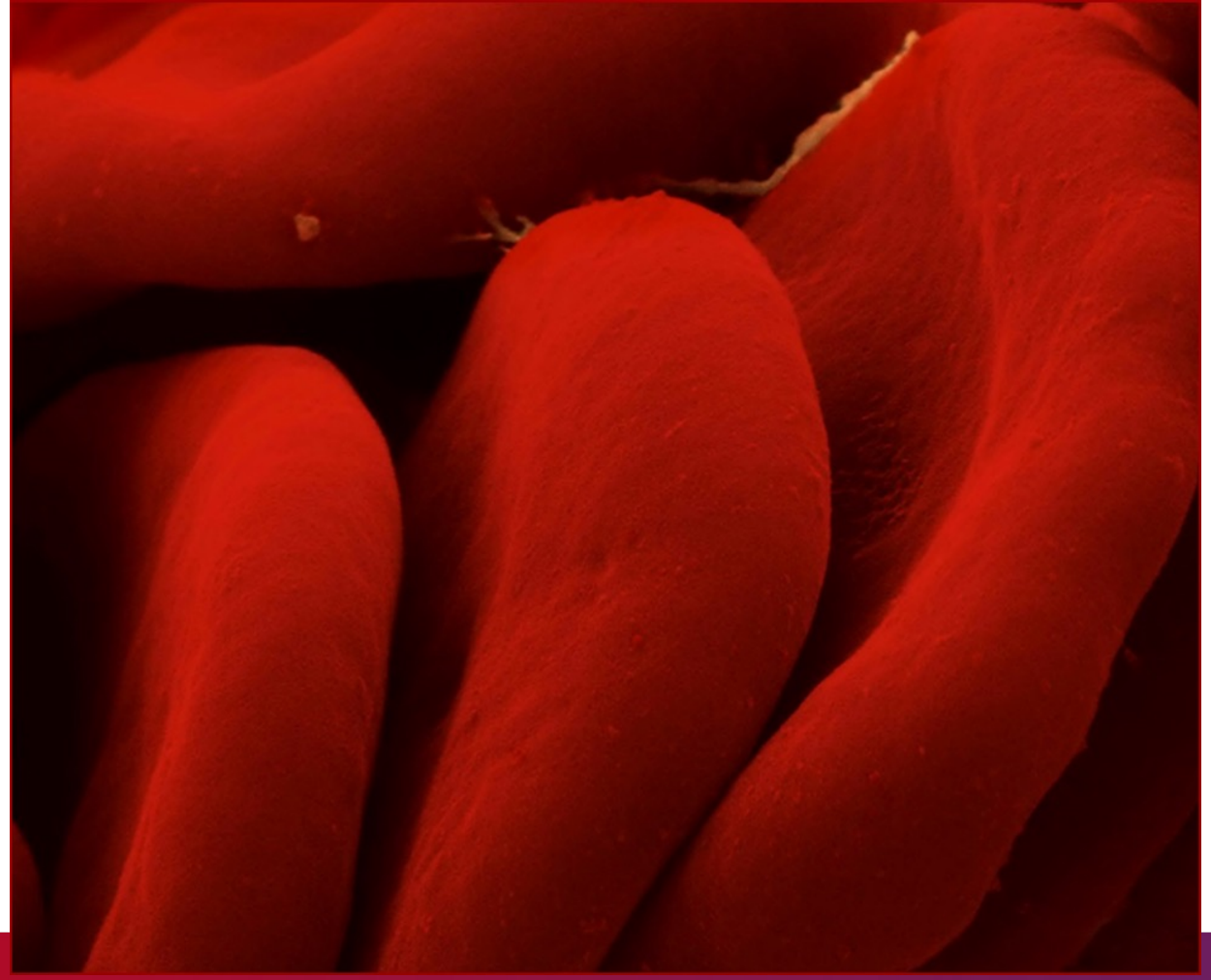
Eisenmangel

Pflanzliche Ernährung in der Pädiatrie: Braucht es Strategien zur Vorbeugung von Nährstoffmangel?



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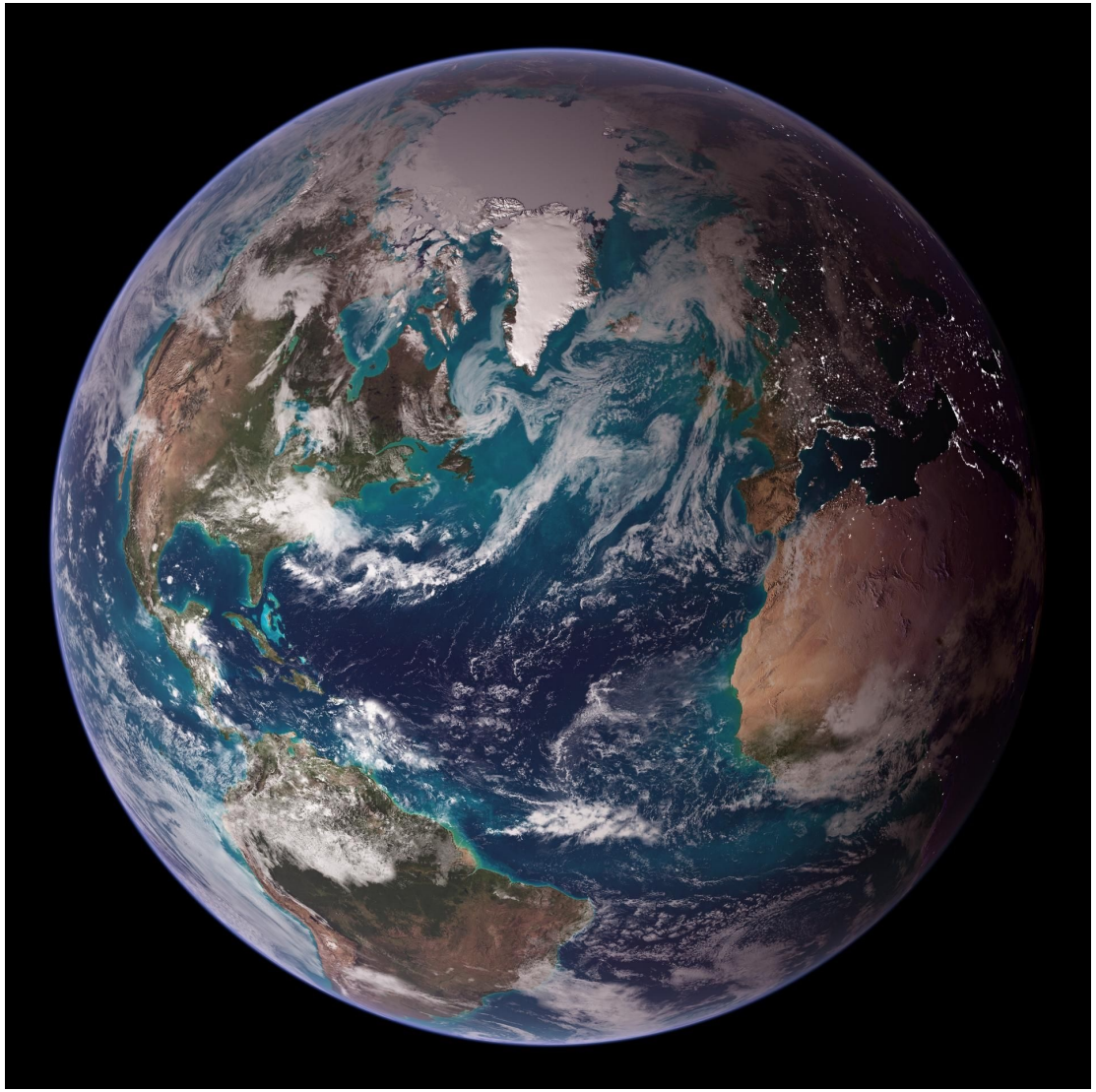
Mitglied der SUPSI

Prof. Dr. Diego Moretti
Nutrition Research, Departement of Health,
University of Applied Sciences of South Switzerland (SUPSI)
Swiss Distance University of Applied Sciences (FFHS)
Zürich, Switzerland

Iron is the 4th element on the earth crust



In European WRA:

Depleted stores (<30 µg/L SF): 40-55%

ID (<15 µg/L SF) :10-32%

IDA: 2-5%

Milman et al. 2017, AJCN

Chlorosis

- Misterious disease,
- Variety of definitions
- “Green sickness “, a disease characterise by pale skin, and lack of energy, shortness of breath, dyspepsia.
- ‘Love sickness’, *morbo virgineo*
- Considered a nervous disease
- Notion of *Materia Morbi*

