

# Fortification of whole maize flour with iron as NaFeEDTA: time for governments to act

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# Why fortification?

- *Wide consumption of staple foods*
- *Consistent delivery*
- *Safe*
  - low levels of micronutrients in food-based approaches compared to supplementation*
  - Iron: safety in malaria endemic areas*
- *Minimal reliance on behaviour change*
- *Sustainable*

# Why iron?

- Most common micronutrient deficiency worldwide
- Effects on:
  - Cognitive function
  - Work output
  - Eventually on economic development

Potential to improve progress towards achievement of the Millennium Development Goals especially in Sub-Saharan Africa

# Iron fortification of flour

- Cereal flours are an attractive vehicle for flour fortification
- Cereal flours are rich in inhibitors of iron absorption
- Electrolytic iron:  
Low-cost; stable; mandatory by law for flour fortification in South Africa
- Absorption studies using stable isotopes: electrolytic iron has low bioavailability.
- Iron from NaFeEDTA is more bioavailable, particularly in high-phytate diets



# Field Trials

## Electrolytic iron:

- Did not improve iron status in refined flour (Nestel et al, 2004)  
(Study population: Low anaemia prevalence indicating low iron deficiency burden).

## NaFeEDTA:

- Recommended for fortification of high phytate flours (WHO)
- No published reports from field trials using NaFeEDTA in flour

No sensory effect of NaFeEDTA was found in the current trial





**Does  
flour fortification  
with iron  
work?**

# Objectives

- To compare the effect on iron status of daily consumption during 5 weeks of whole maize flour fortified with electrolytic iron (56 mg/kg) and iron as NaFeEDTA (56 mg/kg (high) and 28 mg/kg (low)).
- To assess if the effect of iron fortification of whole maize flour with electrolytic iron and NaFeEDTA depends on iron status at baseline  
(do iron deficient children benefit more from the intervention than iron sufficient children?)

# Intervention



## Four types of flour

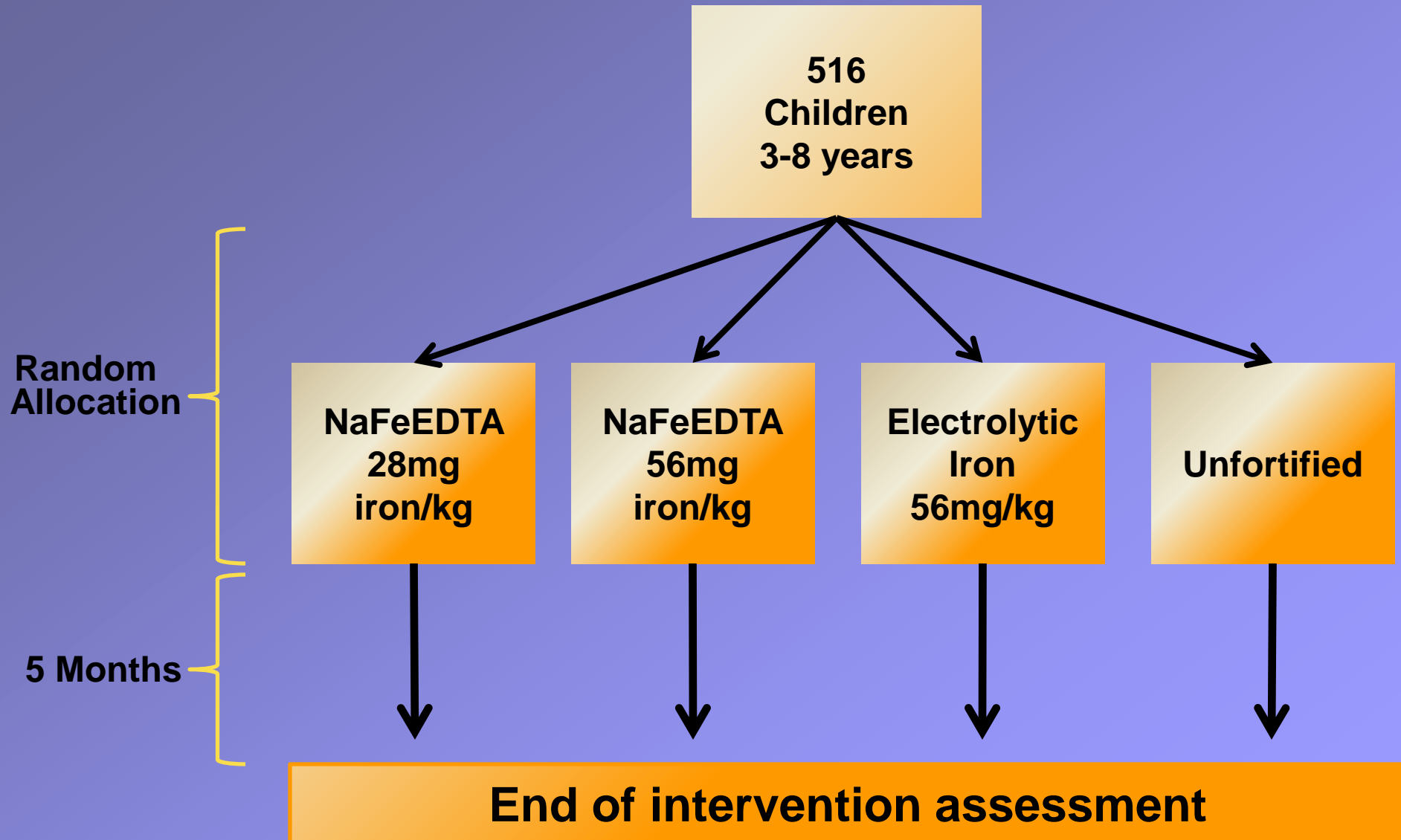
- 28mg/Kg iron from Ferrazone®
- 56mg/kg iron from Ferrazone®
- 56mg/kg iron as electrolytic iron
- Unfortified flour

