

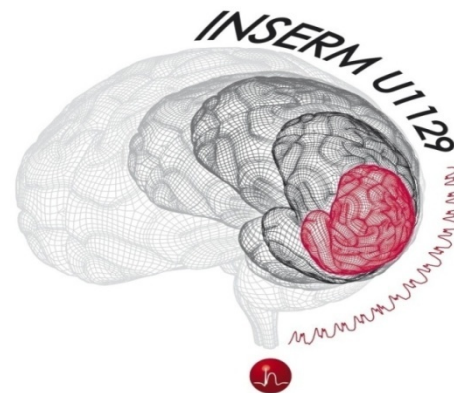
Health effects of coffee. Physiology and pathology

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General aspects on coffee

- Coffee is the drink most often consumed after water: 255 kg per second, i.e. 8 million tons per year



- Hence, this fascinating drink has raised very much interest, especially in terms of its potential effects on our health

Different constituents of coffee

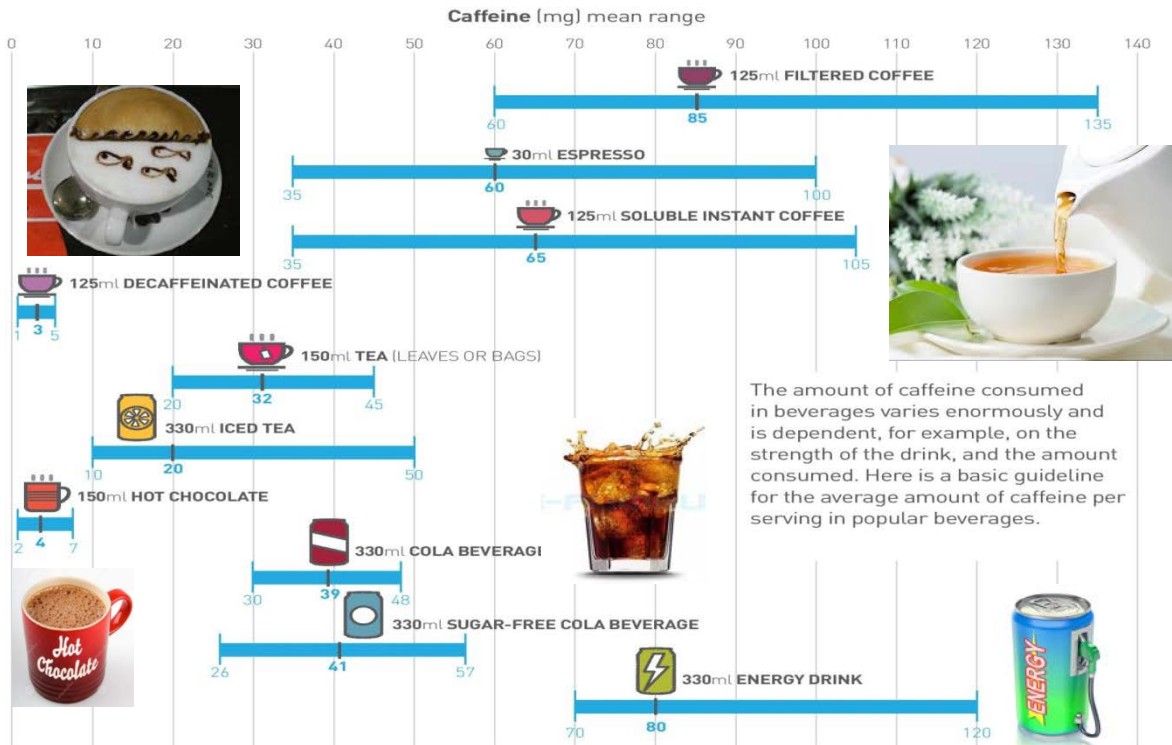
- Coffee contains more than 1000 substances

Components in roasted coffee	% of dry weight	% of dry weight
	Arabica	Robusta
Caffeine	1.3	2.4
Chlorogenic acid	2.5	3.8
Quinic	0.8	1.0
Trigonelline	1.0	0.7
Caramelized products (ex: melanoidins)	23.0	22.5

- Lipids: diterpenes (cafestol and kahweol): 1.4-3.2% in green coffee
- Coffee contains also proteins, minerals (calcium, magnesium), and vitamins (mainly from the B group)

Caffeine content of various drinks

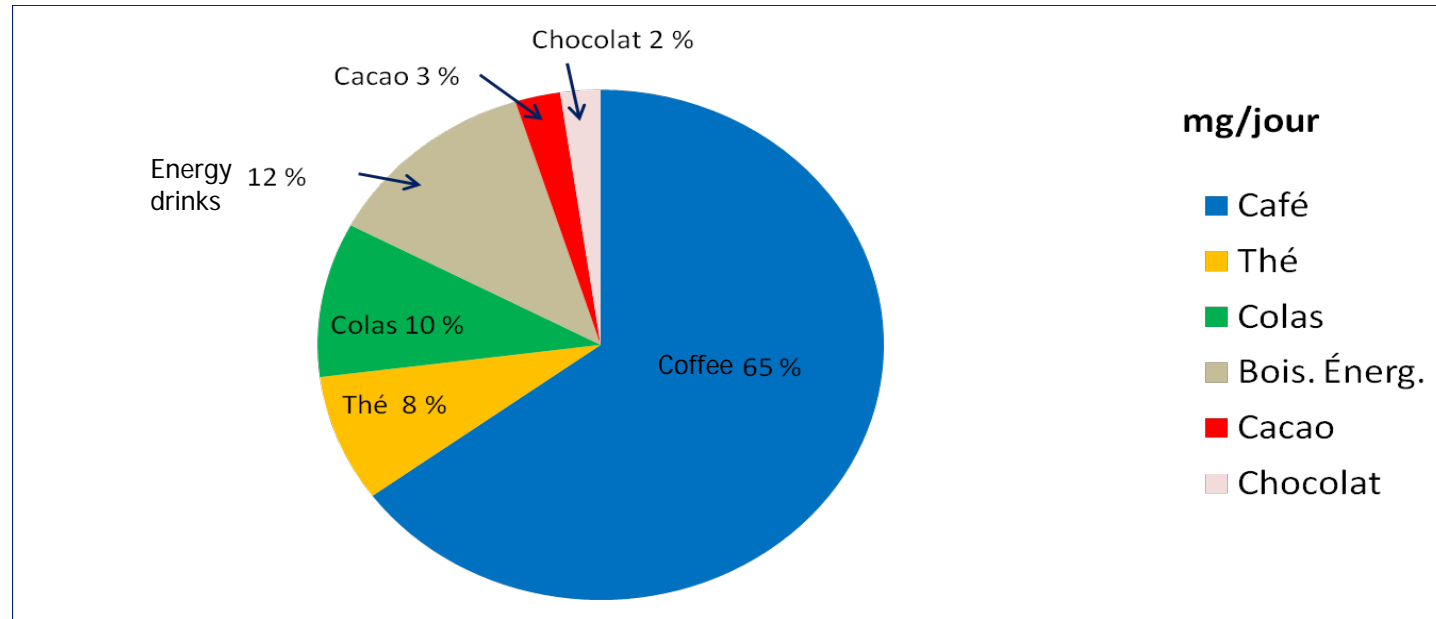
SOURCES OF CAFFEINE



The amount of caffeine consumed in beverages varies enormously and is dependent, for example, on the strength of the drink, and the amount consumed. Here is a basic guideline for the average amount of caffeine per serving in popular beverages.

- Low to moderate intake: 1-3 cups/day
- High intake: over 5 cups/day

Caffeine intake, Austria (Rudolph et al., 2014, EJCN)




Recommended doses of caffeine intake (EFSA, 2016)

Type of population	Maximal dosage advised in one sitting (mg)	Maximal daily dosage advised (mg or mg/kg)
Adults	200 mg (2 cups)	400 mg (4 cups)
Intense sports activity in adults	200 mg up to 2 h before the exercise	Not determined
Pregnant women	200 mg (2 cups)	200 mg (2 cups)
Nursing women	200 mg (2 cups)	400 mg (4 cups)
Adolescents and children	Not determined	3 mg/kg

- 7/10 French people drink coffee daily. The most regular consumers are over 55 years (92% drink coffee every day).
 - 10% consume over 6 cups per day, i.e. 550 mg.
- Source : Yougov survey for Travelex, October 2016.

