Vitamin B12 deficiency in Guatemala

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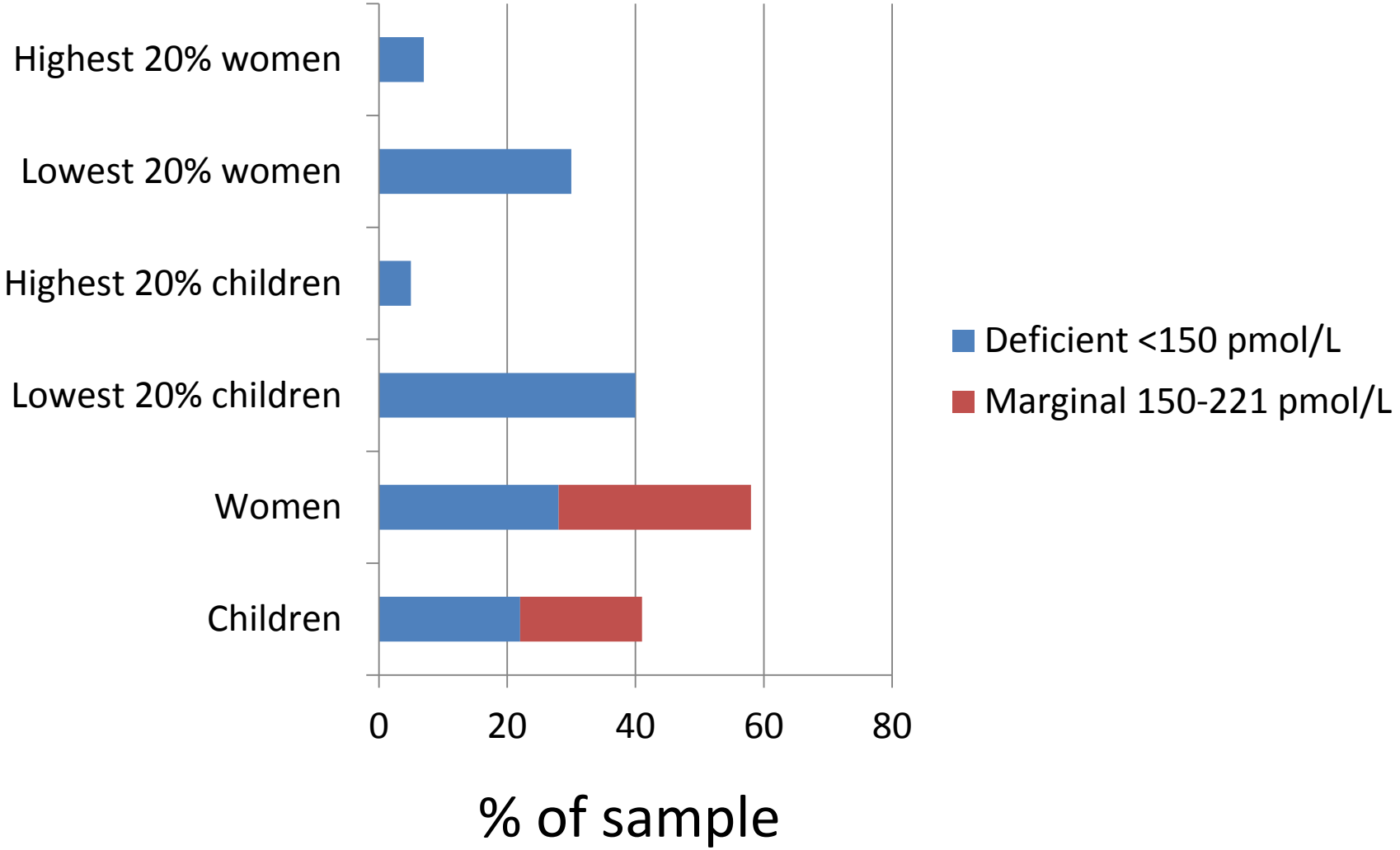
Outline

- Vitamin B12 deficiency is probably the most common MN problem in Guatemala.
- Across life span, male and female.
- Cause is low animal source food intake, and
- for infants, low maternal stores during pregnancy and lactation.
- Breast milk low in B12 and other MN.

