MICRONUTRIENTS IN PREGNANCY

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passion for food

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eurreca

EURopean micronutrient RECommendations Aligned

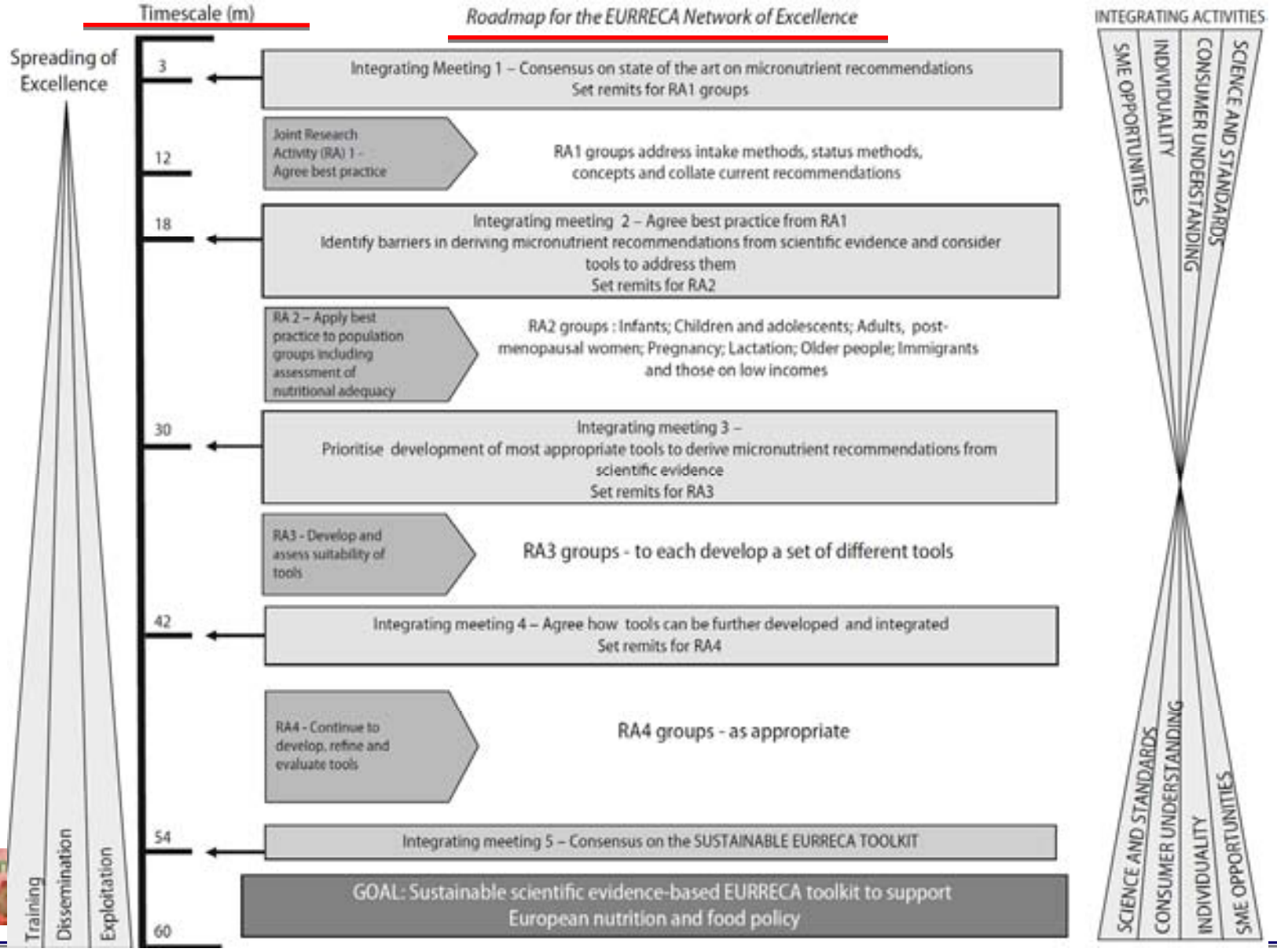
A large heterogeneity of micronutrient recommendations exists across Europe both quantitatively and qualitatively, thereby a common agreement should be sought on the different uses and applications of nutrient recommendations

(Pijls L et al. (2009) Food Chemistry 113, 748-753).