General effects of coffee and caffeine

- 
- Low to moderate intake (50-250 mg caffeine in one sitting= 1 small to 2 large cups of coffee)
 - ✓ Positive effects: feeling of well-being, relaxation, good mood, energy, increased vigilance, better concentration
 - High to very high intake (400-800 mg caffeine in one sitting= 4 to 8 large cups of coffee)
 - ✓ Negative effects: nervousness, anxiety, aggressiveness, insomnia, tachycardia, tremor



The moderate consumption of coffee and caffeine (3-4 cups per day) is not considered to present any health risk

Interindividual differences

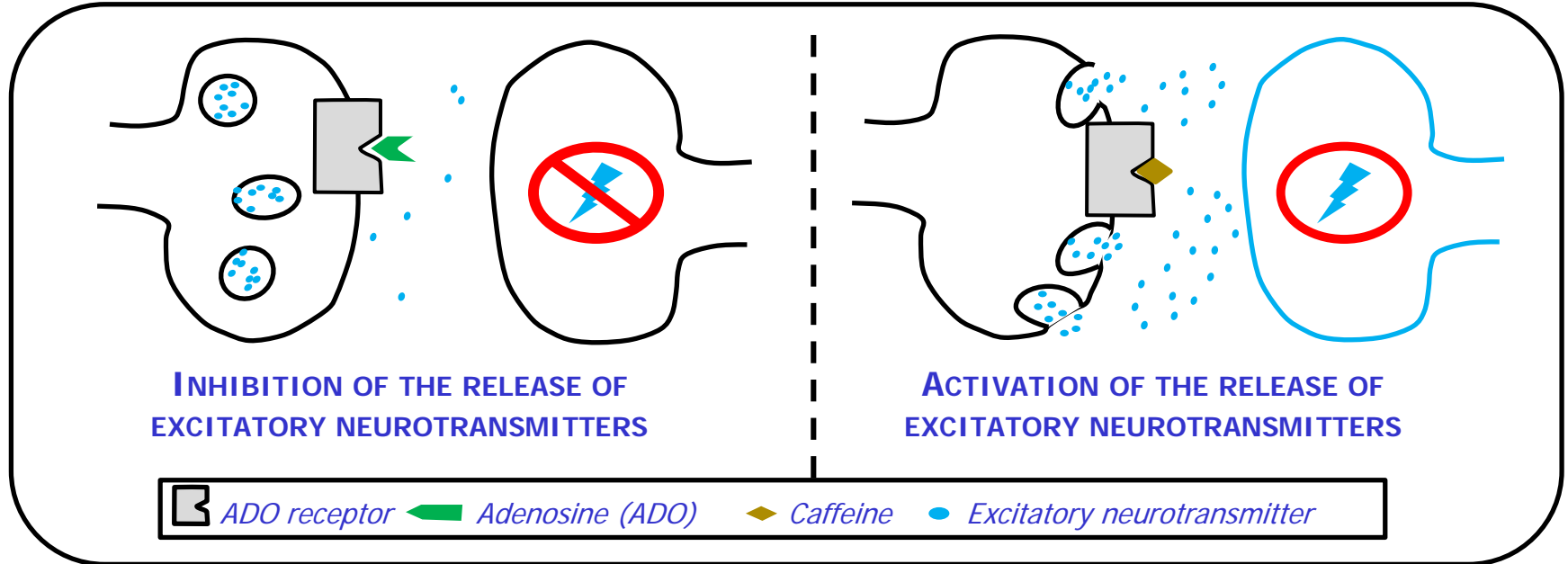
- Caffeine consumption and effects are influenced by the expression of some genes
- Caffeine metabolism: half-life 2.5-4.5 h
 - Influence of the variable expression of the gene coding for the enzyme metabolizing 95% of caffeine (cytochrome P450 isozyme 1A2-CYP1A2)
 - Slow (54%) and rapid metabolizers (46%)
- Spontaneous caffeine consumption
 - Influence of diverse genetic variations (polymorphisms) of the adenosine A2A receptor (main cerebral target of caffeine)

Individuals adjust their consumption habits to reach a balance between the searched positive effects and the adverse effects possibly felt

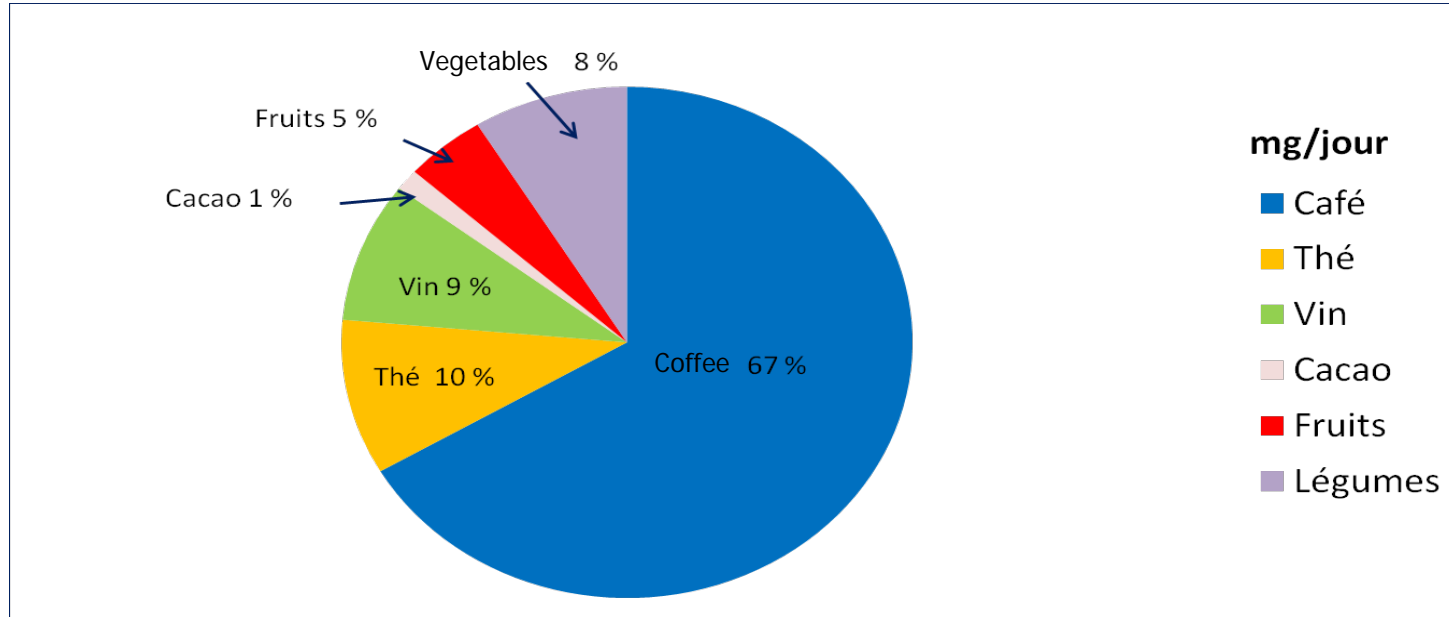
How does caffeine act?