Prevalence of B12 deficiency: ENMICRON 2009-2010



B12 studies in Guatemala

Year	Group	Results
1997	Women 3 mo. lactation	47% def/marginal Infants elevated MMA, milk low B12
2008	Infants 7 mo.	61% def/marginal RDA for 6 mo. no sig. benefit 7 mo. correlated with 12 mo. Infant status negatively assoc. breastmilk
2003	Schoolers	33% def/marginal Not related to H pylori or bact. overgrowth
2007	Women & child 12 -21 mo. lactation	49% infant, 68% mothers def/marginal Low milk B12, correlated with maternal serum B12 Child B12 status neg. associated with breast milk Neither RDA or beef sig. effect improved child B12 Child B12 at 12 mo. tracked to 21 mo. Child B12 at 21 mo. correlated with maternal B12

Continuum of mother-child B12 depletion

Maternal depletion in pregnancy

↓

Low B12 stores in infant at birth
& in colostrum, breast milk

↓

Infant depletion at 3 months

↓

Depletion at 7, and 12 months (r=0.49)

Breastfed freq (-)

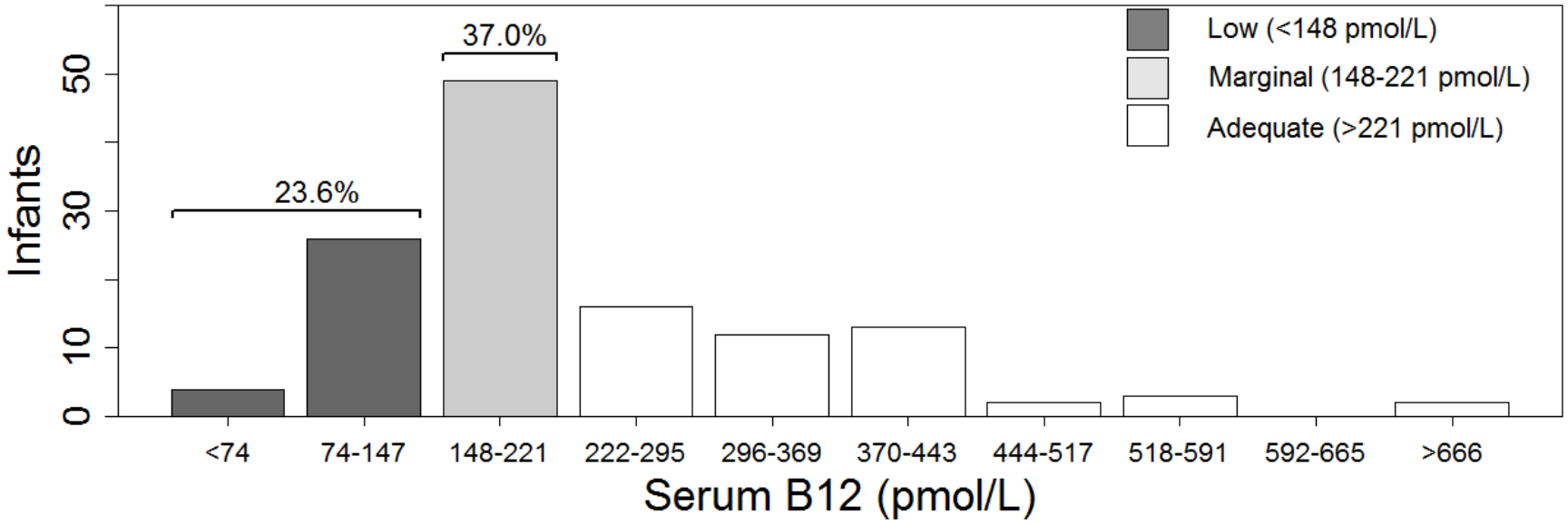
Cows milk (+)

↓ (r=0.54)