The EURopean micronutrient RECcomendations Aligned (EURRECA) project aims to provide standardized approaches to reveal and beneficially influence variability within the EU in micronutrient recommendations for vulnerable population groups

Adapted from Ashwell et al. (2008) Eur J Nutr 47:2–16

the EURRECA Project

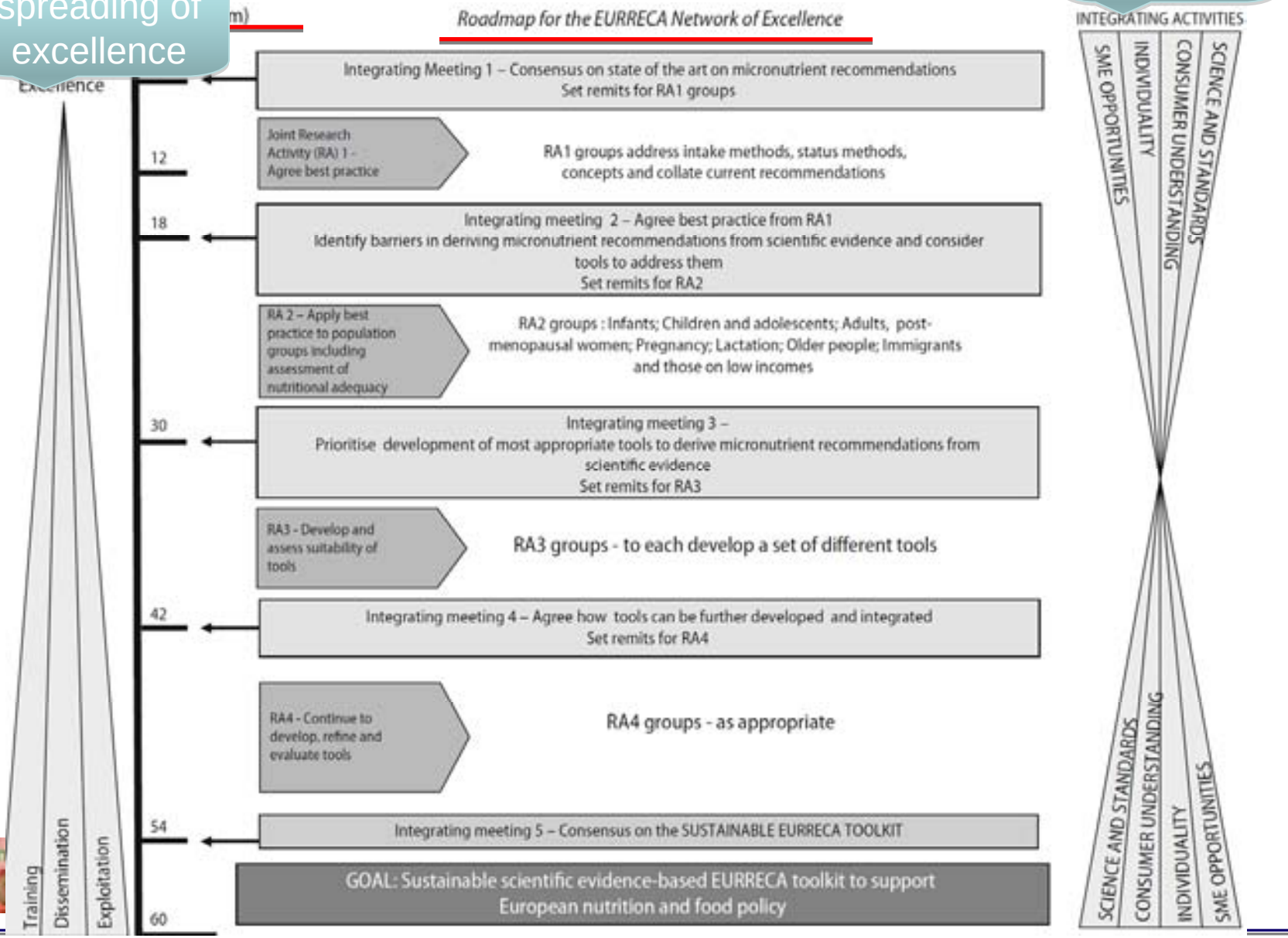


Adapted from Ashwell et al. (2008) Eur J Nutr 47:2–16