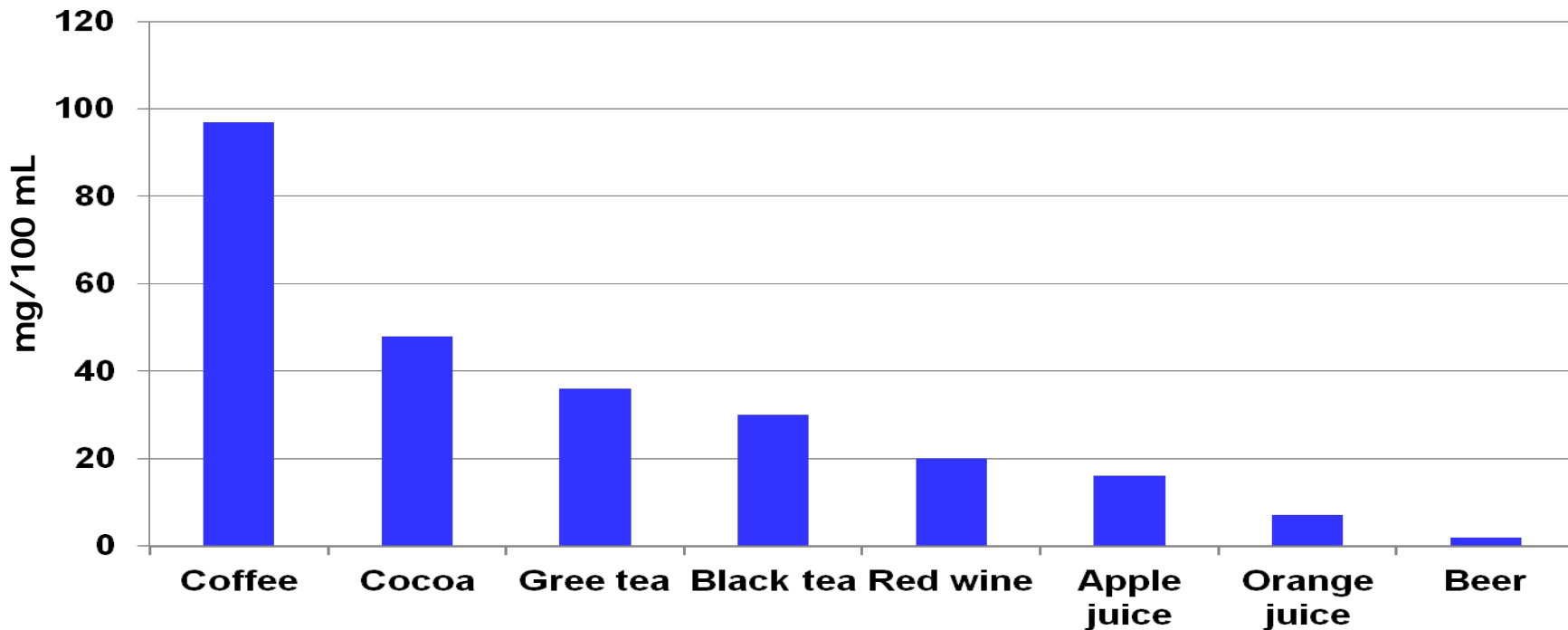
- Adenosine modulates brain excitability
- Caffeine acts as an antagonist at adenosine receptors



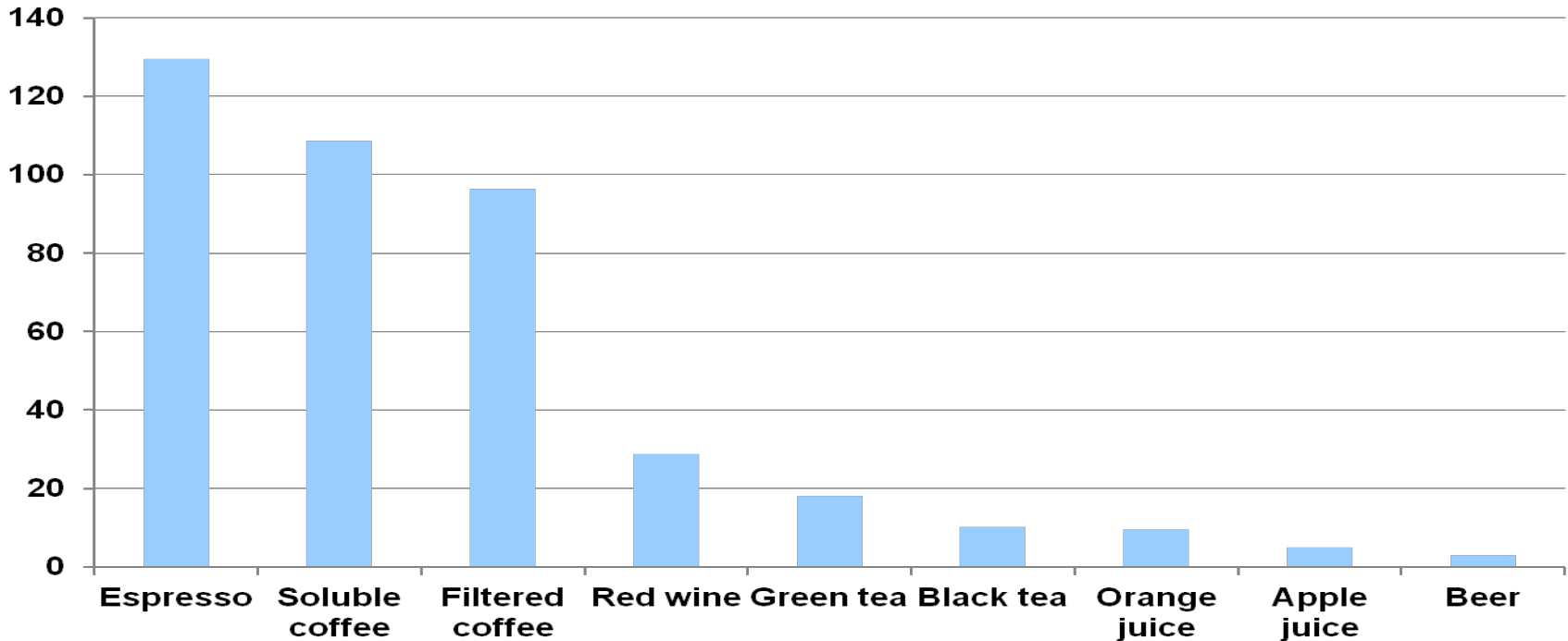
Polyphenol intake, France (Perez-Jimenez et al., 2011 AJCN)



Polyphenol content of drinks



Total antioxidant capacity of various drinks



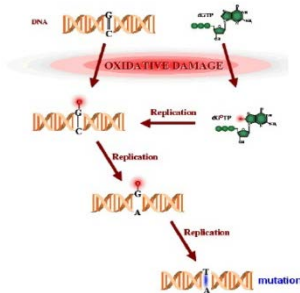
How do antioxidants act?



These apples demonstrate how oxidative stress breaks down your cells, causing premature aging and disease.



Oxidative damage to DNA – DNA mutation



- Preserve cell and membrane integrity
- Protect against
 - free oxygenated radicals induced cell damage
 - lipid peroxidation and protein damage
 - inflammation and infection
- Activation of detoxification processes
 - enzymes and pathways
- Preserve the integrity of DNA

Effects of coffee on the brain: physiological conditions



Effects of coffee/caffeine on vigilance, mood and performance



- Low doses of caffeine (20-200 mg) have positive effects on mood, vigilance and energy
 - Improvement of self-confidence, concentration ability and efficacy in intellectual tasks
 - Effects mostly marked in situations of reduced vigilance
 - Improvement of visual perception, reaction time, car driving and driving sleepiness



- The effects of caffeine on performance and memory are rather indirect

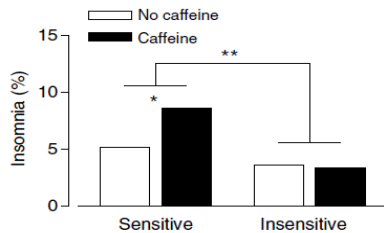
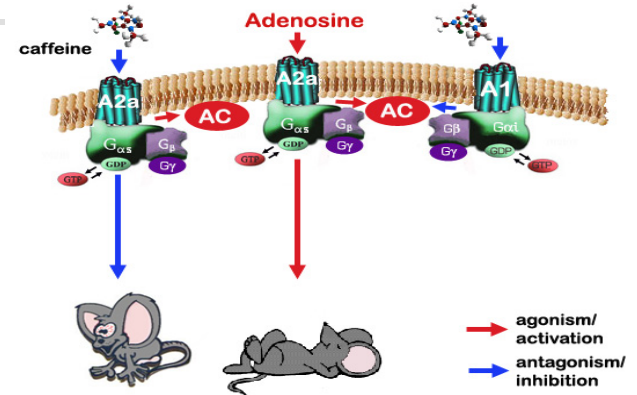
Effects of coffee/caffeine on headache/migraine