The doctor and his patient
Jan Steen, Rijksmuseum, Amsterdam

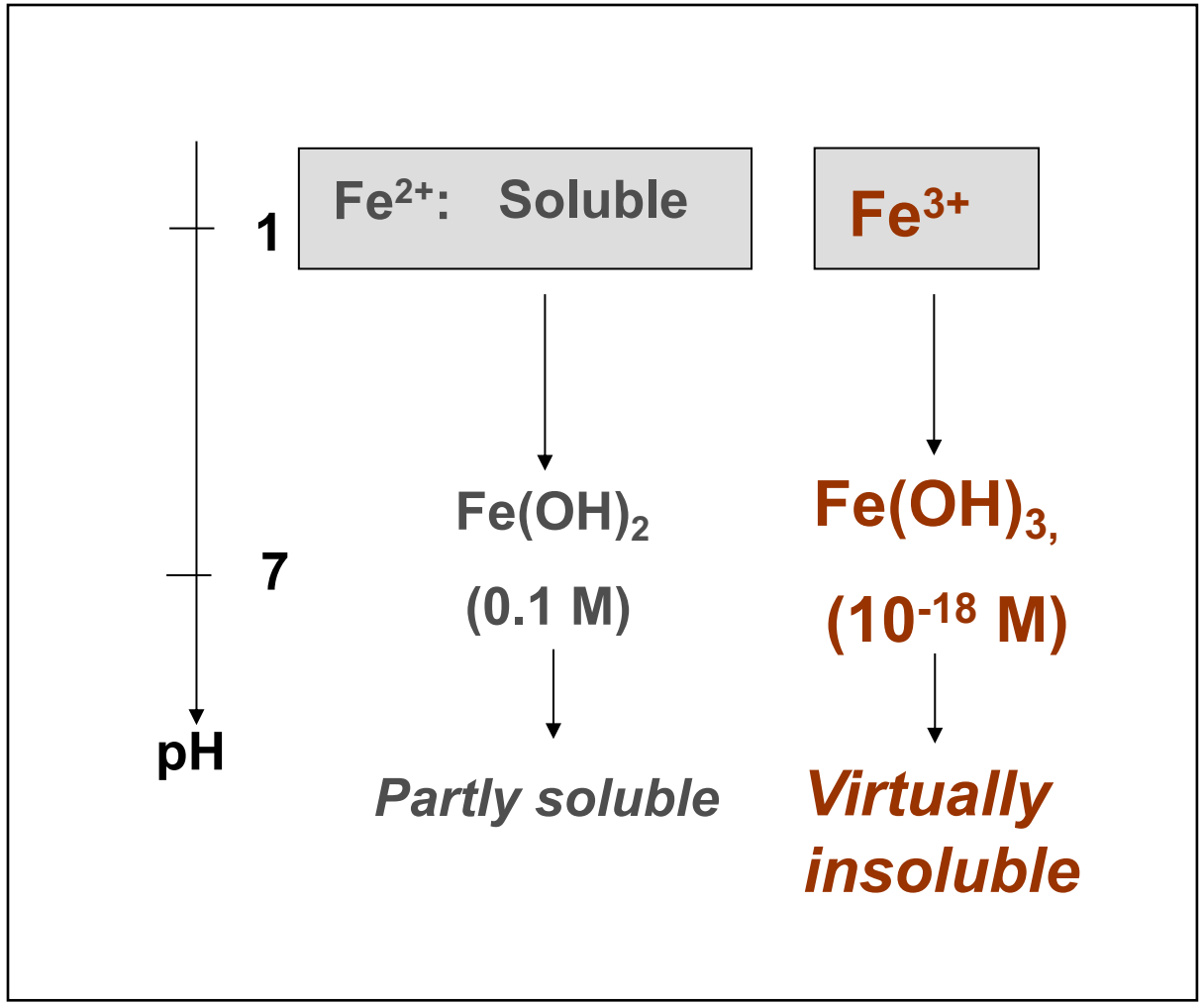
Iron chemistry

$$Fe^{2+} \leftrightarrows Fe^{3+}$$

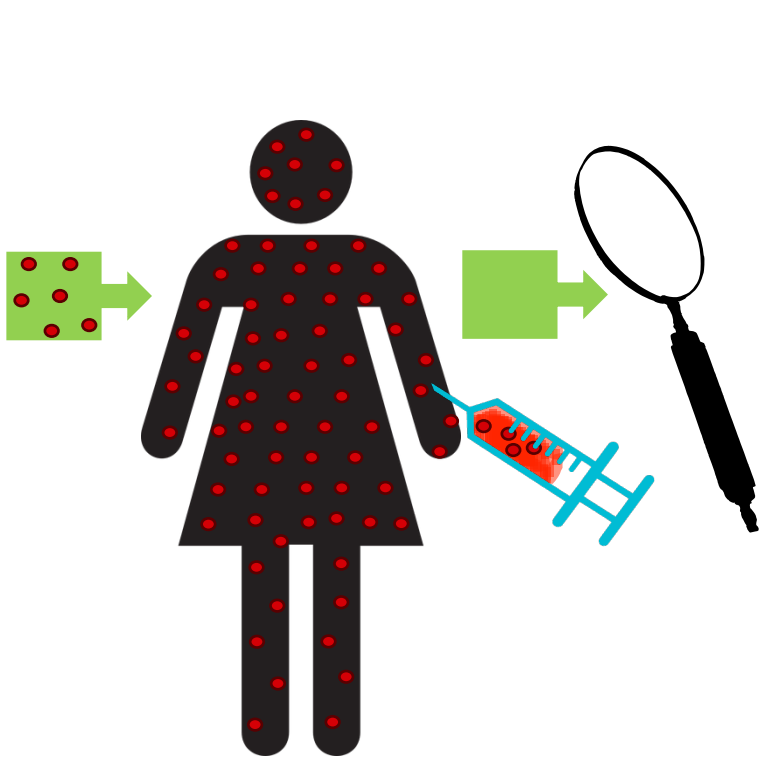
$$Fe^{3+} + O_2^- \rightleftarrows Fe^{2+} + O_2$$

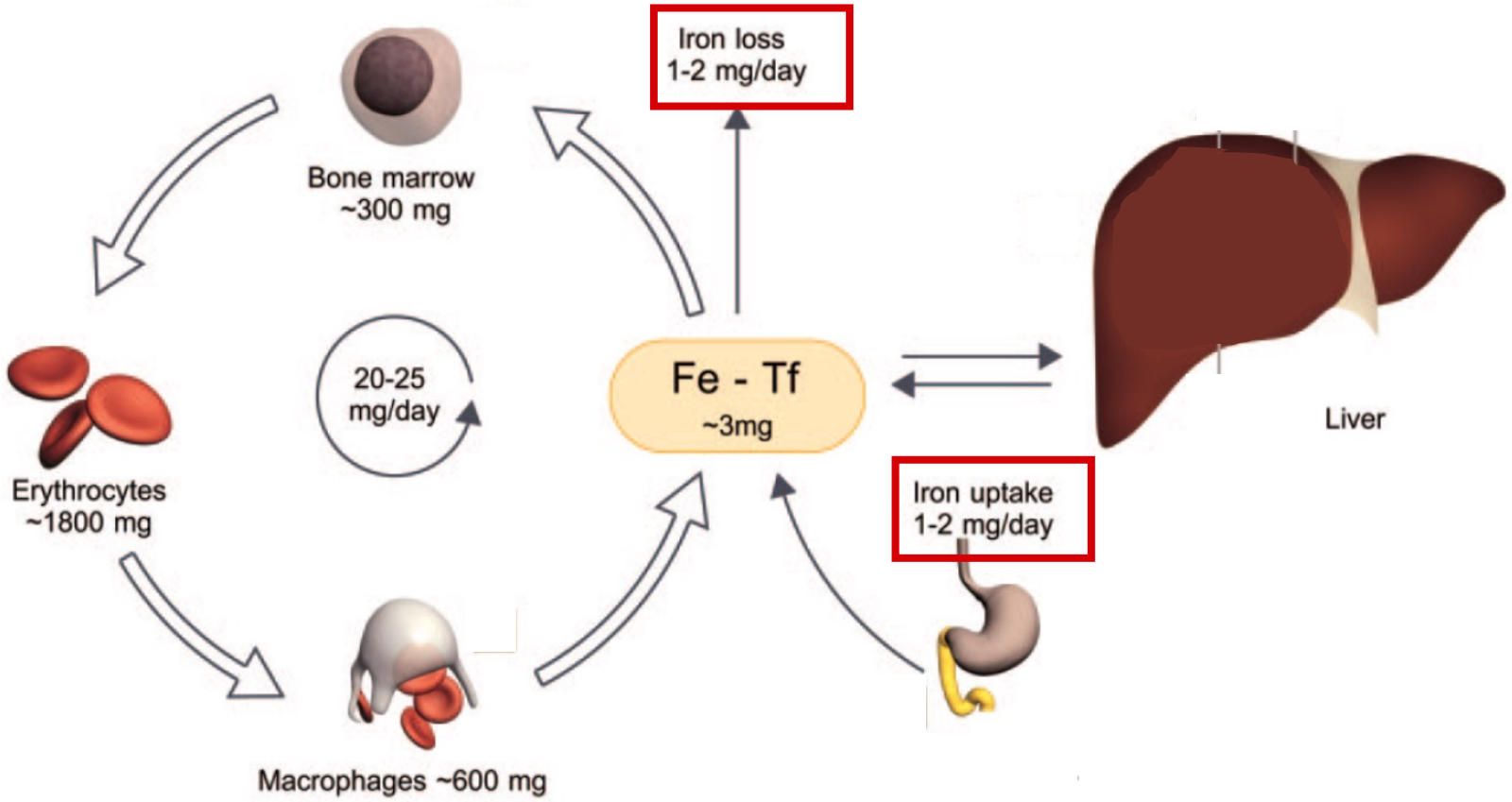
$$2O_2^- + 2H^+ \rightleftarrows H_2O_2 + O_2$$

