	Avoidance	Too expensive	OCOP	RCOP	Not interested	Avoidance	Too expensive	OCOP	RCOP
N	2843	1423	840	5925	1374	6166	4277	3644	21587	6232
Restrictive diet (%)	24·6	25·9	29·4	25·3	22·1	52·9	54·4	59·1	54·2	51·1
≤ High school diploma (%)	22·1	30·6	36·3	22·9	16·5	15·1	24·5	24·3	16·3	13·5
Monthly income										
<1200 euros	10·8	14·3	23·1	11·8	11·2	18·0	25·2	33·3	19·5	15·0
1200-1800	23·6	27·4	33·6	25·2	24·8	27·2	29·4	34·9	28·5	26·8
1800-2700	27·2	25·4	26·2	27·9	27·1	26·9	23·3	22·0	26·8	28·0
>2700	38·4	33·0	17·2	35·1	36·9	27·8	22·1	9·7	25·3	30·1
Current smokers (%)	15·7	15·3	15·5	15·2	14·5	17·6	16·6	18·3	16·6	13·4
Low PA level	19·0	18·3	20·4	16·6	14·0	21·7	20·0	23·0	17·7	15·8

Association between cluster and corpulence
Conclusion

• The probability of being overweight or obese was significantly lower in men (OR 0.64/0.38) and women (OR 0.58/0.52) of the RCOP cluster than in the 3 non-consumer clusters.
• A significantly reduced probability, but of much less magnitude (OR 0.87/0.88), was also found in female OCOP.

These associations could be likely related to their healthier food pattern, but adjustment or not for the nutrition mPNNS-GS score, did not altered the magnitude of the associations (not shown).
This raises the question of possibly unexplored characteristics associated with consumption of organic food.

Indeed, previous research reported markedly lower contamination of organic foods by pesticide residues (compared to conventional foods) and authors have reported an association between pesticide exposure or residues in the body and obesity and type 2 diabetes (*Lee et al., 2007 & 2011, Rönn et al, 2011*).....
... the potential role of organic food in preventing excessive adiposity should thus be tested in further studies.

Autres rapports médiatisés…
qui nourrisent le doute !

- Article de Dangour et al., Am J Clin Nutr 2009:
  bilan sur 55 études (extrait du rapport FSA),
  pas de différence : des conclusions infondées

- Rapport Gueguen & Pascal, 2010 :
  des constats comparables sur les données
  vs rapports AFSSA et FSA, conclusions discutables.

- Article de Smith-Sprangler, Ann Int Med 2012:
  bilan sur 153 études veg: Bio > P et phenols, tend. Mg
  bilan sur 51 études anim : Bio > AG n-3 lait, poulet
  des bias importants

Phyto-microconstituents (anti-oxydants)

(*AFSSA report 2003:* n= 11 studies: 4 Vegs; 7 Fruits)

« From the data analysed, the contents in phenolics (anti-oxydants) appear higher organic foods vs conventional foods «

A recent literature survey estimated that overall organic products have a two fold higher content in phenolics vs conventional ones.
(Rembialkowska, JSFA, 2007)

Two more recent literature surveys estimated that organic products have a higher content in phenolics vs conventional ones.
(FSA 2009; Lairon 2010)

Two very recent syntheses showed higher contents in anti-oxydants (and vitamin C in one) in organic products.
(Brandt 2011; Smith-Sprangler 2012)

Animal foods: fatty acid contents

In cow milk (n= 14 studies till 2011)

Teneur en acides gras oméga-3 des produits laitiers bio et conventionnels

Produit	Pays	Teneur en oméga 3 en bio par rapport au conventionnel	Source
Lait	Pays-Bas	+ 116%	Bloskma J, 2008
Lait	Allemagne	+ 100%	Schröder M, 2011
Lait	Italie	+ 57%	Bergamo P, 2003
Fromage	Italie	+ 51%	Bergamo P, 2003
Beurre	Italie	+ 91%	Bergamo P, 2003
Lait	USA	+ 68%	Ellis K, 2006
Lait	Italie	+ 26%	Lavrencic A, 2007
Lait	Slovénie	+ 21%	Lavrencic A, 2007
Lait	Allemagne	+ 83%	Molkentin J, 2007
Lait	UK	+ 65%	Butler G, 2008
Lait	USA	+ 64%	O'Donnell , 2010
Lait	Suède	+ 45%	Larsen, 2010
Lait	Dannemark/G	+ 104%	Slots, 2009
Lait , commerce	GB	+ 57%	Buttler, 2011
Moyenne		+ 68%	

C. Aubert/D.Lairon

n-6 / n-3 Ratio:

lower in org. milks (- 44%, - 90%)

Conclusion :

much higher omega-3 PUFA levels & higher n-3/n-6 ratio in org. milk and dairies.

Cereals and bread making

Wholegrain cereals (and to a less degree partly refined ones) are very rich in fibres, minerals, vitamins and anti-oxydants.
(2 - 5 fold higher vs refined grains)

… But some minerals (Calcium, Fer, Magnesium, Zinc) are there complexed with phytic acid, thus limiting their intestinal absorption.

Making conventional bread with yeast (alcoholic fermentation) only minimaly reduces the phytic acid level,

In contrast,
Making (organic) bread with natural sourdough (micro-organisms mix, lactic fermentation) markedly reduce the phytic acid level, thus increasing the intestinal absorption of these minerals.