- Caffeine contained in coffee
 - Decreases pain in headaches and migraines
- Caffeine alone
 - Can be found in analgesic medication
 - Potentiates the analgesic properties of some drugs (aspirin, ibuprofen, paracetamol)
 - a 130-mg caffeine dose provides significant adjuvant therapy when combined with aspirin or paracetamol/aspirin in a variety of pain states
- Advice: take the anti-pain pill with coffee rather than water

Effects of coffee/caffeine on sleep

- Sleep is one of the functions most sensitive to coffee and caffeine effects



Rétey et al. 2007

- 100-200 mg caffeine (1-2 cups of coffee) at bedtime
 - ✓ Increase sleep latency and decrease sleep quality, mainly deep sleep while REM sleep is not affected
 - ✓ This effect persists for 3-4 h, sometimes longer
 - ✓ The effect varies with subjects, it is linked to a polymorphism of the adenosine A2A receptor

Effects of coffee/caffeine on anxiety

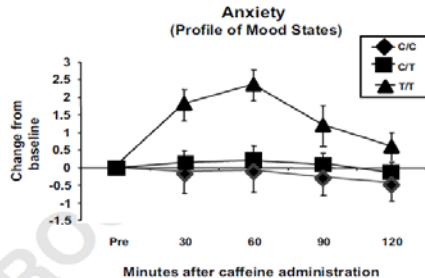


- Coffee and caffeine can generate anxiety

- Usually only at very high doses, far above habitual consumption

- This effects may occur at lower doses in some sensitive individuals (link with a polymorphism of the adenosine A2A receptor)

➔ This increased sensitivity may lead some subjects to spontaneously reduce their coffee consumption

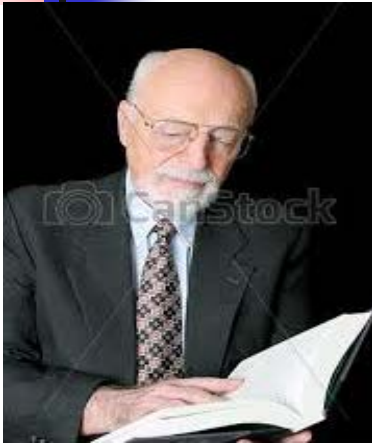


Alsene et al. 2003

Effects of coffee on the brain: Pathological conditions

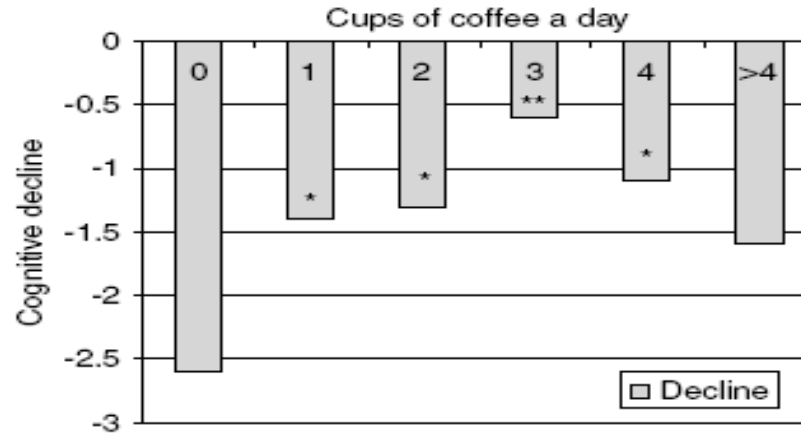


Coffee/caffeine and normal age-related cognitive decline



Prospective study over 10 years: FINE study

- o 676 healthy men born between 1900 and 1920 (SF, I, NL)
- o mini-mental state examination (MMSE scale 0-30)



*Significant vs 0 coffee,
 $p < 0.05$

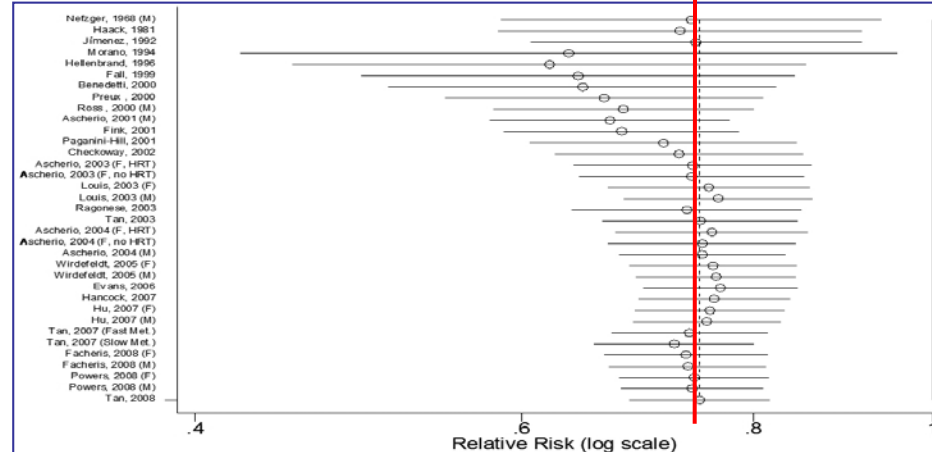
**Ditto, $p < 0.001$

➤ Coffee consumption is inversely related to age-related cognitive decline in European men

van Gelder et al, 2007

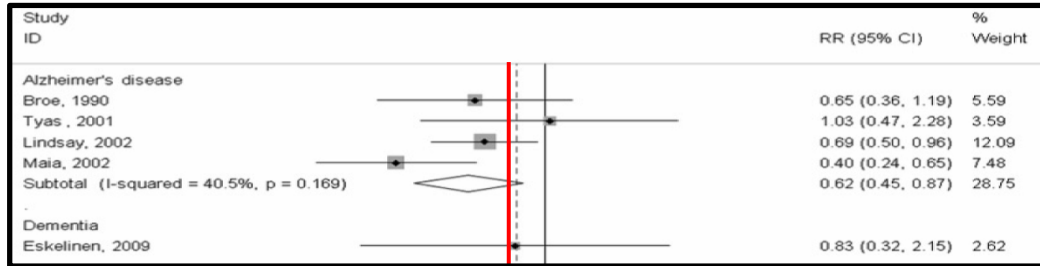
Coffee/caffeine and Parkinson's disease (PD)

Parkinson's disease (PD) results from the degeneration of dopaminergic neurons in the substantia nigra and striatum: leads to motor disturbance



- Effect: dose-dependent
- Effet: causal; direct link between caffeine intake and decreased probability of developing PD; already tested in a clinical trial
- Effect: less marked in women (hormonal treatment)

Coffee/caffeine and Alzheimer's disease (AD)



- A recent meta-analysis found a 16% risk reduction of developing AD in consumers of 3-4 cups of coffee daily compared to non-consumers (Santos et al, 2010)

- In animal models of AD, caffeine and antioxidants inhibit the deposition of β -amyloid peptide and Tau hyperphosphorylation and protect cognitive function (Arendash et al. 2006, 2009; Laurent et al., 2014; Yan et al. 2001)