$$Fe^{2+} + H_2O_2 \rightleftarrows Fe^{3+} + OH^- + \cdot OH$$



Iron metabolism





Swinkels et al, Clinical Chemistry, 2006

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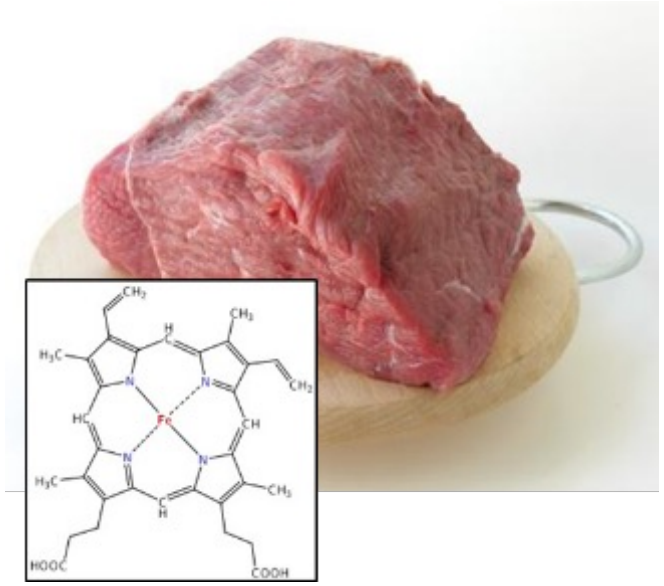
Iron absorption

Heme Iron



Non Heme Fe

	mg/ 100g	mg/ 1000 kcal
Eier	1.9	12.9
Vollkorn weizen	3.9	12.6
Spinat	1.6	76.2
Linsen	3.5	24.8
Erbsen	1.6	23.2
Milch	0.06	0.9