the EURRECA Project

spreading of excellence

integrating activities



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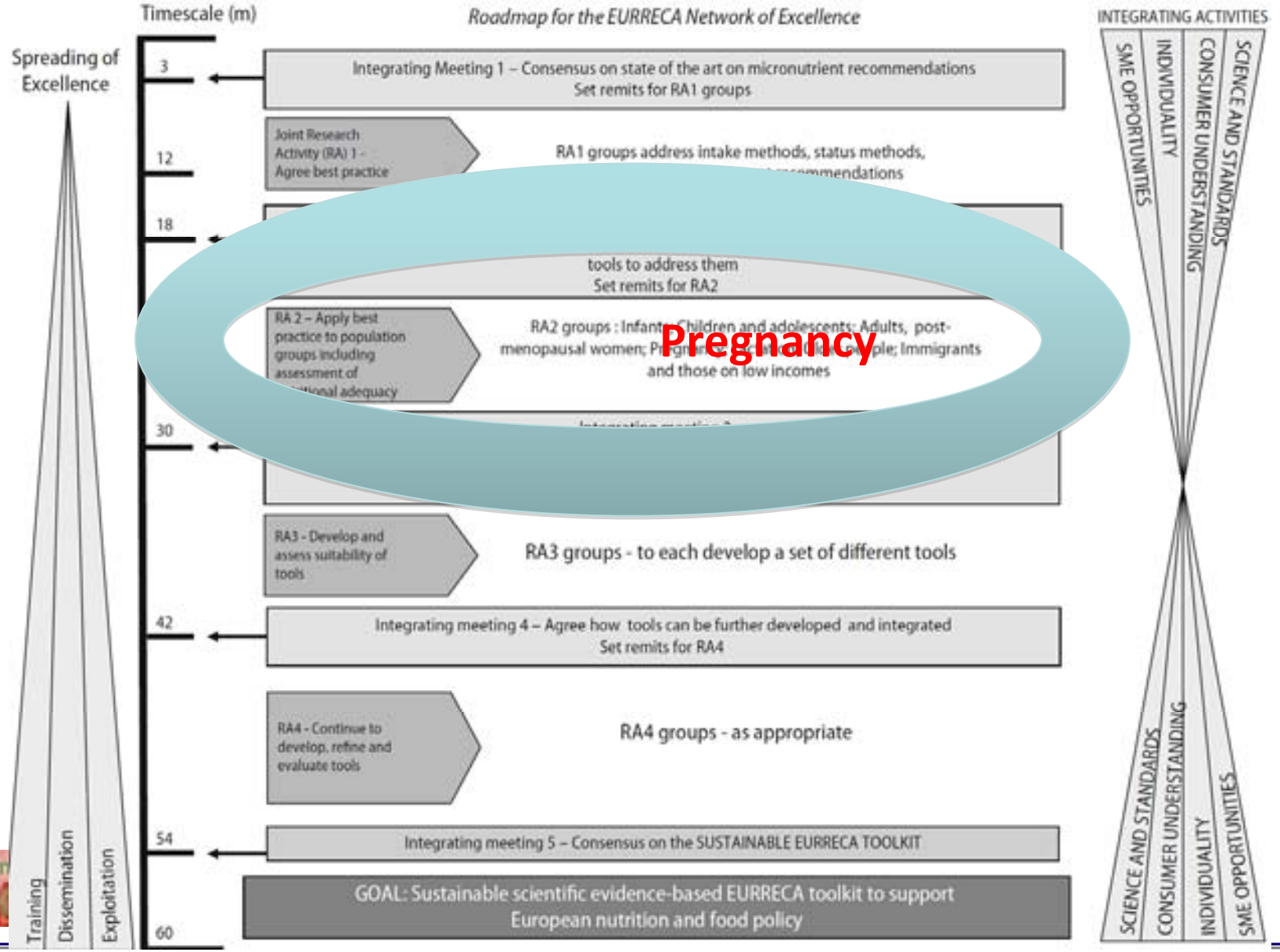
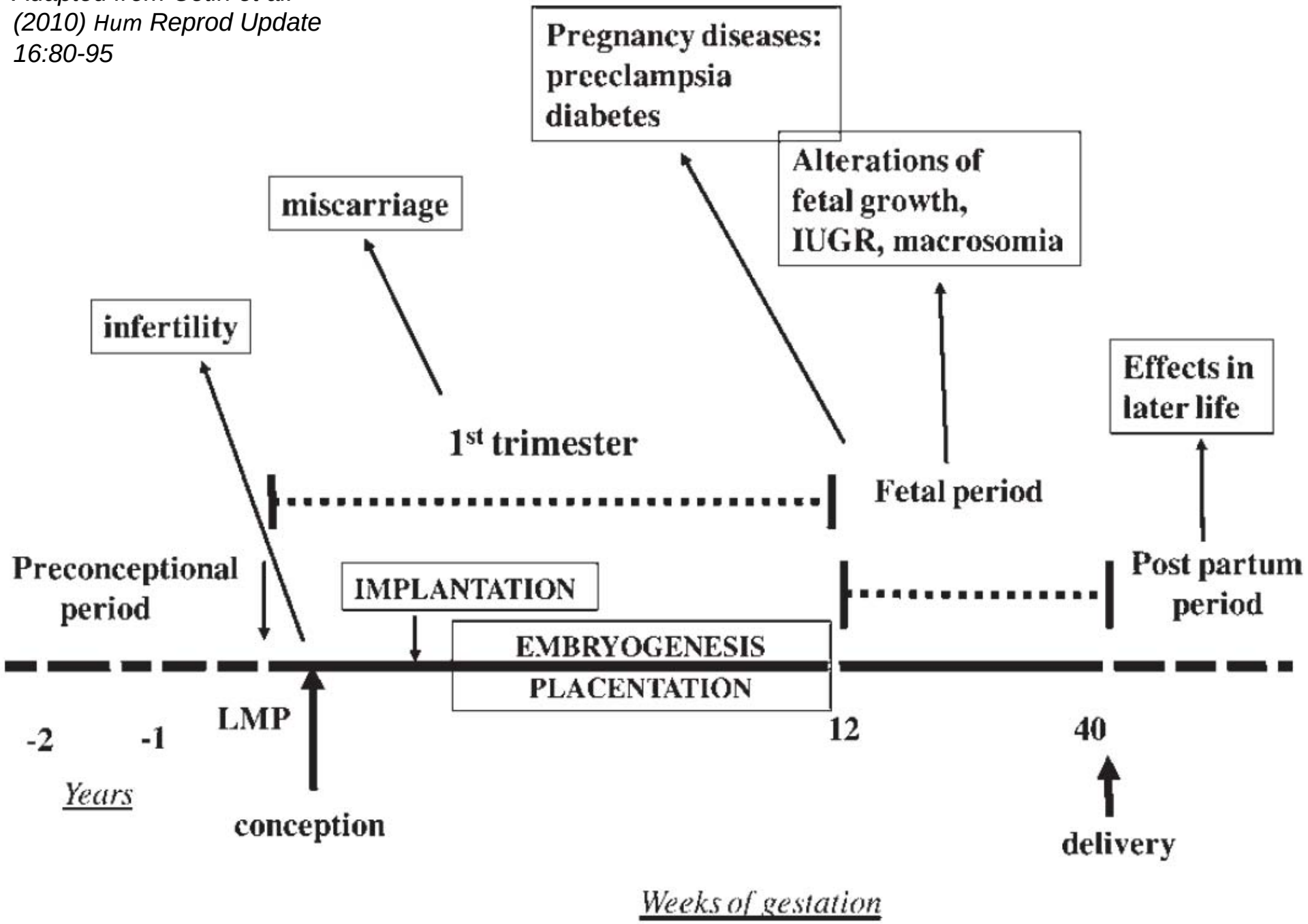


