

**FOODplus**  
Research Centre



Research excellence linking  
sustainable agriculture,  
food and nutrition to improve  
human health.

[www.adelaide.edu.au/foodplus](http://www.adelaide.edu.au/foodplus)



---

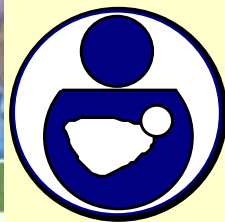
# IRON IN PREGNANCY — A DOUBLE EDGED SWORD

---

Jo Zhou, PhD

Research Fellow

Women's and Children's Health Research Institute &  
School of Paediatrics & Reproductive Health  
University of Adelaide



---

# THE MAJOR ROLES OF IRON

- Haemoglobin (Hb): O<sub>2</sub> carrier
- Energy production
- Synthesis of DNA
- Regulating synthesis of neurotransmitters in the CNS → brain function
- Inadequate iron → iron deficiency (ID) & iron deficiency anaemia (IDA)

---

# IRON DEFICIENCY ANAEMIA (IDA)

- Common nutritional deficiency
  - Health consequences
    - Fatigue & reduced work capacity
    - Increase susceptibility to infection
    - Impaired cognitive function
    - Severe IDA: Adverse pregnancy outcomes
  - High risk groups:
    - Young children & pregnant women
-

# ESTIMATED IRON NEEDS FOR A NORMAL FULL TERM PREGNANCY

Physiological losses	~220mg
Fetus & Placenta	~315mg
Expansion of RBC mass	~500mg
<b>Total estimated</b>	<b>≈ 1035mg</b>

This is equivalent to an average of ~ 4mg /d absorbed iron

Adapted from FAO/WHO Joint  
Expert Consultation Report, 1988

---

# HOW MUCH IRON IS NEEDED FROM THE DIET TO PROVIDE 4MG OF ABSORBED IRON?

- The amount of dietary iron absorbed depends on
    - Source of iron & the dietary composition
    - Body iron stores
    - Stage of pregnancy
    - Other health conditions
  - Ranged from ~20mg/d (20% absorbed) to ~80mg/d (5% absorbed)
-

# RECOMMENDED INTAKE IN AUSTRALIA

	RDI (mg/d)	UL (mg/d)
Pregnant	27	45
Non-pregnant	18	45

Ref: NHMRC  
2006

RDI: Recommended dietary intake; UL: upper intake level

- Actual intakes of Australian women: ~14mg/d  
→ IDA: 11% (Makrides 2003)
- Definition of IDA (WHO):
  - IDA: Hb < 110g/L & ferritin < 12ug/L

---

# HOW IS THE PROBLEM OF IDA IN PREGNANCY ADDRESSED?

- Two approaches:
    - Prevention – Routine iron supplements  
eg. US & France: routinely 30 – 60mg/day
    - Treatment – Selective iron supplements  
eg. Australia & UK: screen for anaemia and treat
  - What are the benefits & risks?
-