## Form of administration:

- Thick porridge
- Consumed twice a day every weekday



# Study Design



# Treatments and iron intake

Treatment	Amount of flour consumed	Amount of iron from fortificant	% RDA *
28 mg/Kg NaFeEDTA	100g	2.8	20
	150g	4.2	40
56 mg/kg NaFeEDTA	100g	5.6	18
	150g	8.4	37
56 mg/kg electrolytic iron	100g	5.6	18
	150g	8.4	37
Placebo	-	-	-

\* Based on requirement for 2-5 and 6-12 year olds on a 5% bioavailability diet

# Biochemical measures

Indicators of iron status measured in venous blood:

- Haemoglobin concentration in whole blood
- Plasma ferritin concentration
- Plasma transferrin receptor concentration

Marker of infection:

- C-reactive protein

To eliminate possible effects of malaria on iron status indicators:

- Blanket malaria treatment 2 weeks before the end of the intervention

# Baseline characteristics

	%
Malarial parasitaemia ( <i>P. Falciparum</i> )	49
Anaemia	52
Iron deficiency <sup>1</sup>	15
Iron deficiency anaemia <sup>2</sup>	10
Worm infection (Hookworm, <i>Trichuris</i> , askaris)	12
Hookworm infection	11

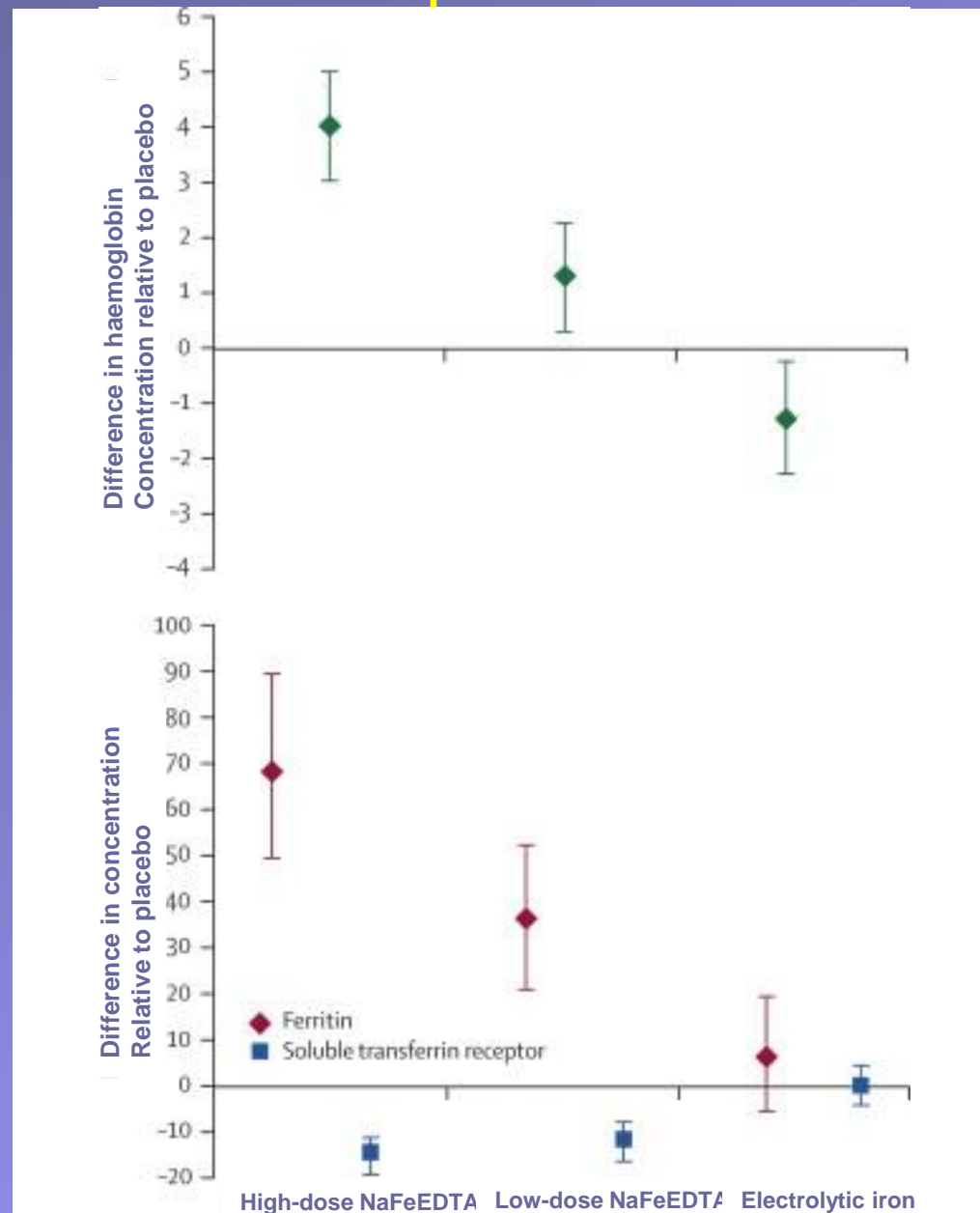
Baseline characteristics similar across groups except iron status indicators: haemoglobin, ferritin (higher in placebo group), sTfR lower in placebo group (**n= 516**)

<sup>1</sup>Plasma ferritin concentration <12 µg/L or <15 µg/L for children ≤ age 5 years or > 5 years

<sup>2</sup>Haemoglobin concentration < 110 g/L and <115 g/L for children aged <5 years and ≥5 years.