Pesticide exposure with conventional foods

(used in conventionnal agriculture; forbiden in Org. agriculture)

In 2010, France (Générations futures report) :

The foods consumed by a 10y kid during a typical 4-meal day …
… provide residues from 36 different pesticides.

In 2012, France (Institut de veille sanitaire, Ministry of Health):

During a survey of 390 representative French adults … ,
… all people contained residues of :

- 11 organochlorine pesticides (serum),
- 6 organophosphate pestides (urine)
- and 5 pyrethrynoïd pesticides (urine).

Thus, today, every adult people is contaminated by a large mix
of pesticide residues, most being now recognized as endocrine disruptors.

Pesticides and diseases : A French official report in 2013

Bilan des études analysées sur l'exposition aux pesticides et la survenue d'une pathologie chez l'adulte[15] et l'enfant

Association positive entre exposition professionnelle aux pesticides et pathologies chez l'adulte (d'après la synthèse des données analysées)

Pathologies	Populations concernées par un excès de risque significatif	Présomption d'un lien[a]
LNH	Agriculteurs, applicateurs de pesticides, ouvriers en industrie de production	++
Cancer de la prostate	Agriculteur, applicateurs de pesticides, ouvriers en industrie de production	++
Myélome multiple	Agriculteurs, applicateurs de pesticides	++
Maladie de Parkinson	Professionnelles et non professionnelles	++
Leucémies	Agriculteurs, applicateurs de pesticides, ouvriers en industrie de production	+
Maladie d'Alzheimer	Agriculteurs	+
Troubles cognitifs[b]	Agriculteurs	+
Impact sur la fertilité, fécondabilité	Populations professionnelles exposées	+
Maladie de Hodgkin	Populations agricoles	±
Cancer du testicule	Populations agricoles	±
Tumeurs cérébrales (gliomes méningiomes)	Populations agricoles	±
Mélanome cutané	Populations agricoles	±
Sclérose latérale amyotrophique (SLA)	Agriculteurs	±
Troubles anxio-dépressifs[b]	Agriculteurs, agriculteurs ayant des antécédents d'intoxications aiguës, applicateurs	±

[a] Les cotations reprennent l'appréciation de la présomption du lien d'après l'analyse des résultats des études rapportées dans la synthèse : présomption forte (++), présomption moyenne (+) et présomption faible (±)

Pesticides and diseases : A French official report in 2013

Association positive entre exposition professionnelle ou domestique aux pesticides et cancers et développement de l'enfant (d'après la synthèse des données analysées)

Effets	Populations concernée par un excès de risque significatif	Présomption d'un lien[a]
Leucémies	Populations professionnelles exposées pendant la grossesse, populations concernées par une exposition résidentielle en période prénatale	++
Tumeurs cérébrales	Populations professionnelles exposées pendant la grossesse	++
Malformations congénitales	Populations professionnelles exposées pendant la grossesse	++
	Populations exposées au domicile (proximité, usages domestiques)	+
Morts fœtales	Populations professionnelles exposées pendant la grossesse	+
Neurodéveloppement	Populations professionnelles exposées pendant la grossesse	±

[a] Les cotations reprennent l'appréciation de la présomption du lien d'après l'analyse des résultats des études rapportées dans la synthèse : présomption forte (++), présomption moyenne (+) et présomption faible (±)

Bacteria contaminations

•*AFSSA Report 2003:*
« Restriction of sillage reduces the contamination risk (E. coli O157, *Listeria monocytogenes). «*

•*Article by Smith-Sprangler, Ann Int Med 2012:*
No difference in the prevalence of contamination of plants or meats (chicken, pig, beef) in org. products vs conventional ones for:
E. Coli, Salmonella, Campylobacter, Lysteria

Bacteria resistance to antibiotics

• *AFSSA Report 2003:*
« The level of resistance to antibiotics (14) is lower in turkey, pig, veal in organic farms. » , from Bertrand, 2002.

• *Article by Smith-Sprangler, Ann Int Med 2012:*
The risk to find bacterias resistant to ampiciline or to 3 or more antibiotics is lower in organic meats (chicken, pig).

Mycotoxins

• Mycotoxins are secondary metabolites secreted by molds such as *Aspergillus*, *Penicillium* et *Fusarium*.

•*AFSSA Report 2003 : «Available data show that variable contamination levels are found in organic foods, while there is no overall difference with the contamination levels in conventional products. »*

• *Recent studies tend to find less mycotoxins in organic foods.*
Article by Smith-Sprangler, 2012 (DON)

Nitrates

• *AFSSA Report 2003 : « It appears that production methods in organic agriculture led to overall 50% reduced yearly nitrate levels in organic vegetables vs conventional ones. »*

Genetically Modified Organisms (GMOs)

Since the first availability of OGM crops from the market, organic agriculture bodies have stated that :

- GMO crops are uncompatibles with organic agriculture principles aiming at respecting natural balances.

- Thus, GMO crops have been banned as primary crops and breeds as well as ingredients for food processing.

- *Indeed, new studies suggest some important side-effects such as :*

- resistance to herbicides, resistance to Bt toxin, gene transfers in crops,

- liver/kidney toxicity, tumoral devoppement in animals fed GMO foods).

- present GMO toxicity evaluation procedures are unsuitable.