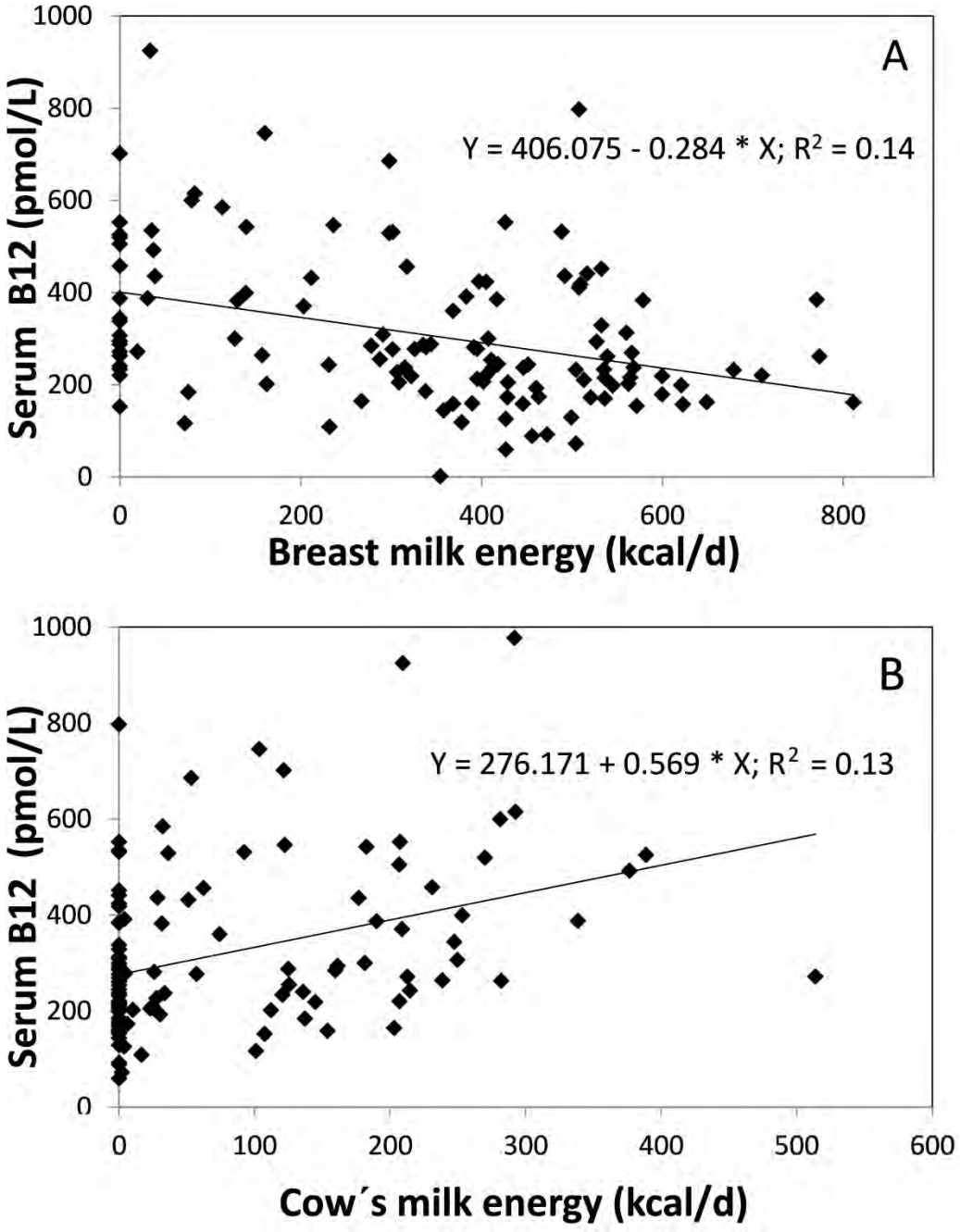
Depletion at 21 months (still correlated with early maternal B12 status)

↓ weight, length, motor development

B12 status at age 6 months (Santa Elena, n=127)