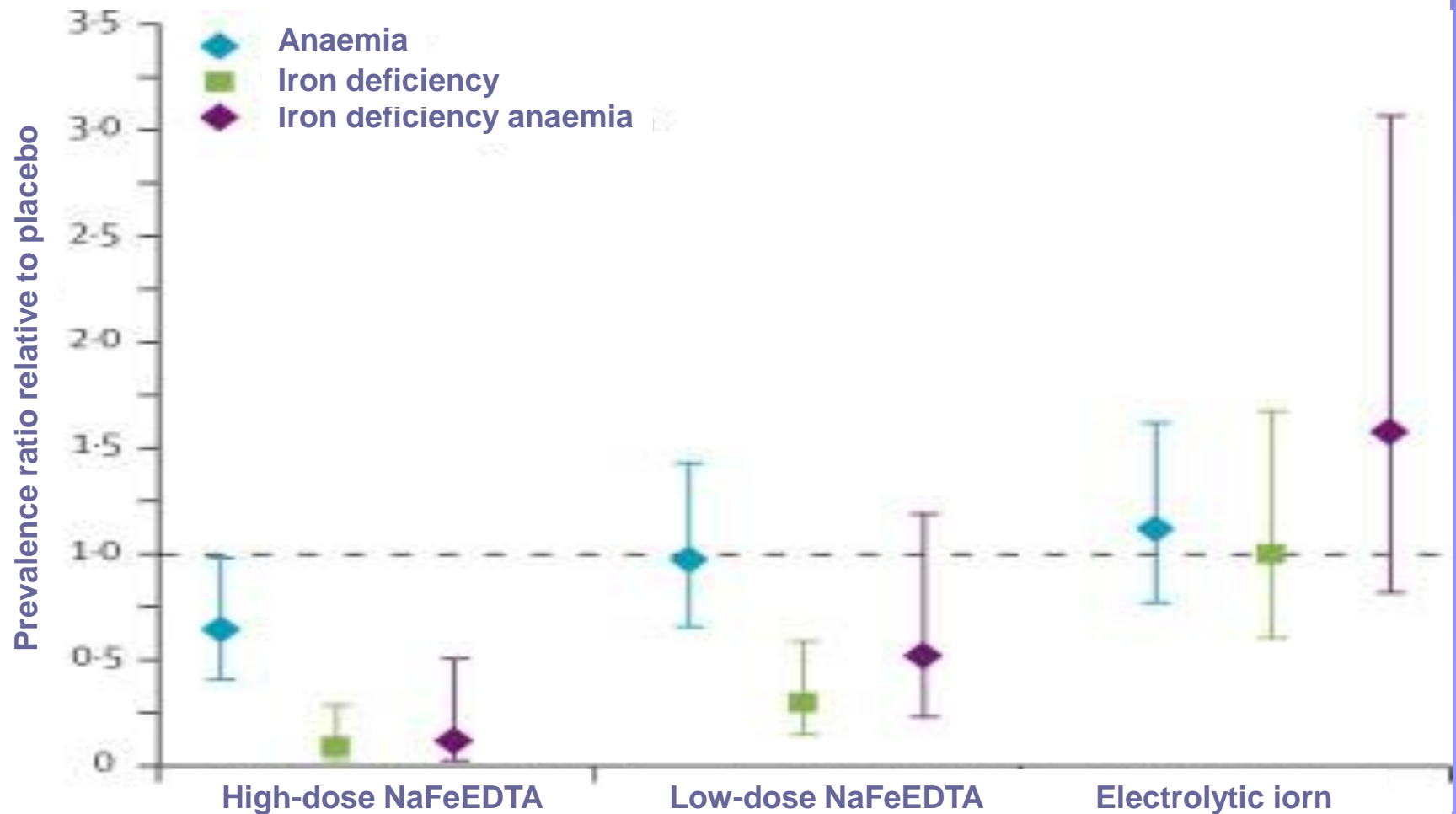


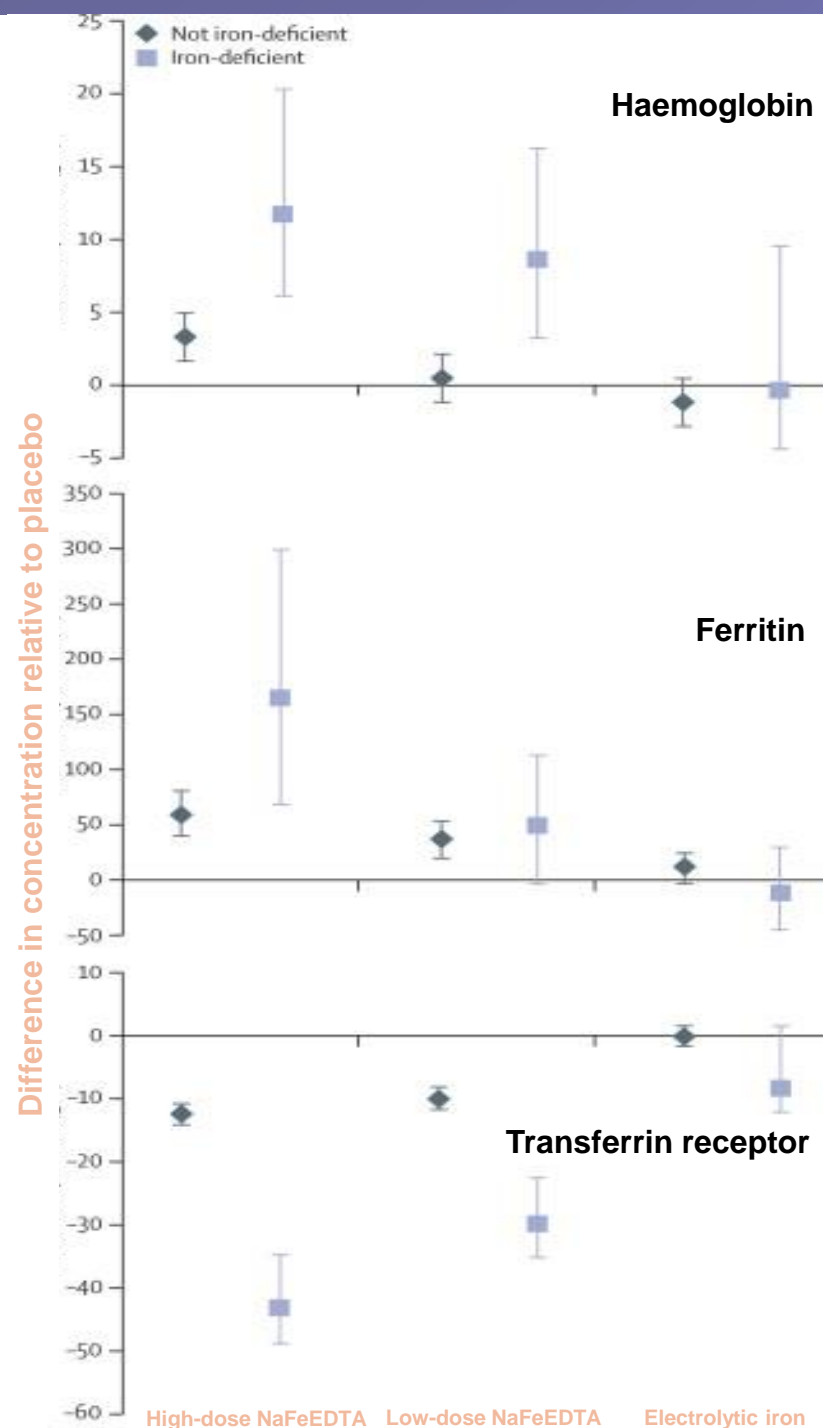
# Effect of interventions on haemoglobin, ferritin and transferrin receptor concentrations



Adjusted for baseline concentrations of haemoglobin, ferritin, soluble transferrin receptor and C-reactive protein  
Error bars indicate 95% CIs.