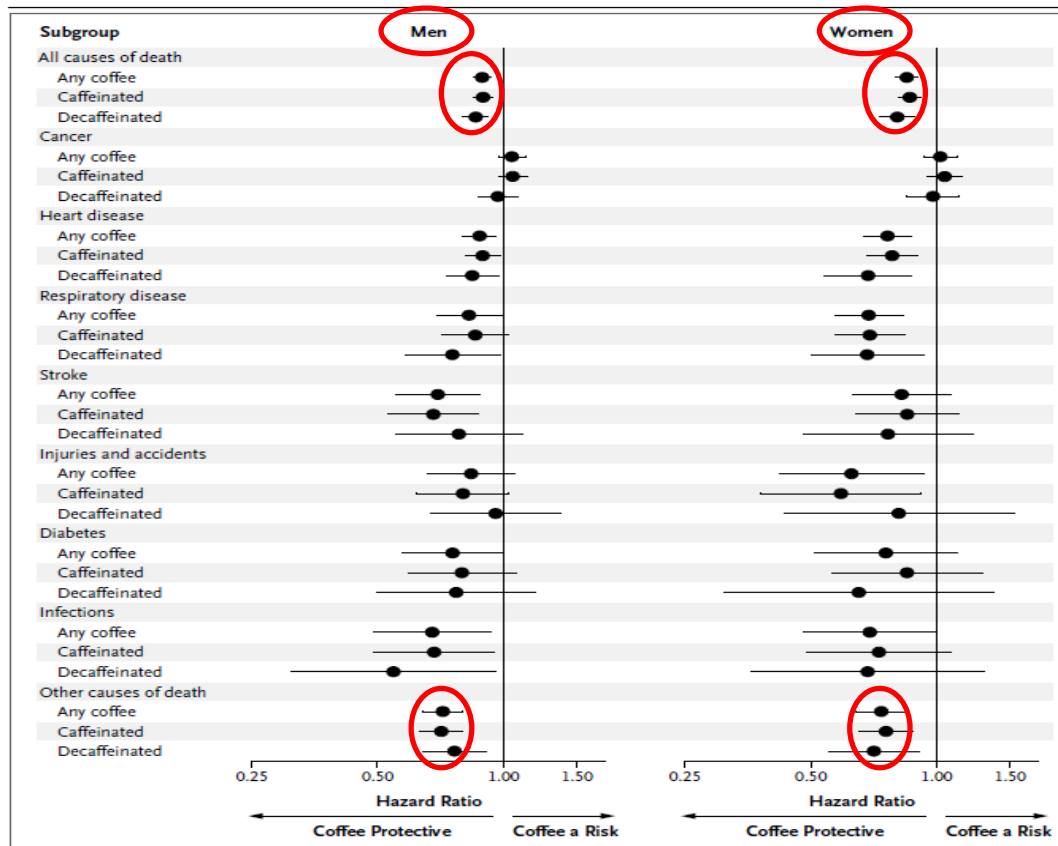
■ Points to clarify

- Limited database, prospective studies are needed
- Mechanism of action unclear: both caffeine and antioxidants could act on symptoms

Other health effects of coffee: mortality



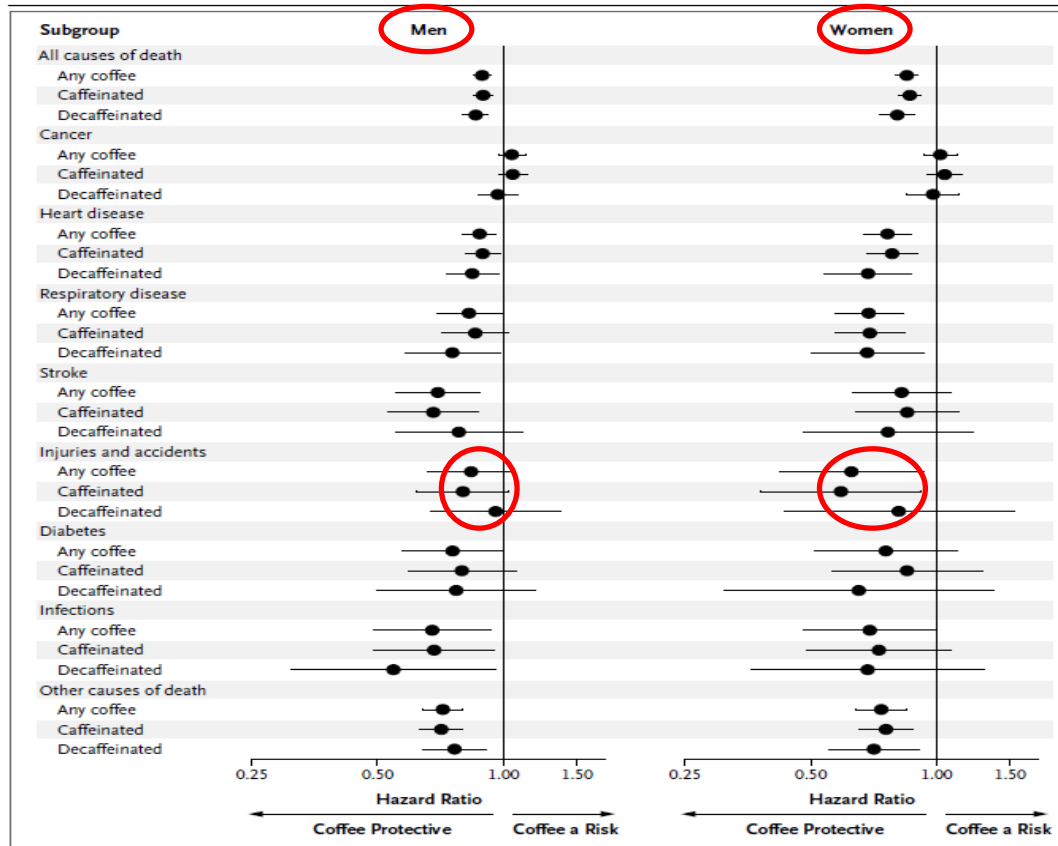
Coffee and mortality



➤ Decrease of mortality all causes similar with regular and decaf

➤ Tendency to larger effects of coffee consumption in women compared to men

Coffee and mortality

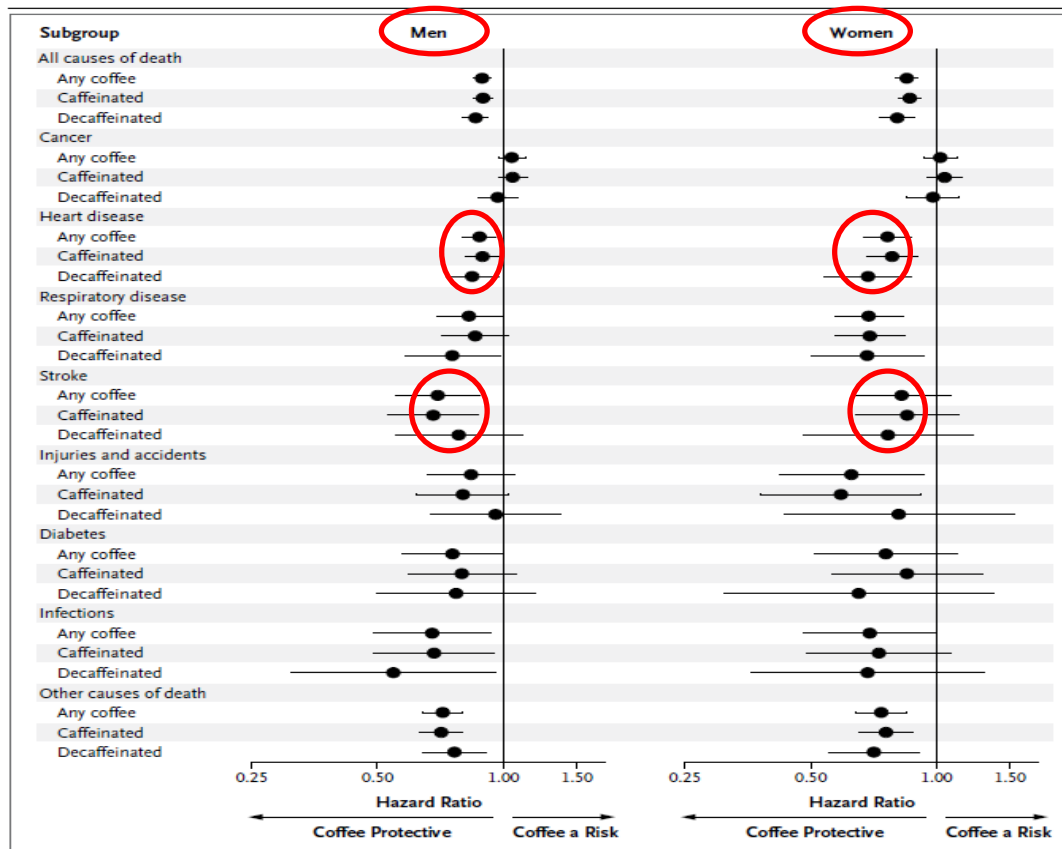


- Coffee, mainly regular coffee decreases mortality linked to injuries and accidents; decaf has no effects in men, a slight effect in women
- Could reflect the effects of coffee (caffeine) on vigilance and concentration