Pregnant women do not always meet their increased micronutrient requirements

Diet = important determinant of pregnancy outcomes and infant health both in short and long-terms:

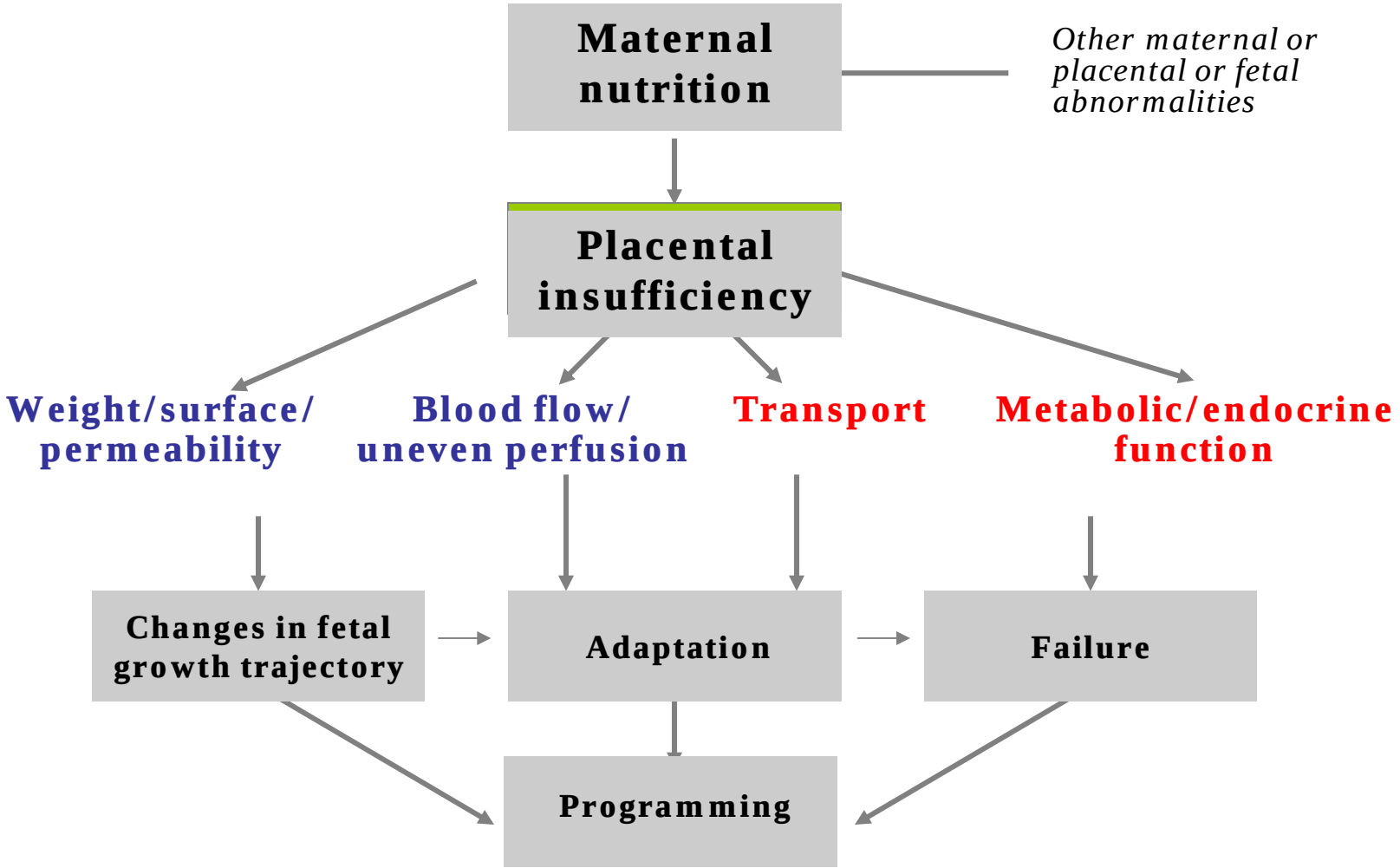
- significant association between inadequate or poor nutrition and high “reproductive” risks
- different impacts of the timing of nutritional insults during gestation on both the overall outcome of pregnancy and the nature of adult diseases (i.e. programming the postnatal pathophysiology *[Buckley et al. (2005) Cell Tissue Res **322**: 73–79]*) ⇨ potential to affect cell numbers or differentiation in the developing embryo