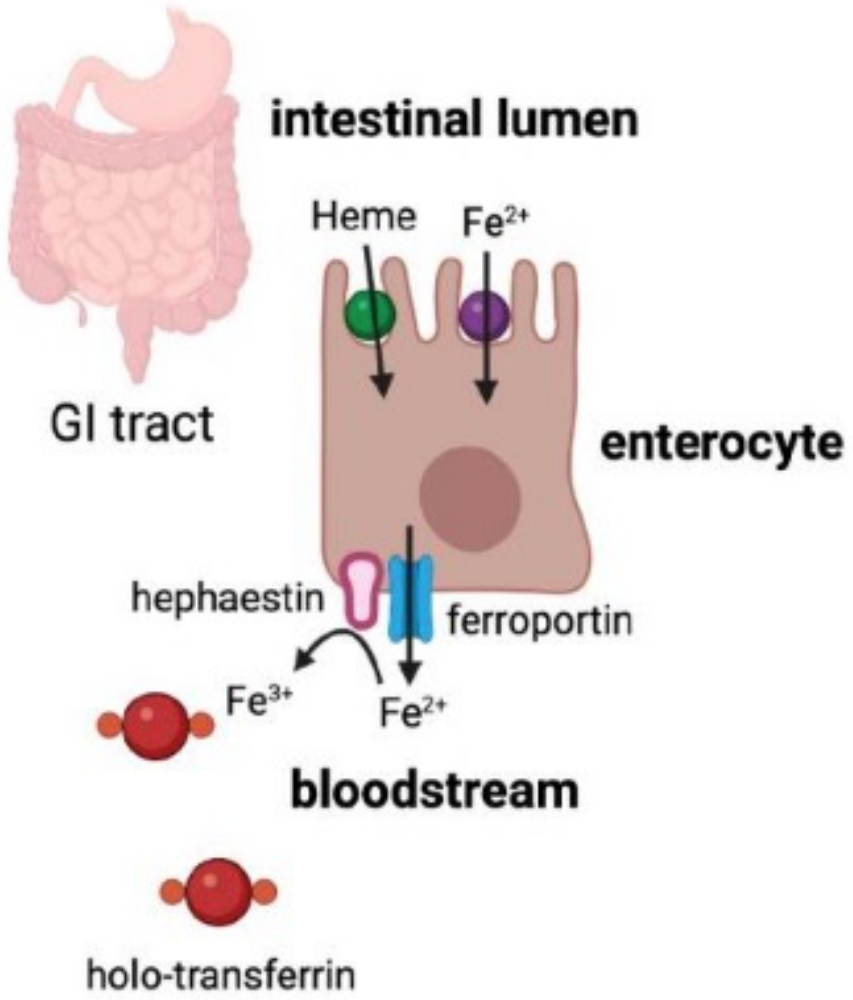
Meat Fish and Poultry

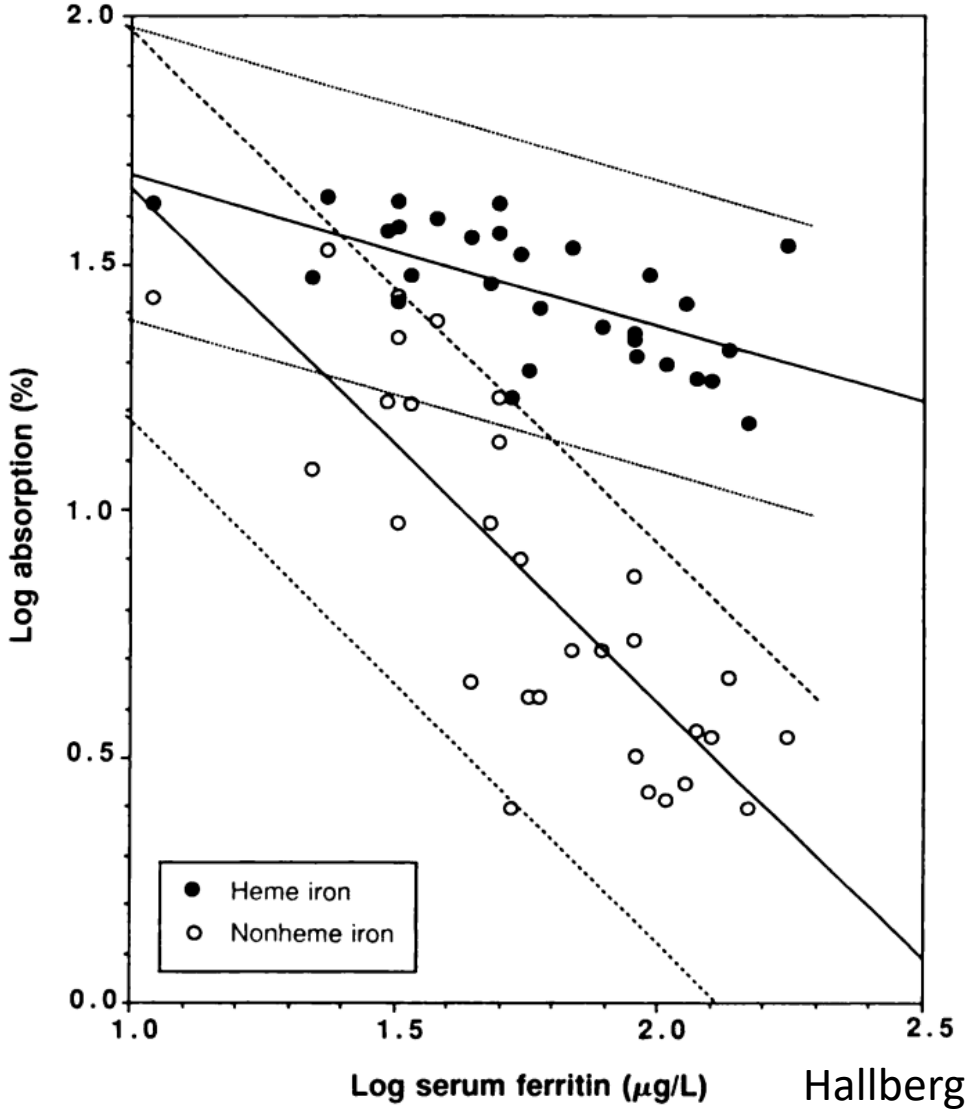
Absorption
of 20-35%

Plant based foods, Fungi, Insects

Absorption 1-20 %

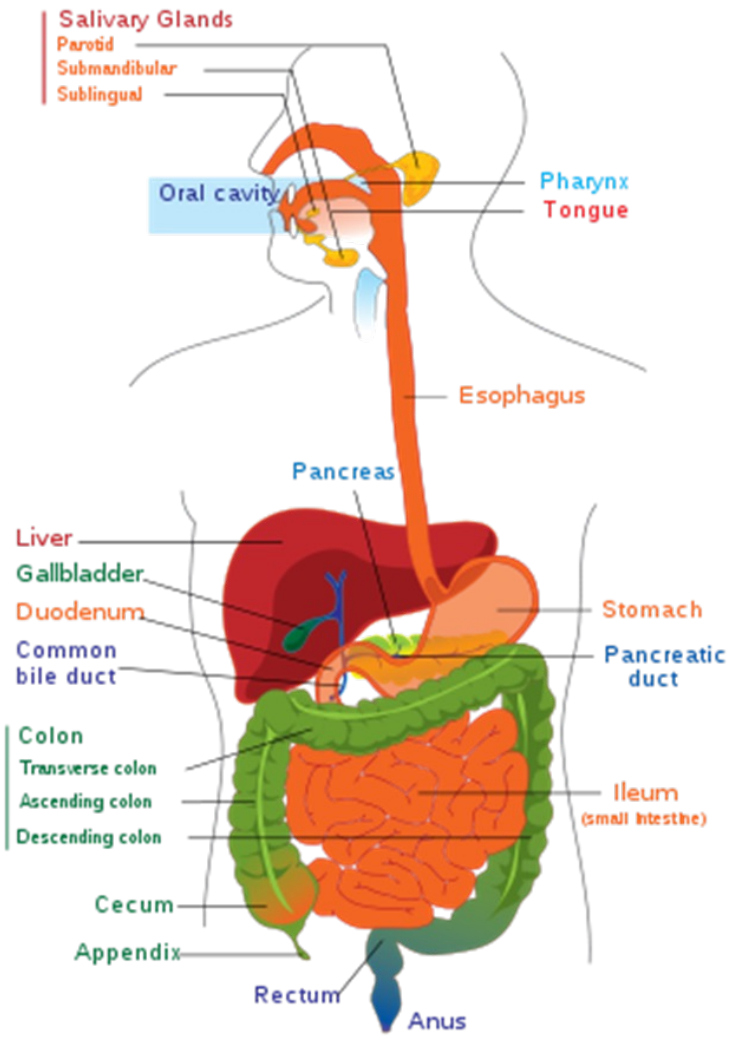
Non Heme Iron vs Heme iron absorption





Hallberg 1997 et al. , AJCN

Iron absorption



1

7

pH

Fe^{2+}: Soluble

Fe^{3+}: Soluble

Heme Fe

$Fe(OH)_2$

(0.1 M)

Partly soluble

$Fe(OH)_3$,

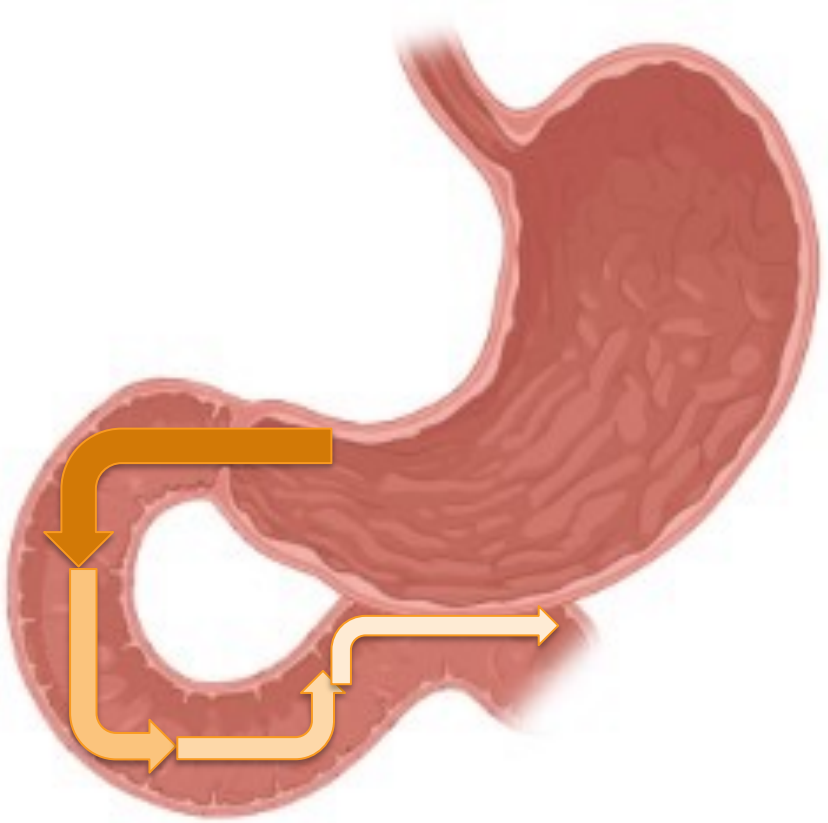
(10^{-18} M)