Effects of coffee on the cardiovascular system

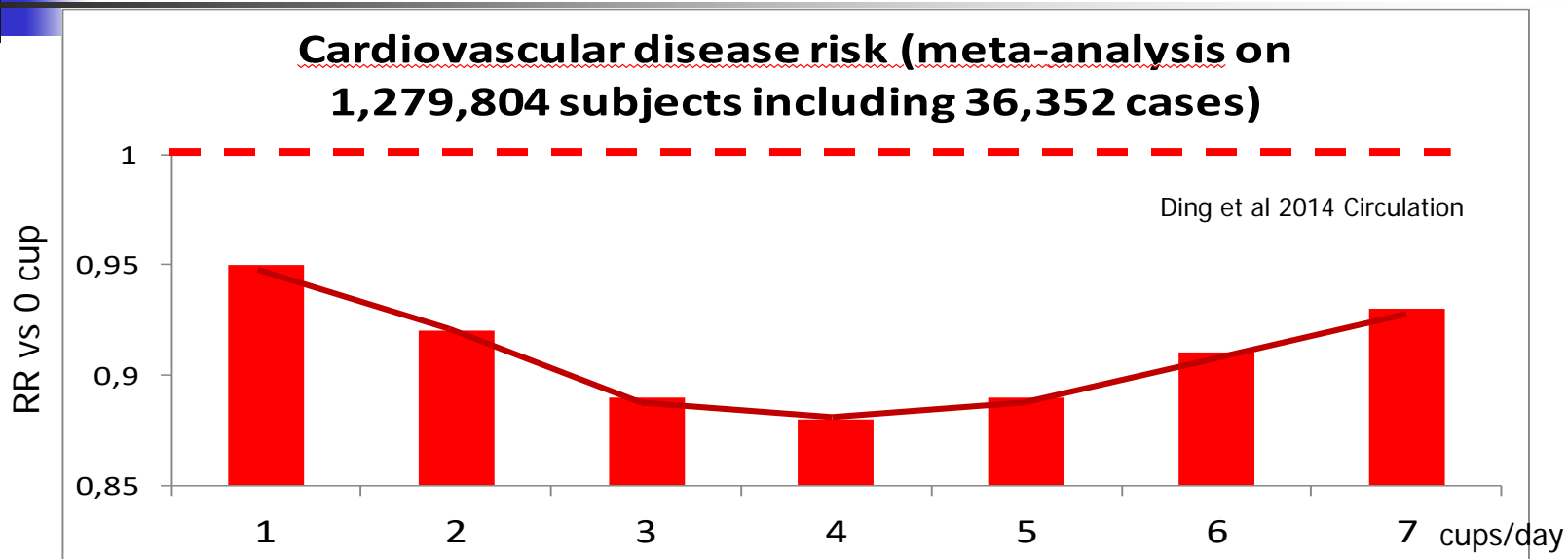


Coffee and mortality due to heart disease



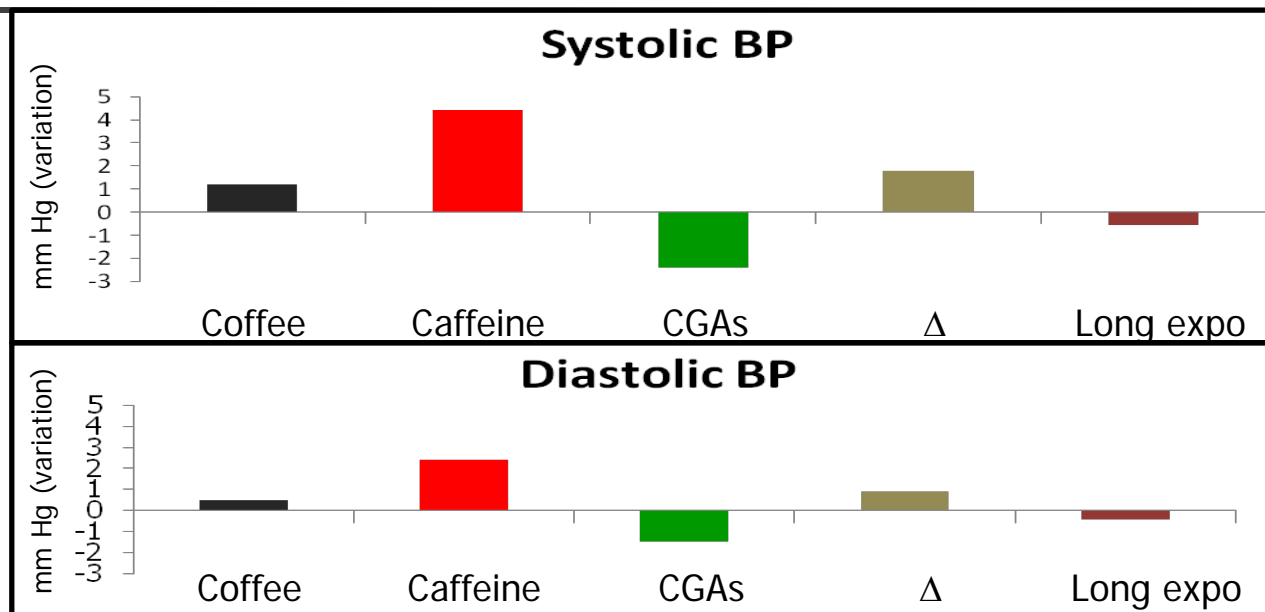
➤ Coffee reduces mortality due to heart disease and stroke, decaf is as effective as regular coffee, hence role of caffeine and polyphenols

Cardiovascular disease risk



- Non-linear reduction of cardiovascular disease risk, maximum for 3-5 cups daily; significant for coronary heart disease and stroke
- No negative effect of higher dosages
- Reduction of mortality

Coffee, caffeine and arterial blood pressure

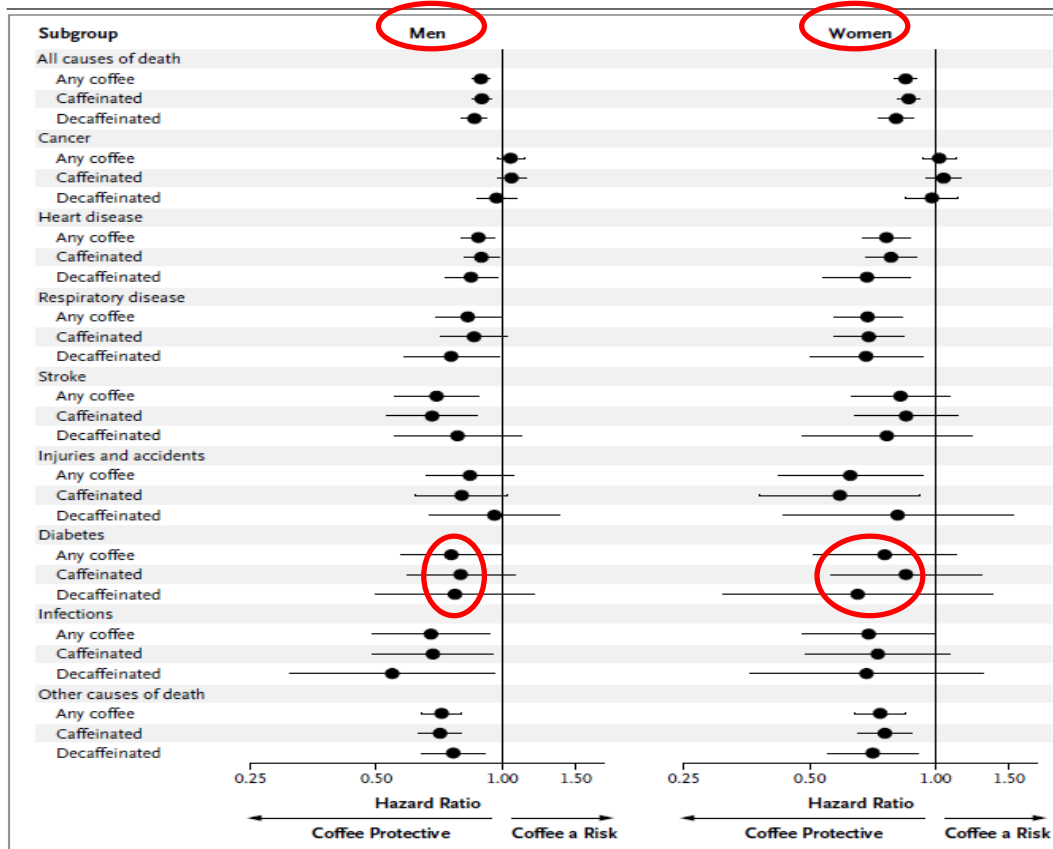


- Coffee does not affect blood pressure but caffeine alone increases blood pressure
- Coffee consumption is inversely associated with risk of hypertension