---

# IRON SUPPLEMENTATION IN PREGNANCY: SUMMARY OF A COCHRANE REVIEW

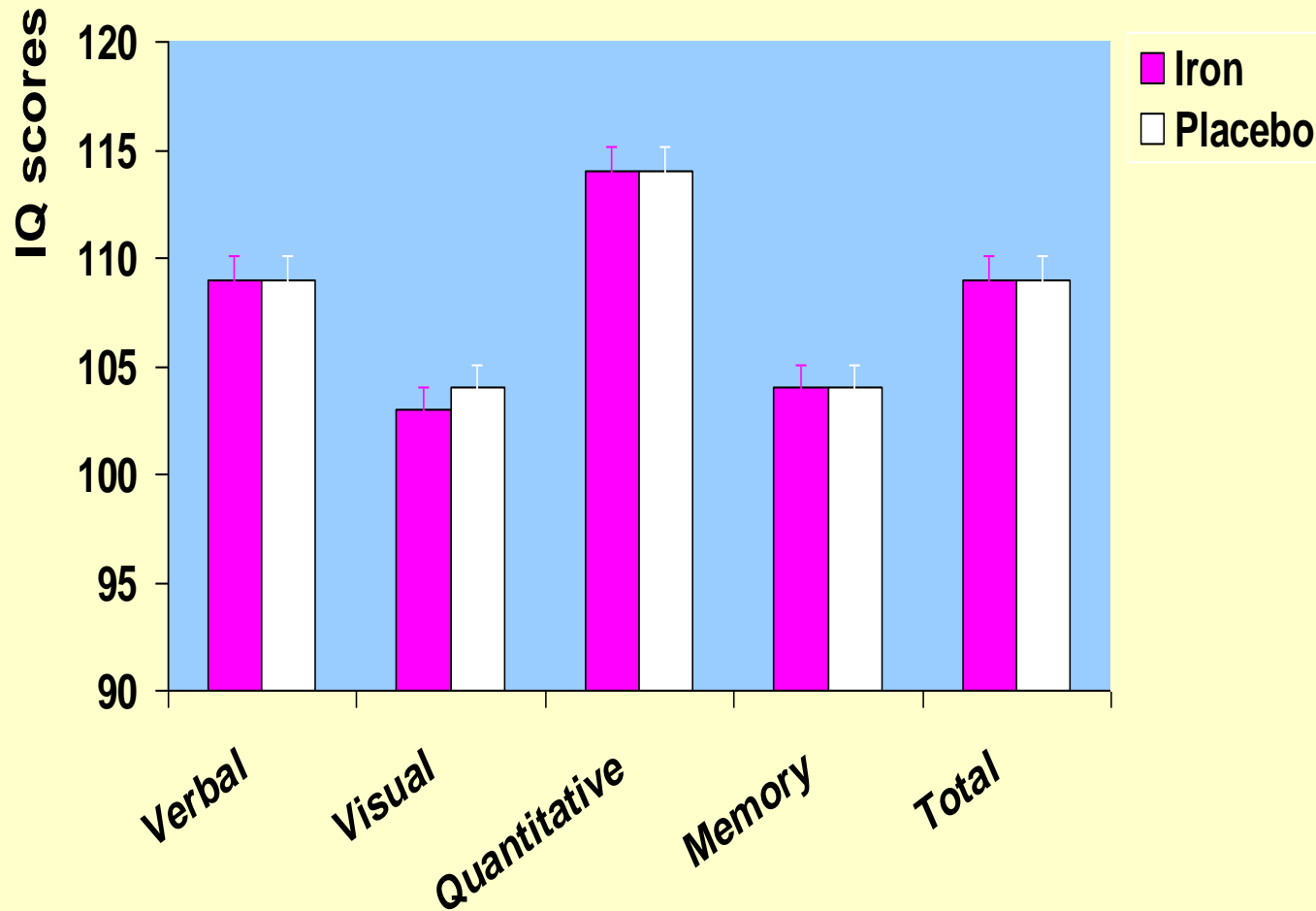
- Effective in preventing IDA & improving biochemical markers of iron status of mothers
  - Lack of benefit in clinical outcome measures
    - No difference in birth weight
    - No difference in the risk of low birth weight, perinatal death, admission to special care
  - Higher risk of haemoconcentration (Hb >130g/L) & GI side effects
  - Few studies conducted in non-anaemic
  - Lack of data on long term outcomes
-

# ADELAIDE MOTHERS' AND BABIES' IRON TRIAL (AMBIT)

- Non anaemic women (n=430) from 20 weeks gestation
- 20mg iron or placebo per day to birth
- At end pregnancy, ID ↓  
58% vs 35% IDA ↓  
11% vs 3%