Virtually insoluble

Common non- heme iron pool

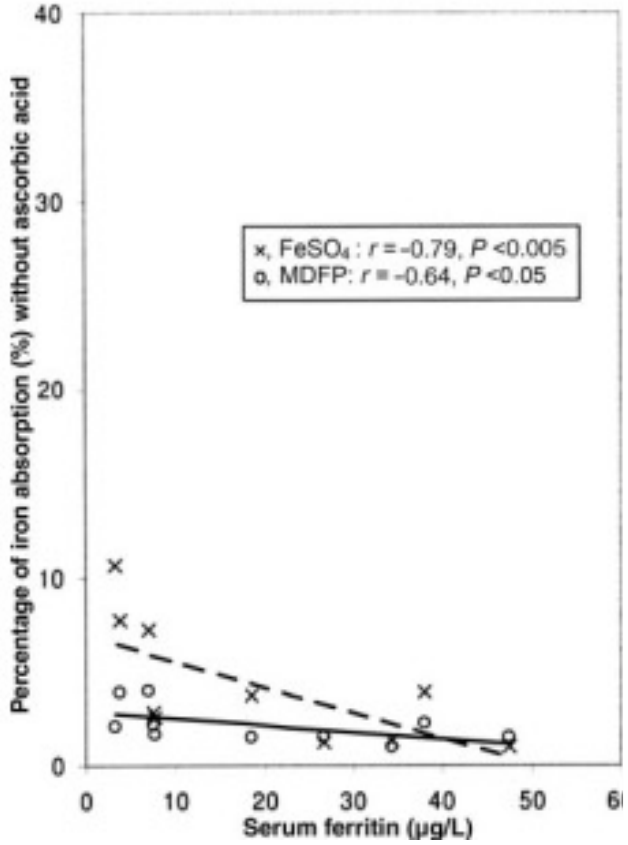
Heme iron pool

Iron fortification compounds solubility



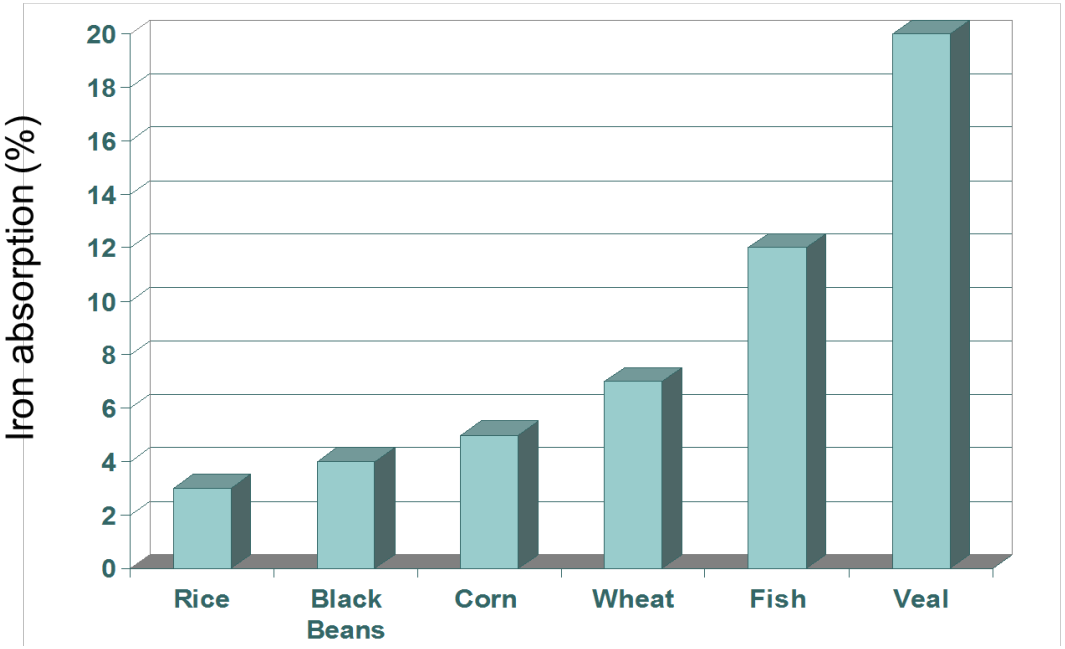
Progressive decrease in iron solubility with increasing pH

Binding to food components (phytic acid, AA, phenolics,..) more pronounced



Moretti et al. AJCN, 2006

Heme iron and non heme iron



Martinez Torres, 1973

Meat, Fish, Poultry

(Haem Fe)

Absorption 20-30%

- Vegetables, Legumes, Cereals
- **(nicht non heme Fe)**
- Variable absorption 1%-20/30%; fasting, supplements 30-40%

Factors influencing iron absorption

- Heme iron absorption
  - Body iron stores
  - Amount of heme iron in diet
  - Food preparation (temperature and time)
  - Calcium content of diet
- Nonheme iron absorption
  - Body iron stores
  - Amount of bioavailable nonheme iron in diet
  - Balance between enhancers and inhibitors of iron absorption
    - Enhancers: Meat, fish, ascorbic acid, alcohol
    - Inhibitors: Phytate, polyphenols, calcium, soy protein

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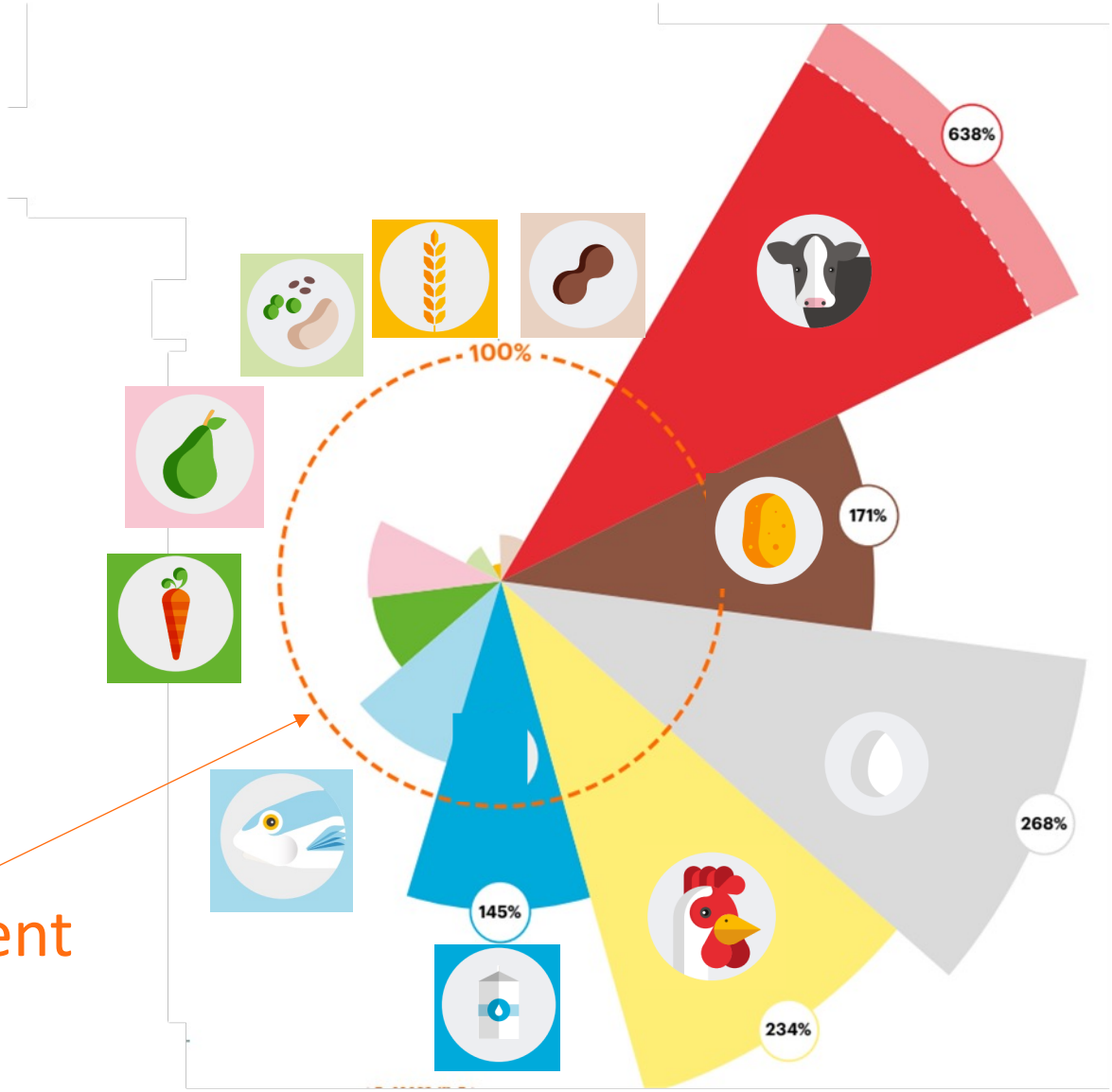
Dietary sufficiency

Planetary healthy diet

The food system:
20-30% of human environmental impact
(EIPRO, 2006)



Planetary sufficient diet

Lancet EAT commission, 2019

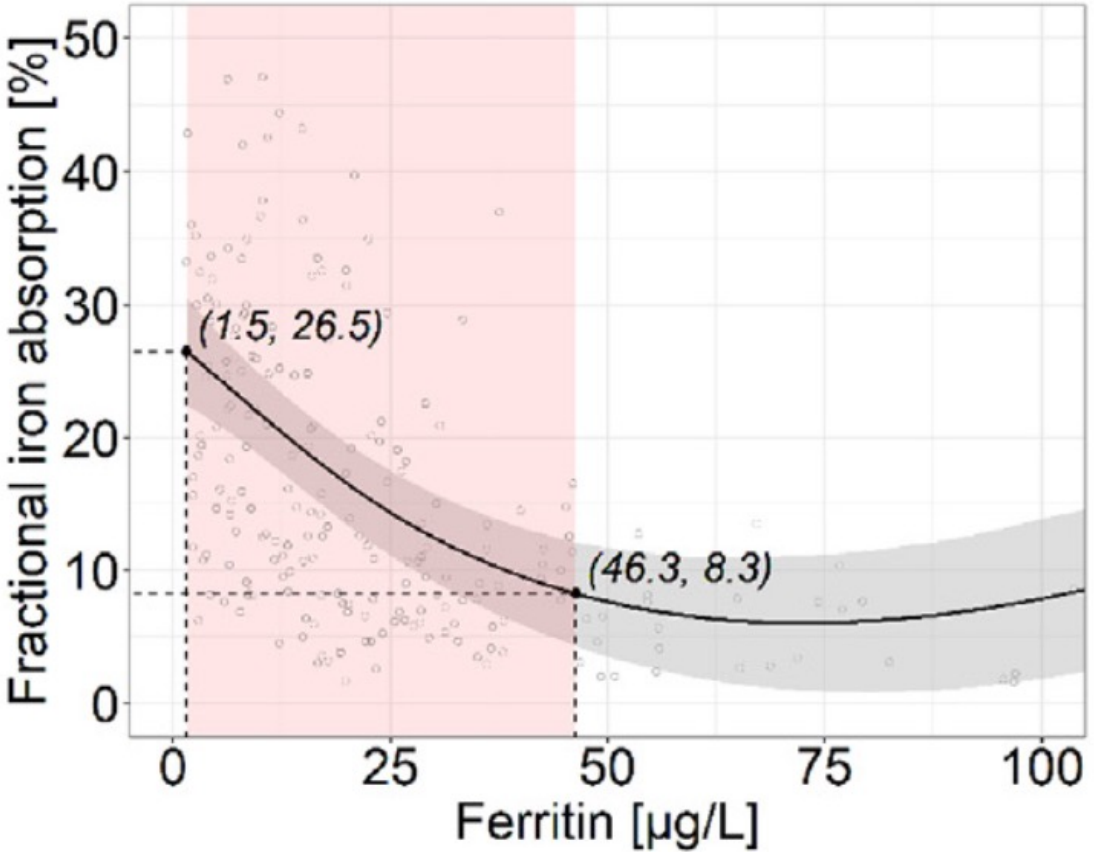
Selected recommended daily intakes for iron, according to the estimated dietary bioavailability