Adapted from Cetin et al. (2010) Hum Reprod Update 16:80-95



intrauterine programming of health

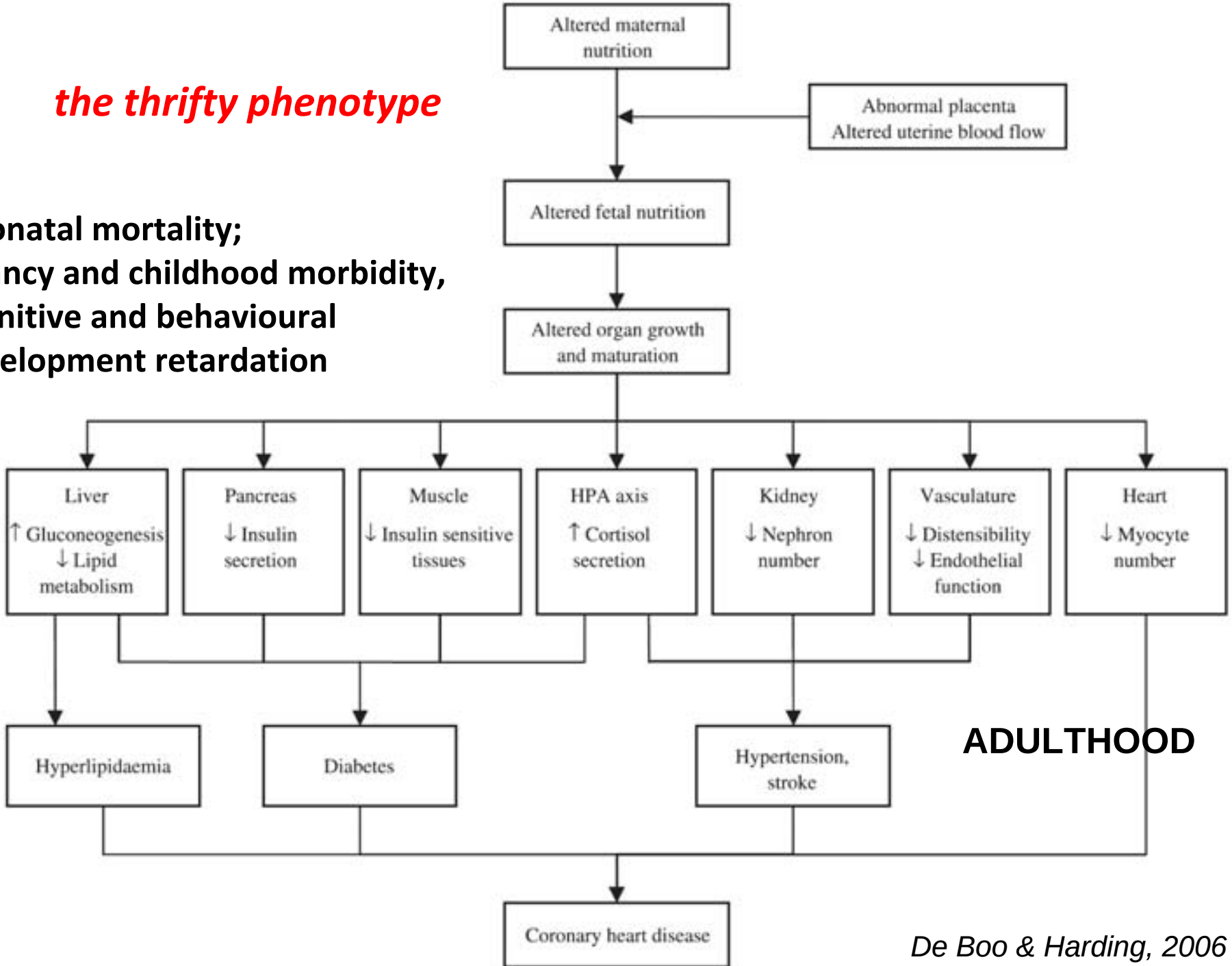
mother placenta fetus newborn infant child adult