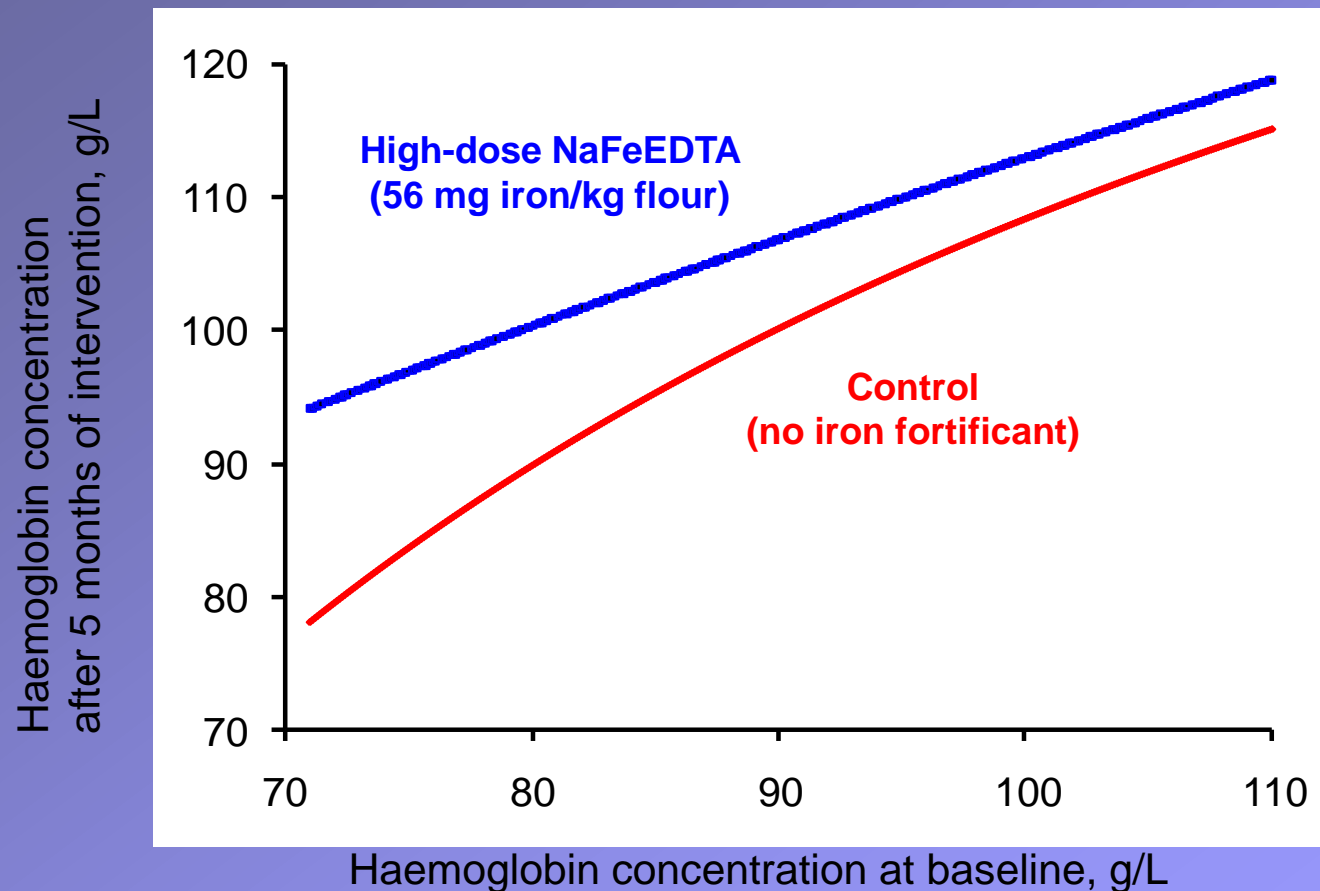
# Effect of intervention on iron status indicators





Effect of fortification with NaFeEDTA in children with low vs normal iron status

# Flour fortification with NaFeEDTA: more efficacious in children with low iron status



\* Adjusted for malarial infection, plasma concentration of soluble transferrin receptor concentration, ferritin and C-reactive protein



# Fortification with NaFeEDTA works

In young children consuming whole maize flour:

- Fortification with NaFeEDTA (56mg/kg) reduced the prevalence of iron deficiency anaemia by 89% after 5 months of intervention.
- Children with iron deficiency benefit more than in their peers without iron deficiency (12 g/L vs 3g/L)
- Fortification with NaFeEDTA (28 mg/kg) showed a similar trend but the effects were more modest
- There was no evidence that fortification with electrolytic iron improved iron status.

# Conclusions

- NaFeEDTA is the preferred iron fortificant for whole maize flour fortification
- Electrolytic iron is not suitable for fortification of whole maize flour

# Policy implications

- Fortification of flour with iron is possible even in the most demanding conditions – Ted Greiner. Lancet 2007
- The World Health Organization considers fortification with iron as safe.

Flour fortification with iron is the only feasible intervention with demonstrated efficacy to reduce the enormous burden of iron deficiency in Africa.

Governments and industries must enact and reinforce legislation for industrial fortification of flour with iron.

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Thank You!