	Children (1–3 years)	Children (4–6 years)	Women (19–50 years)	Women during pregnancy (second trimester)	Women during breastfeeding (0–3 months lactation)	Men (19–50 years)
15%	3·9	4·2	19·6	>50·0	10·0	9·1
10%	5·8	6·3	29·4	>50·0	15·0	13·7
5%	11·6	12·6	58·8	>50·0	30·0	27·4

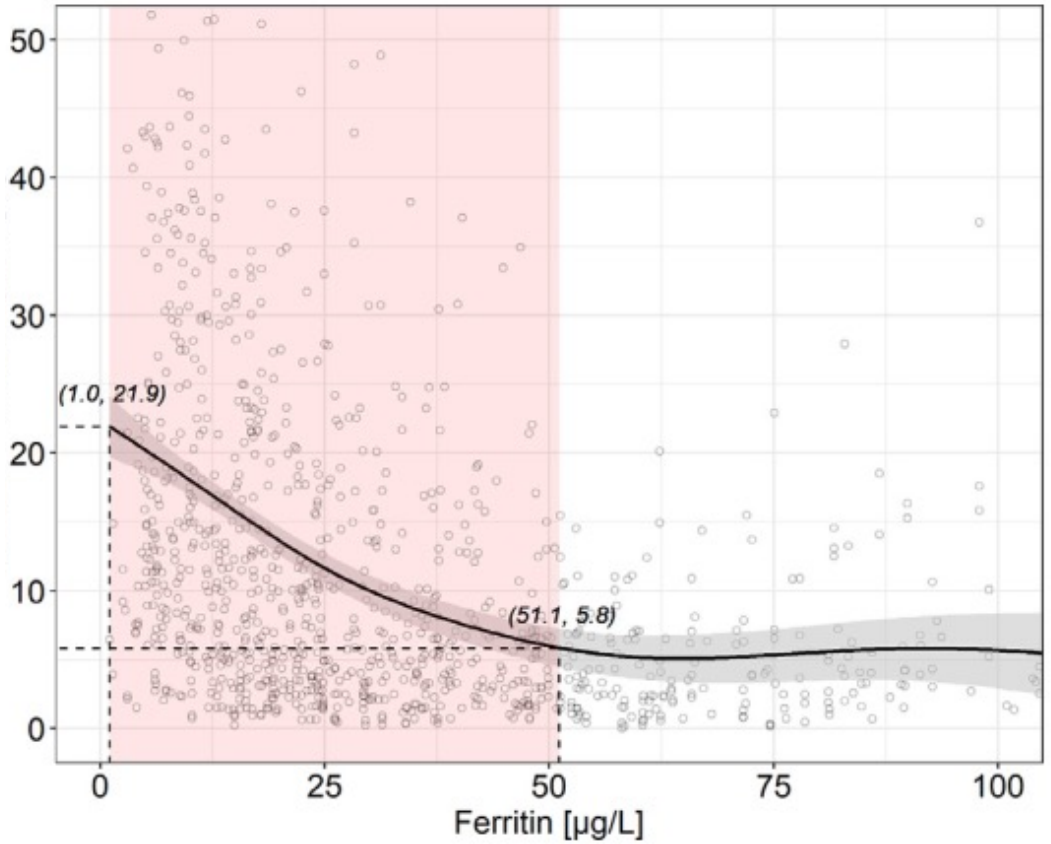
Bioavailability	Diet
15%	Rich in vitamin C and animal protein
10%	Rich in cereals, low in animal protein, rich in vitamin C
5%	Poor in animal protein, poor in vitamin C