Coffee and type 2 diabetes



Coffee and mortality from diabetes

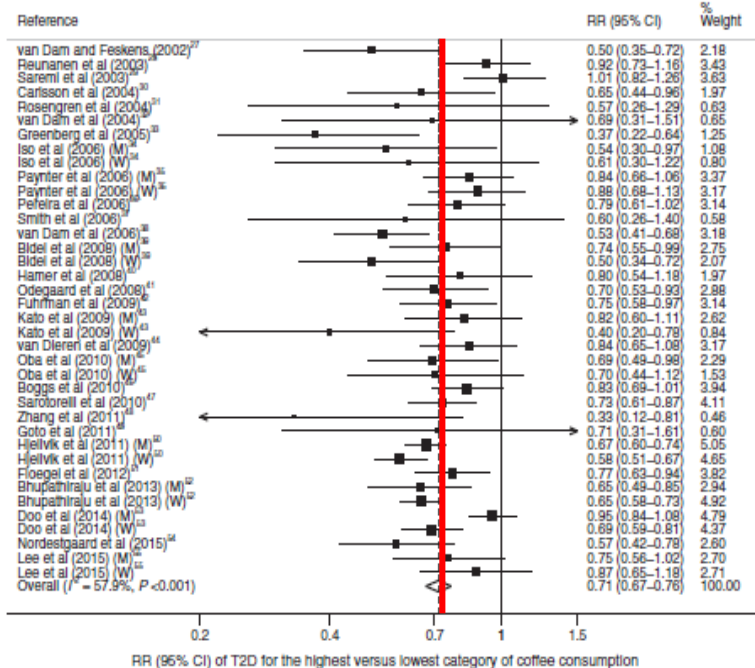


➤ Coffee reduces mortality due to type 2 diabetes and its complications

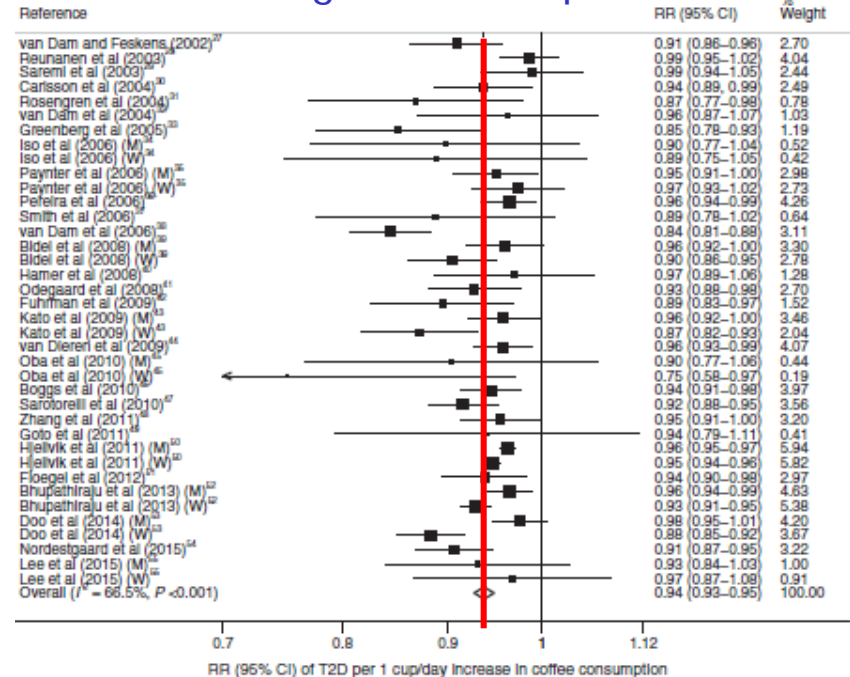
➤ Decaf is rather more effective on mortality than regular coffee, hence large role of polyphenols

Coffee and type 2 diabetes

Overall risk/29% decrease

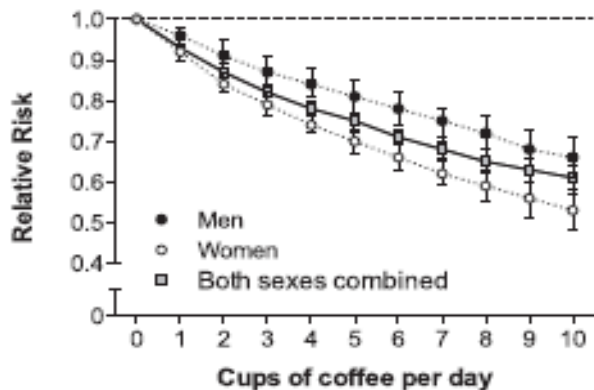


Risk change for one cup: -6%



Coffee and type 2 diabetes

- Coffee prevents type 2 diabetes: reproducible and powerful effect



- Negative association found in American, European and Asian populations
- Dose-dependent relationship between risk reduction (20-40%) and increasing consumption of coffee (3-7 cups/day)
- Observed in men and women, obese and non obese subjects
- Decaf is as powerful as regular coffee, hence effect mostly mediated by the antioxidants contained in coffee

Modulation of the risk of developing type 2 diabetes

- Addition of sugar to coffee reduces its protective potential
- Filtered coffee > boiled coffee and decaf > regular
- Effect more pronounced over 60 years

- Changes over quite short periods (4 years) modify the risk
 - Every increase by one cup of coffee/day decreases the risk by 11% for the next 4 years
 - Every decrease by one cup of coffee/day increases the risk by 17% for the next 4 years

- Daily consumption of 3-4 cups of coffee acts on the evolution of diabetes: it prevents prediabetics from developing diabetes provided that the coffee is consumed black without sugar or cream

Coffee and metabolic syndrome

- Metabolic syndrome is the conjunction of various problems in carbohydrate, lipid and vascular regulation associated to overweight
- These problems may induce in the long term type 2 diabetes and predispose to atherosclerosis and stroke
- Coffee consumption reduces by 25% the risk of metabolic syndrome
 - Reduces waist size
 - Accumulation of abdominal fat
 - Hypertension
 - Concentration of triglycerides in blood



How does coffee act?

- Effect of the antioxidants of coffee that act at various steps of glucose metabolism
- Thermogenic and anti-inflammatory effects; modulation of adenosine receptor signaling; microbiome content and diversity
- Potential role of the diterpene cafestol
 - Increases insulin production
 - Shows antidiabetic properties in mice
- Pathologies associated to diabetes
 - Reduction of diabetic retinopathy in a rat model
 - Decrease of the risk renal complications shown in Korean women
 - Acceleration of wound healing