Sibley, Turner, Cetin. ...Jansson, Powell. Placental phenotypes of IUGR. Pediatric Res 2006

the thrifty phenotype

Neonatal mortality;
infancy and childhood morbidity,
cognitive and behavioural
development retardation



De Boo & Harding, 2006

Characteristics of pregnancy to be highlighted from the nutritional perspective

- **Dynamic state**: adjustments in nutrient metabolism evolve continuously as the mother switches from an anabolic condition during early pregnancy to a catabolic state during late pregnancy

- **Three compartments model**, i.e, mother/placenta/fetus, each of them has different metabolism;

Critical factors affecting micronutrient requirements in pregnancy

- Maternal micronutrient status and intake (quality of diet, dietary patterns, micronutrient bioavailability)
- Timing of micronutrient intake
- Maternal age (i.e., poor obstetric outcomes more frequent in pregnant adolescents)
- Pregestational maternal BMI
- Socio-economic and cultural background

Maternal diet

- ***Eating patterns***
  - reduced early delivery risk with maternal mid-pregnancy **Mediterranean-type diet** rich in fruit and vegetables (i.e., high intake of vitamin C, folate, a-tocopherol, magnesium, calcium, iron and vitamin D intake and low sugar and cholesterol intake *(Mikkelsen et al. (2008), Acta Obstetr Gynecolog 87, 325-330)*
  - increased cleft lip or palate risk and high plasma total homocysteine levels with maternal periconceptional **Western diet** i.e. high in meat, pizza, legumes, and potatoes, and low in fruits (Vujkovic et al. 2007)
  - slightly increased risk for delivering preterm by consuming food at a **lower optimal frequency** (risk of hypoglycemia) *(Siega-Riz et al. (2001), Am J Epidemiol 153, 647–652)*

Timing of micronutrient intake

FOLATE

Coenzyme in single-carbon transfers in the metabolism of aminoacids and nucleic acids ⇨ substrate donor in the remethylation of homocysteine into methionine, catalyzed by methionine synthase and 5,10-methylenetetrahydrofolatereductase (MTHFR).