Zimmermann and Hurrell. Lancet 2007;370:511–20

Iron absorption regulation in infants and women

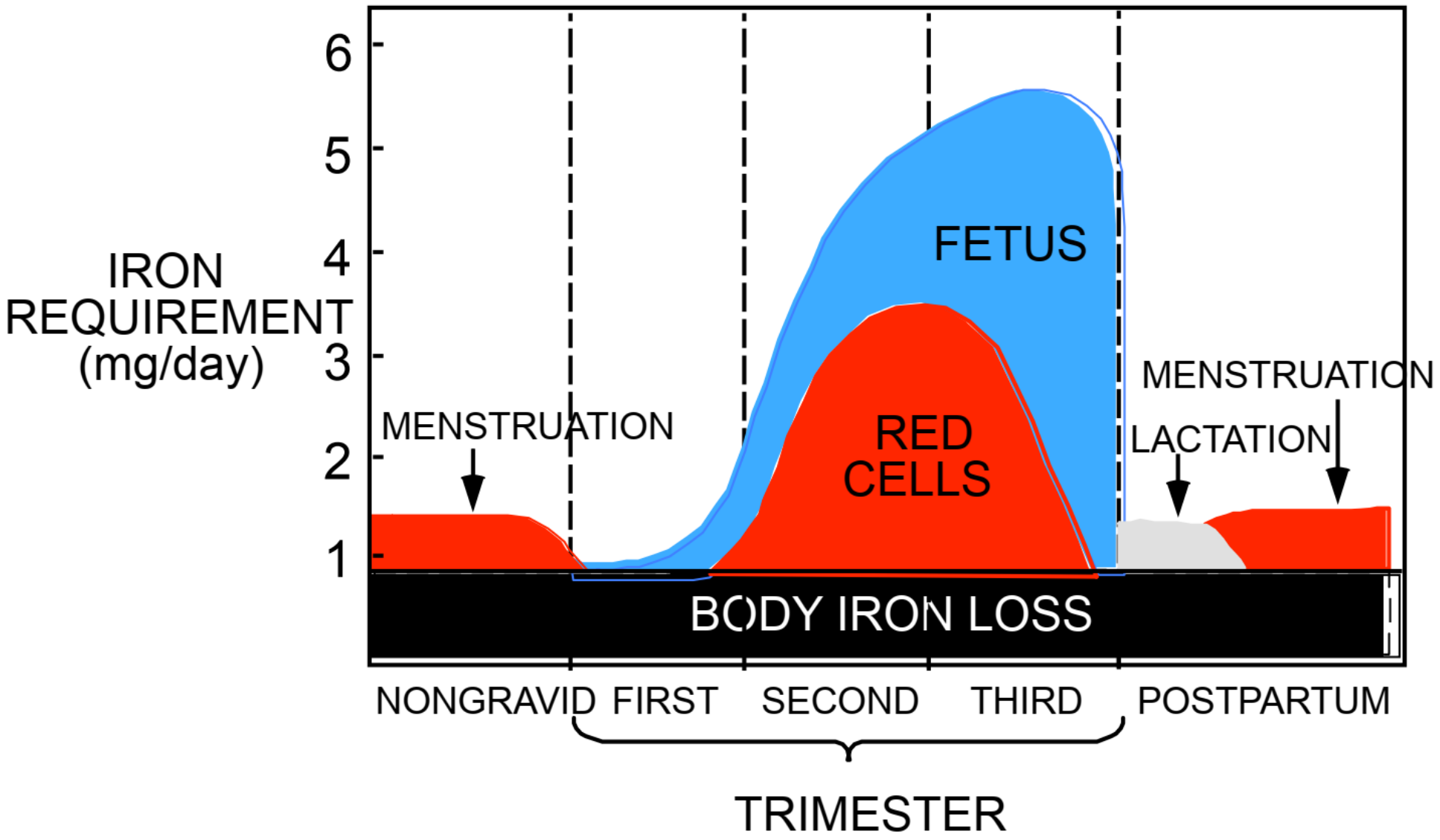


Von Siebenthal et al., 2023, AJCN



Galetti et al., 2022, EClinMed

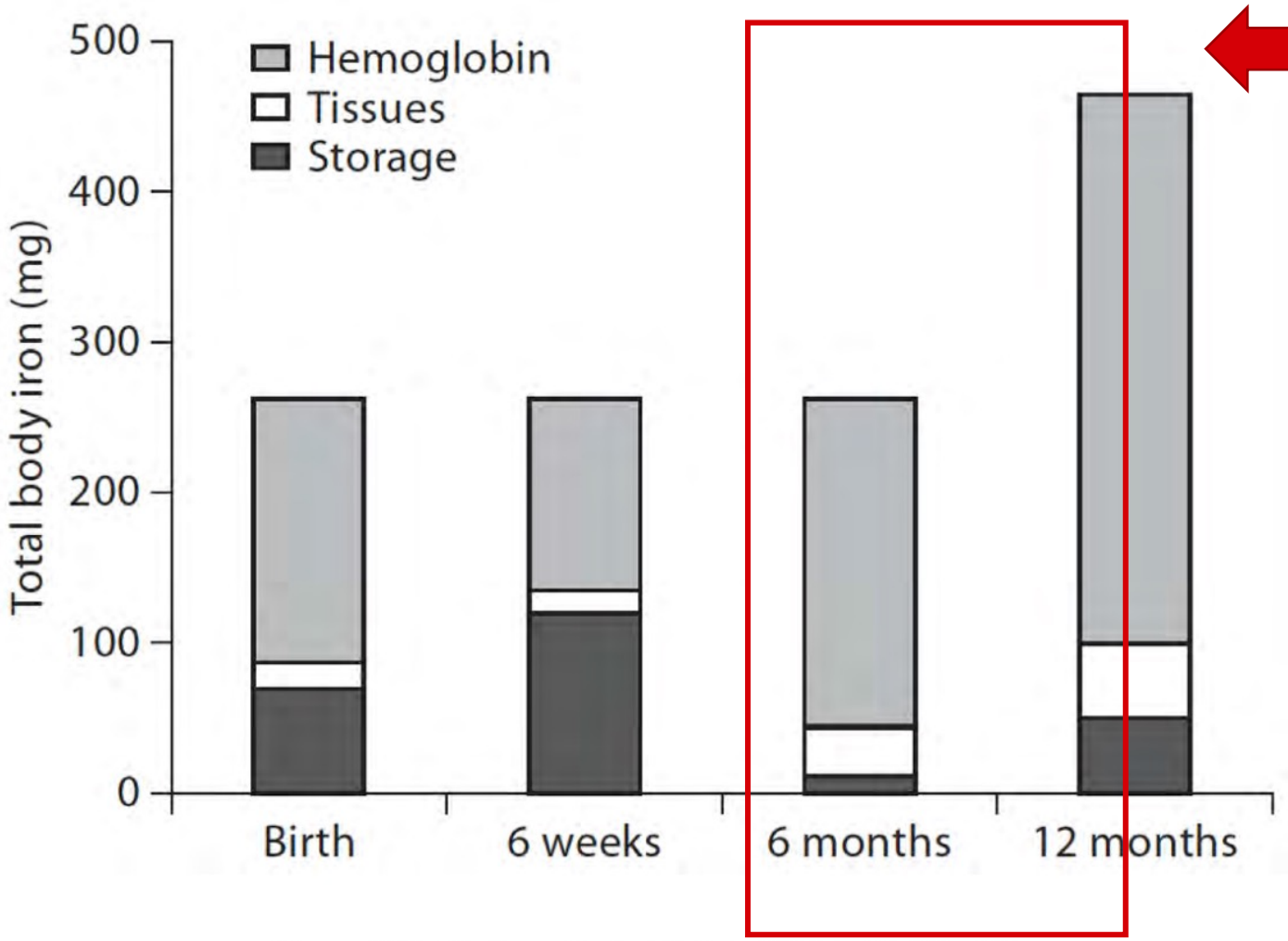
Iron requirements during pregnancy



Iron “cost” of pregnancy

	Amount of iron (mg)
AGGREGATE LOSSES:	
Fetus, Umbilical cord and Placenta, Maternal Blood Loss	- 510
Obligatory Losses	- 230
Increased Maternal Red Cell Mass	- 450
AGGREGATE TOTAL	- 1190
NET LOSSES:	
Contraction of Maternal Red Cell Mass	+ 450
NET TOTAL	- 740

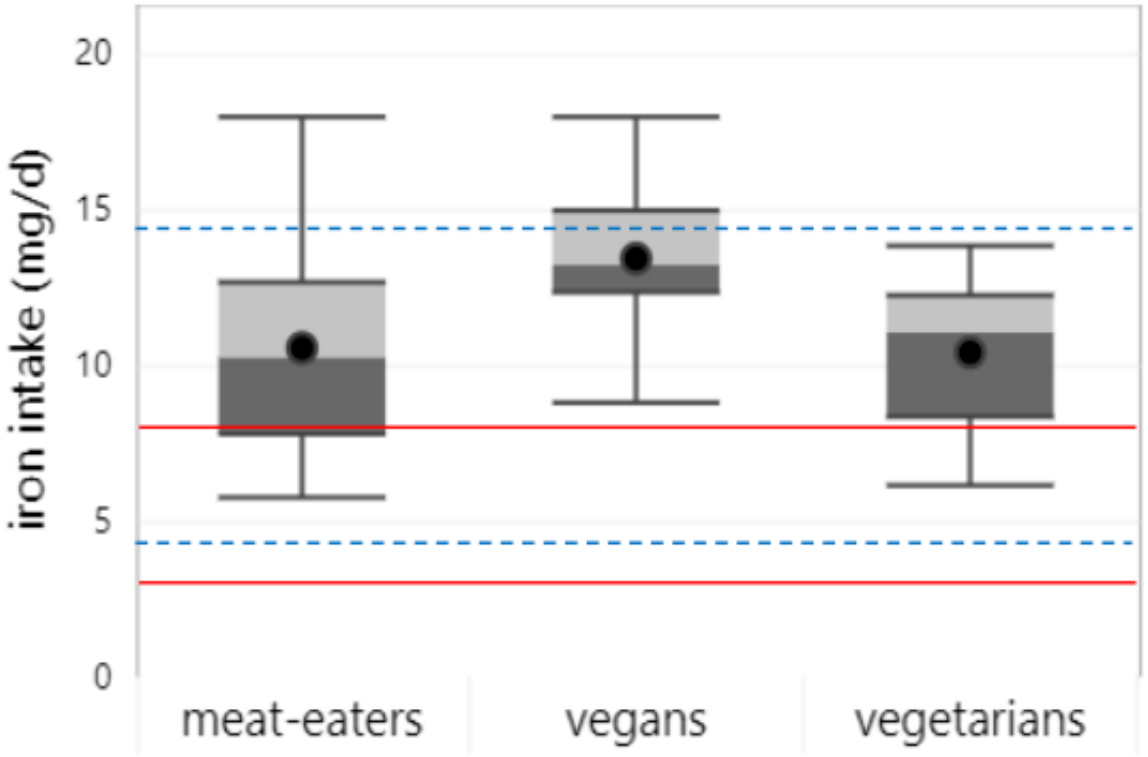
Body iron during the first year of life (1000 days)