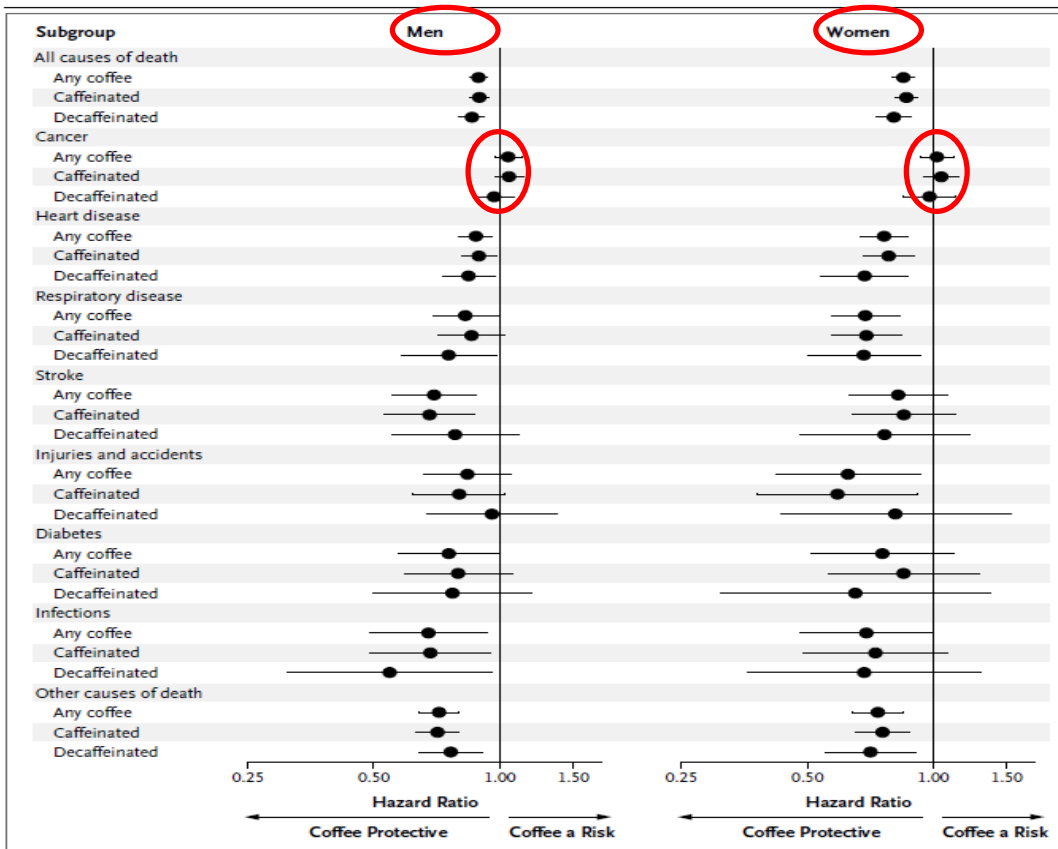
Coffee and cancer



Coffee and Proposition 65

- Recent long-running legal case in California that just came out which could result in 'cancer warning' labels on all coffee cups and packaging
- Linked to the presence of acrylamide in coffee which is formed during the roasting process
- Acrylamide is a carcinogen if administered alone in large amounts to rodents but coffee is a complex mixture of numerous compounds
- Coffee is by far not the largest contributor to acrylamide intake from food
- This decision, if applied, could affect the whole coffee chain and contradicts real-world and clinical evidence

Coffee and mortality linked to cancer



➤ No effect of coffee consumption on mortality related to cancer

➤ 46-71% reduction in risk of death from chronic liver disease

Effects of coffee on cancer (1)

- Recent reclassification of coffee by IARC (International Agency for Research on Cancer, 2016)
- Coffee has been considered as belonging to group 3: “not classifiable as to its carcinogenicity to humans”

Effects of coffee on cancer (2)

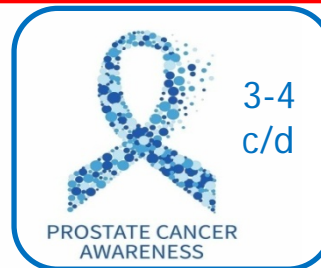
Coffee protects against cancer in some organs



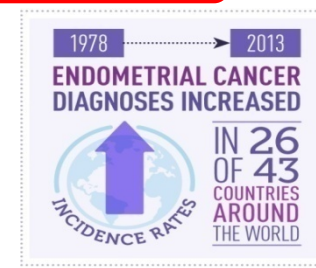
Liver



Breast



Prostate



Endometrium

4 cups/d



Pancreas



Colon-rectum



Skin

Effects of coffee on cancer (3)

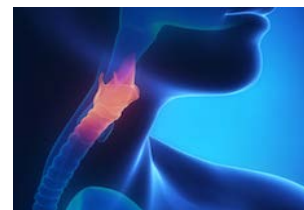
Coffee has no effect on cancer of some organs



Bladder

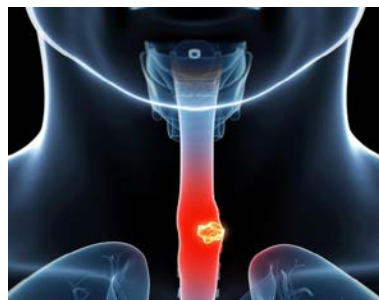


Kidney



Larynx

➤ The recent case in California does not make any sense



Oesophagus



Stomach



Lung

Limitations: observational vs interventional studies



Recent umbrella review (Poole et al., 2017, BMJ) (1)

- Review of evidence of observational and interventional meta-analyses of studies on coffee consumption and health outcomes
- Compiled only meta-analyses on coffee and health
 - Observational: 201
 - Interventional: 17
- Coffee is more often associated with beneficial rather than harmful health effects

Recent umbrella review (Poole et al., 2017, BMJ) (2)

- Risk reduction at intakes of 3-4 cups of coffee/day vs none or high vs low
 - All cause mortality (- 17%)
 - Cardiovascular mortality (- 19%)
 - Cardiovascular disease (- 15%)
 - Incident cancer and specific cancers (- 18%)
 - Neurological, metabolic and liver conditions

- Harmful associations nullified by adjustment for smoking

- Potential negative effects of coffee consumption
 - Pregnancy (low birth weight, preterm birth, pregnancy loss) (+ 22-46%) at all levels of intake
 - Risk of fracture in women not in men (lack of vitamin D?)

Recent umbrella review (Poole et al., 2017, BMJ) (3)

- 201 meta-analyses of observational vs 17 of interventional studies
- Enormous lack of interventional studies allowing to analyze whether coffee is causal
- **Only associations have been studied**
 - The exact role of coffee and its constituents in health effects is still unclear
 - Causality remains to be studied

Effects of coffee on the digestive tract



Coffee and digestion

■ Coffee

- Increases the activity of hepatic enzymes
- Increases the frequency of gallbladder contractions
- Increases pancreatic secretion
- Increases intestinal contraction

• On the other hand, coffee

- Increases the acid secretion of the stomach but only in individuals intolerant to coffee
- Does not influence the development gastro-duodenal ulcers, inhibits the formation of gallstones

Coffee, caffeine and pregnancy



Coffee, caffeine and pregnancy

- In pregnant women, caffeine consumption should not go over 200 mg/day (2 cups of coffee)
- Based on the most recent studies
 - Coffee has no effect on: fertility, congenital malformations or postnatal development
 - Coffee might increase the risk of: low birth weight, preterm delivery, pregnancy loss (≥ 300 mg)
 - Most often no negative effects at 200 mg/day, only seen at higher intakes
- Consumption needs to be reduced towards the end of pregnancy: the half-life of caffeine is prolonged during the 3rd trimester (10.5 h vs 2.5-4.5 h) and is very high in the foetus (about 100 h).

Coffee, caffeine and sports



Caffeine and sports



- Moderate quantities of caffeine (3-6 mg/kg) have beneficial effects in numerous sports
 - Endurance sports
 - Sports with stop-start (team sports and rackets)
 - Sports implying sustained and intense activity (long distance swimming and running, rowing...)
- Direct effects of caffeine on isolated efforts implying force and power, such as dumbbell lifting or sprinting are less clear
- Caffeine is also active in women (endurance, performance, team sports)
- Coffee is active but less used than caffeine tablets, appreciated by marathon runners

Conclusions

- Coffee has rather beneficial effects on health
 - Improves mood and performance
 - Regulates vigilance but can disturb sleep
 - Prevents age-related cognitive decline, mainly in women
 - Prevents Parkinson's and possibly Alzheimer's disease, liver cancer and diseases as well as type 2 diabetes
 - Is protective for the cardiovascular system
 - Can be consumed in moderation during pregnancy
 - Too high dosages might have deleterious effects
- A moderate consumption of coffee/caffeine
 - Has rather positive effects on health and well-being
 - Can be part of a well balanced diet

Astrid NEHLIG

Alimentation
et Santé



Café et santé

VRAI/FAUX
sur ce breuvage... divin



edo sciences

Book on Coffee and health



Thanks for your attention