Altered homocysteine metabolism → hyperhomocysteinemia (HHCY)

HHCY depends on:
- inherited and acquired conditions (i.e., genetic polymorphisms)
- **folate and/or vitamin B_6/B_{12} deficiencies** due to deregulation of their normal metabolism and/or low dietary intake

*Bonnette et al. (1998) Obstet Gynecol **92**:167-70; Ray & Laskin (1999) Placenta **20**:519-529; Locksmith & Duff, 1998; Guéant et al., 2003; Tamura & Picciano, 2006*

Poor folate supply

- Higher plasma homocysteine concentrations related to **pregnancy complications**: placental abruption, stillbirth and increased rates of very low birth weight or preterm delivery

- High risk of **Neural tube defects** (NTDs)
  - malformation occurring when the brain and skull and/or the spinal cord and their protective spinal column do not develop properly within THE FIRST FOUR WEEKS AFTER CONCEPTION *(Frey & Hauser, 2003, Epilepsia 44: S4-S13)*
  - malformation permanently disabling or fatal

Periconceptional consumption of folic acid supplements ↓ not only the recurrence but also the occurrence of NTDs

NTDs are largely preventable if the mother has enough folic acid before she becomes pregnant and early in her pregnancy (periconceptional period: 4 weeks before until 8 weeks after conception)

MRC Vitamin Study Research Group (1991); Tamura & Picciano, 2006.

IRON

• Extra iron required by the growing fetus (300 mg) and used for the formation of the placenta (50–75 mg), expansion of red cell mass (450 mg) and blood loss during delivery (200 mg)

• Requirements for absorbed iron increase gradually through gestation from 0.8 mg/day in the 1st trimester to 7.5 mg/day in the 3rd trimester

- THIRD TRIMESTER **=**

Markedly higher substrate requirements for rapid fetal growth

Millman (2006) Ann Hematol 85:559-565

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Poor iron supply

- **<u>Iron deficiency anemia (IDA)</u>**
  - early in pregnancy, inversely related to placental size and associated with reduced infant growth and increased risk of adverse pregnancy outcomes *(Scholl & Hediger 1994; Hindmarsh et al. 2000; Ronnengerg et al. 2004; Buckley et al. 2005)*
  - during the 2nd trimester has been associated with an increased risk of preterm delivery *(Scholl 2005)*
  - linked to altered behavioral and neural development in infancy *(Murray-Kolb & Beard , 2009)*

Iron supplementation

- Prophylactic iron supplementation during early pregnancy on pregnancy outcomes:
  - RCT from 12 weeks to the 3rd trimester: birth weight significantly higher in supplemented groups than in controls *(Siega-Riz et al., 2006)*
  - RCT from < 20 wk to 28 wk of gestation: in iron group, a significantly higher mean birth weight, lower incidence of low-birth-weight, significantly lower incidence of preterm infants *(Cogswell et al., 2003)*

- Iron supplementation starting from early pregnancy on hemoglobin concentrations and body iron stores in pregnant women:
  - numerous RCTs show beneficial effects (*Allen, 2000; Millman, DOI:10.1007/s00277-008-0518-4)*

- Iron supplementation during the final trimester of gestation:
  - RCT shows a significant effect on iron status during trimester and in postpartum period till 3 mo after delivery *(Preziosi et al., 1997)*

DOCOSAHEXAENOIC ACID (DHA; 22:6n3)

Docosahexaenoic acid (DHA; 22:6 n-3) and arachidonic acid (AA; 20:4 n-6) = **essential for fetal and neonatal growth and development**

Maternal intake (pregnancy and lactation) relates to:

- neonatal brain and visual function
- duration of pregnancy, risk of preterm delivery and preeclampsia

Judge et al. (2007); Innis (2007)

CONCLUSIONS

- ***more research needed***
- ***revision of reccomendations***
- ***spreading of knowledge***

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European Food Information Resource

CASCADE

NuGO
the european nutrigenomics organisation

Thank you for your attention

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