Domellöf M. Ann Nutr Metab 2011;59:59–63

Critical phase, weaning, introduction of solid foods

Iron intake in children/adolescents



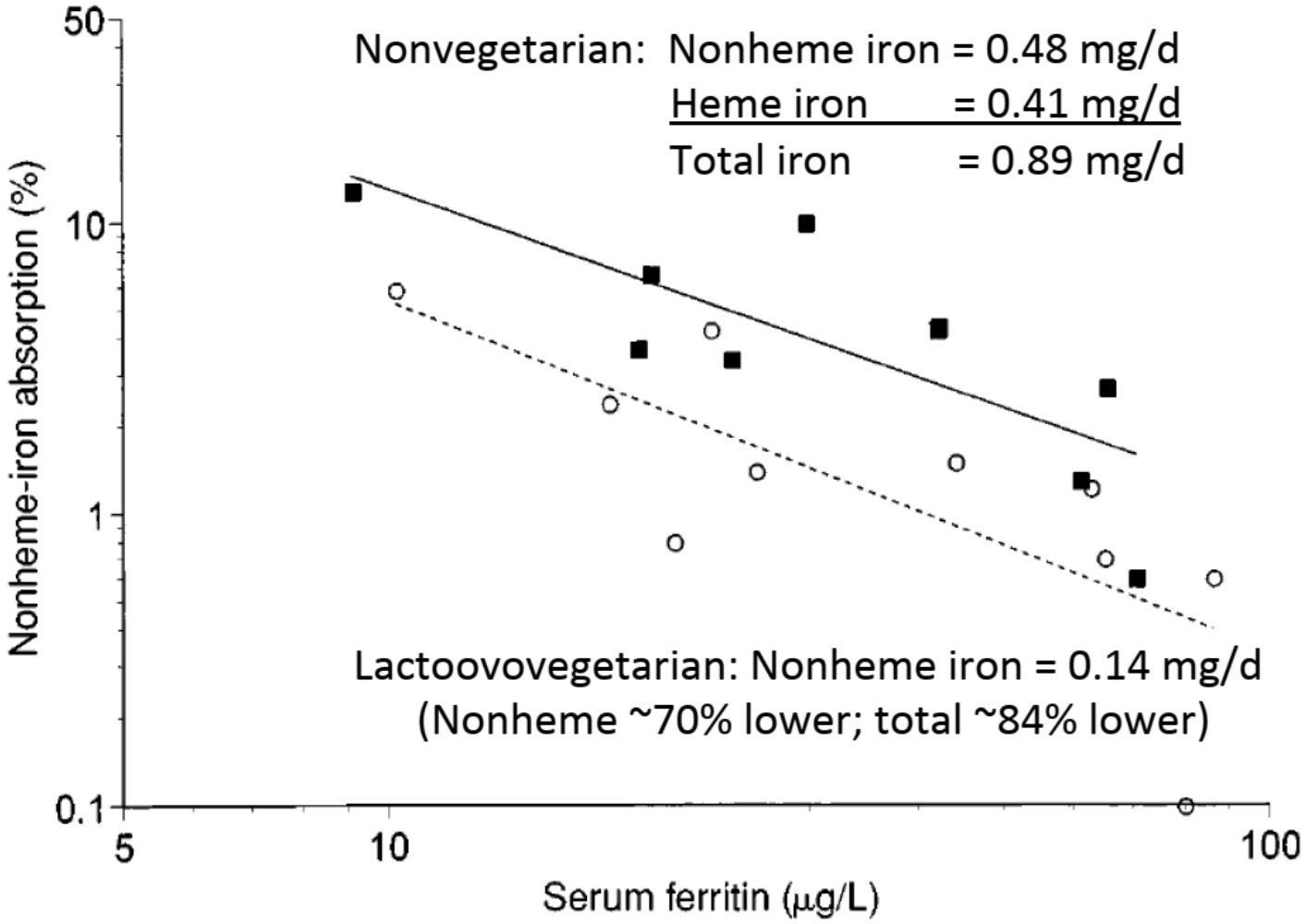
Intakes vs. EAR in children and adolescents

Red lines: EAR for “highest and lowest population groups”.

Blue lines: EAR adjusted for bioavailability for “highest and lowest population groups”.

Neufingerl & Eilander, Nutrients, 2023

Iron absorption from non-heme iron in vegetarian diets/omnivorous diets



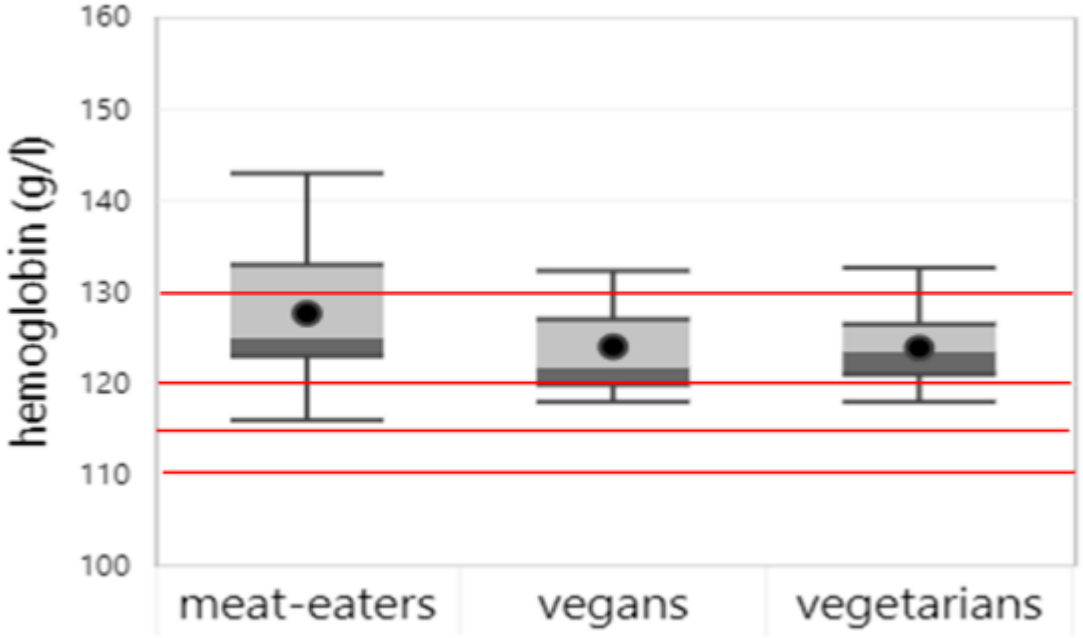
Hunt and Roughead. Am J Clin Nutr 1999;69:944–52

Lactovegetarian Diets (snapshot absorption)

Lower absorption than from a nonvegetarian diet

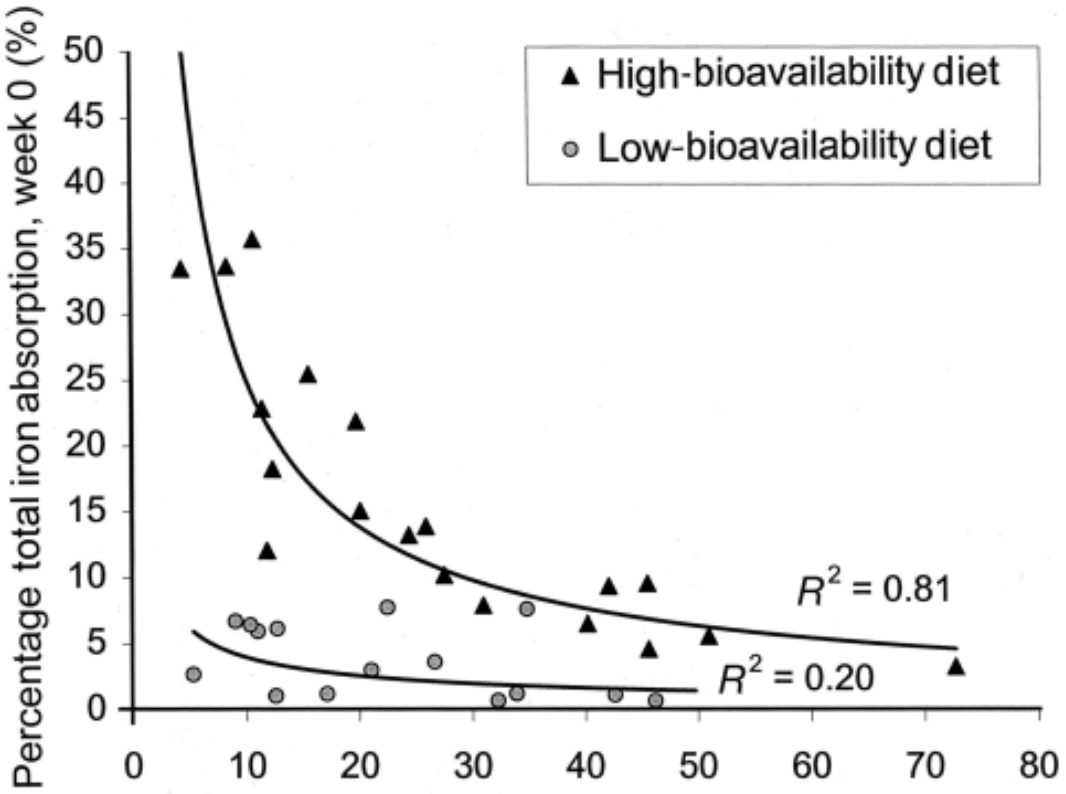
Indications for long term adaptation and no effect on iron status over 12 weeks

Iron status



Neufingerl & Eilander, Nutrients, 2023

High iron bioavailability diets enable effective regulation of iron status



J Hunt, 2003, AJCN

Dietary quality more important than whether the diet is vegetarian, flexitarian or vegan

Summarsing

- The dietary composition has (most likely) a major role in determining iron status
- Other factors such as menstrual losses (highly skewed individually), growth (in childhood an infancy) also play a major role- risk is individual.
- Prevalence data (macroscopic) does not suggest a major difference in rates of anaemia or iron deficiency in vegans or vegetarians vs. omnivores.
- Specific nutritional strategies (dietary) may be useful in female preadolescents and adolescents.
- Current “mainstream” diet is low in iron (due to highly refined products and hygienic standards); enhancers of iron absorption may be difficult to include in the diet (true also for omnivores).

Thank you for your attention !

FFHS

Swiss Distance University of Applied Sciences

Member of SUPSI