# STANFORD-BINET IQ OF AMBIT CHILDREN AT 4 YEARS OF AGE



# CHILDHOOD BEHAVIOUR OF AMBIT CHILDREN AT 4 & 8 YEARS OF AGE

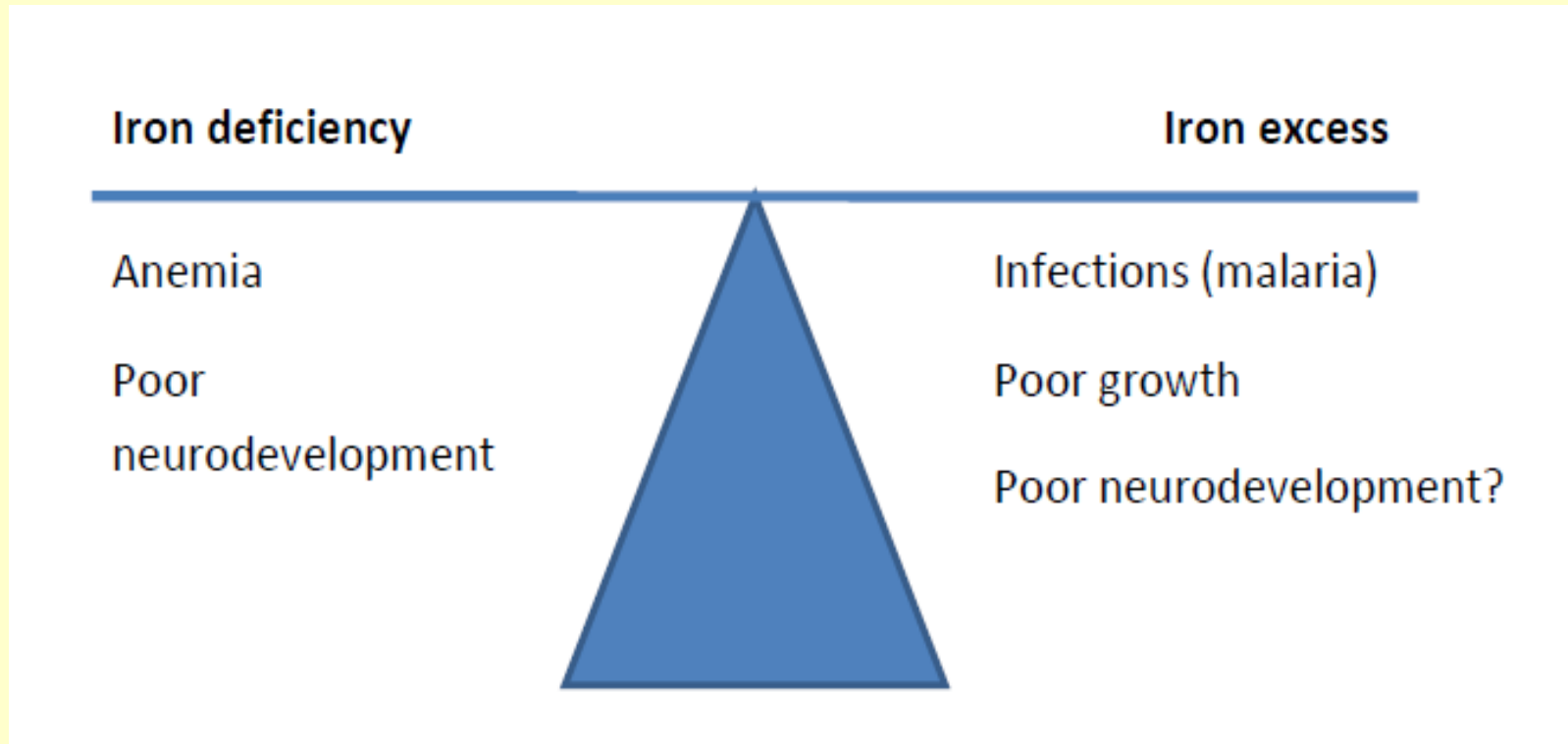
- SDQ to assess emotion, conduct, hyperactivity, peer-problems, and total difficulties
- At 4 years, parents reported more children in iron group with high total difficulties score (24/151, 16% vs 12/149, 8%,  $p=0.037$ )
- At 8 years, teachers reported more children in the iron group with peer-problems (11/132, 8% vs 3/132, 2%)
- Needs cautious interpretation

---

# LOZOFF ET AL, 2008

- Chilean infants, birth weight >3kg, no IDA at 6 months
  - Randomly allocated to formula with high (12mg/L) or low (2.3mg/L) iron content from 6 to 12 months
  - Assessed at 10 years for cognitive development, spatial memory, reading and arithmetic and visual-motor integration
  - High iron group had poorer performance for spatial memory and visual-motor integration
-

# BALANCE OF BENEFIT AND HARM



Domellof, 2010

# ESTIMATED IRON REQUIREMENTS: DID WE GET IT RIGHT?

Basal losses	~220mg
Fetus & Placenta	~315mg
Expansion of RBC mass	~500mg

- Based on to achieve target Hb of 130 g/L
  - Mean Hb: 130 g/L in iron supplemented women vs. 110 g/L in non-supplemented
  - Is higher Hb beneficial?
- Large population cohort studies suggested:
  - U-shape relationship between Hb & pregnancy outcomes
  - Levels of Hb associated with optimal pregnancy outcomes: 95 – 120g/L (Garn 1981 & Steer et al 1995)

---

# IRON NEED IN PREGNANCY: DO WE NEED TO RETHINK OUR TARGET?

- Many assumptions in estimating requirements:
    - Bioavailability of dietary iron
    - Target Hb & criteria to define IDA
      - Hb: 130g/L → cut-off 110g/L (WHO criteria)
      - Hb: 110g/L → cut-off 90-95g/L
  - Further research to better define iron requirements is warranted
-

# SUMMARY & IMPLICATION FOR PRACTICES

- Iron is a double –edged sword:
  - Generates free radicals, more is not necessary better!
  - No evidence to support routine supplementation in well nourished population
- Strategies to ensure adequate iron nutrition in pregnancy
  - Selective iron supplementation
  - Encourage intake of iron rich foods
  - Improve iron absorption



# ACKNOWLEDGMENT

---

- All families participated
  - CNRC staff
  - Colleagues & Collaborators:
    - Prof Maria Makrides
    - Prof Bob Gibson
    - Prof Caroline Crowther
    - A/Prof Peter Baghurst
    - Ms Annie Parsons
  - NHMRC
  - Channel 7 Children Research Foundation
-