Anaya-Loyola 2007

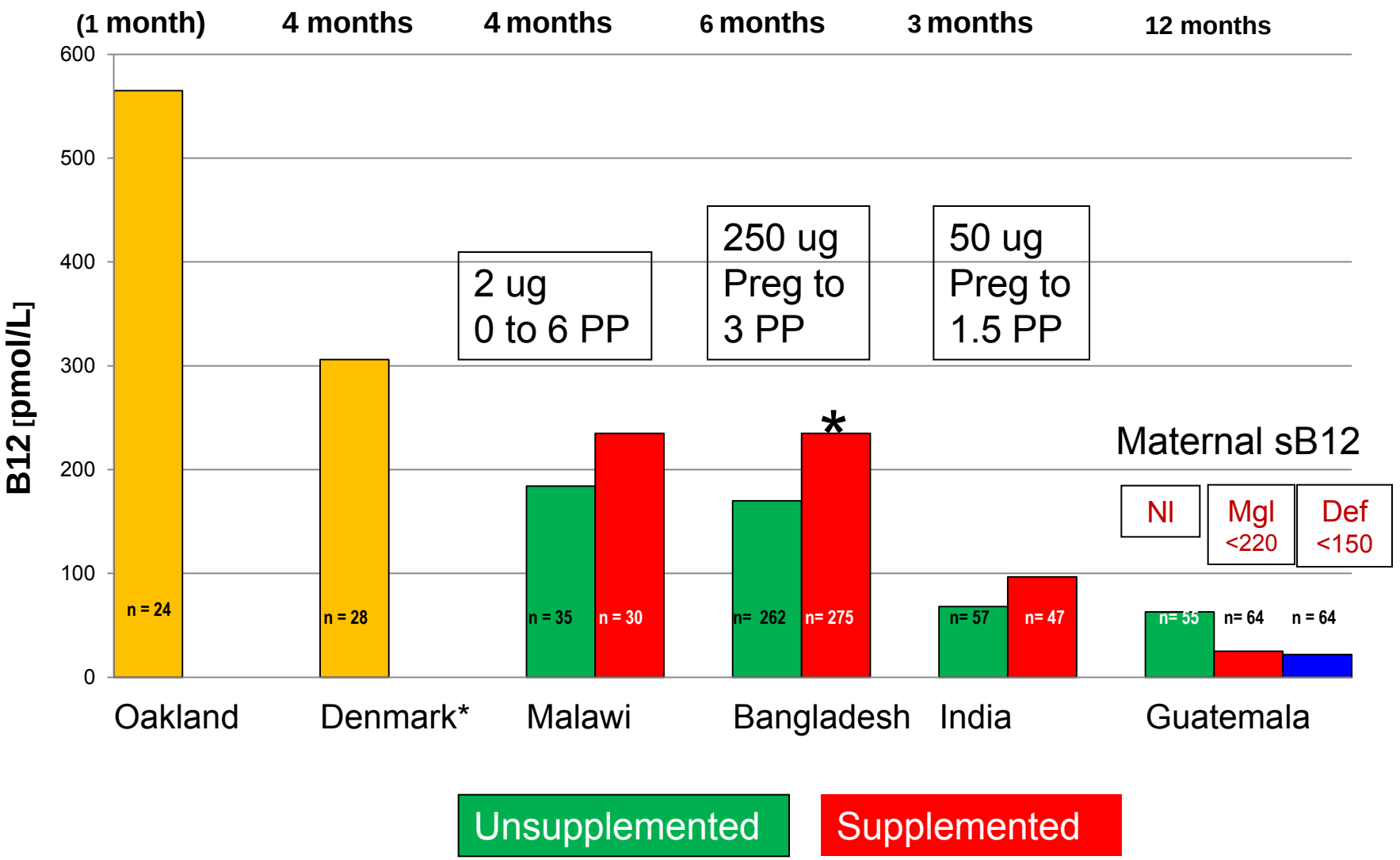


Infant serum B12 at 7 mo. is *inversely* related to breast milk intake, and positively to cow's milk intake.

Cows milk has much more B12 than breast milk, especially in Guatemala

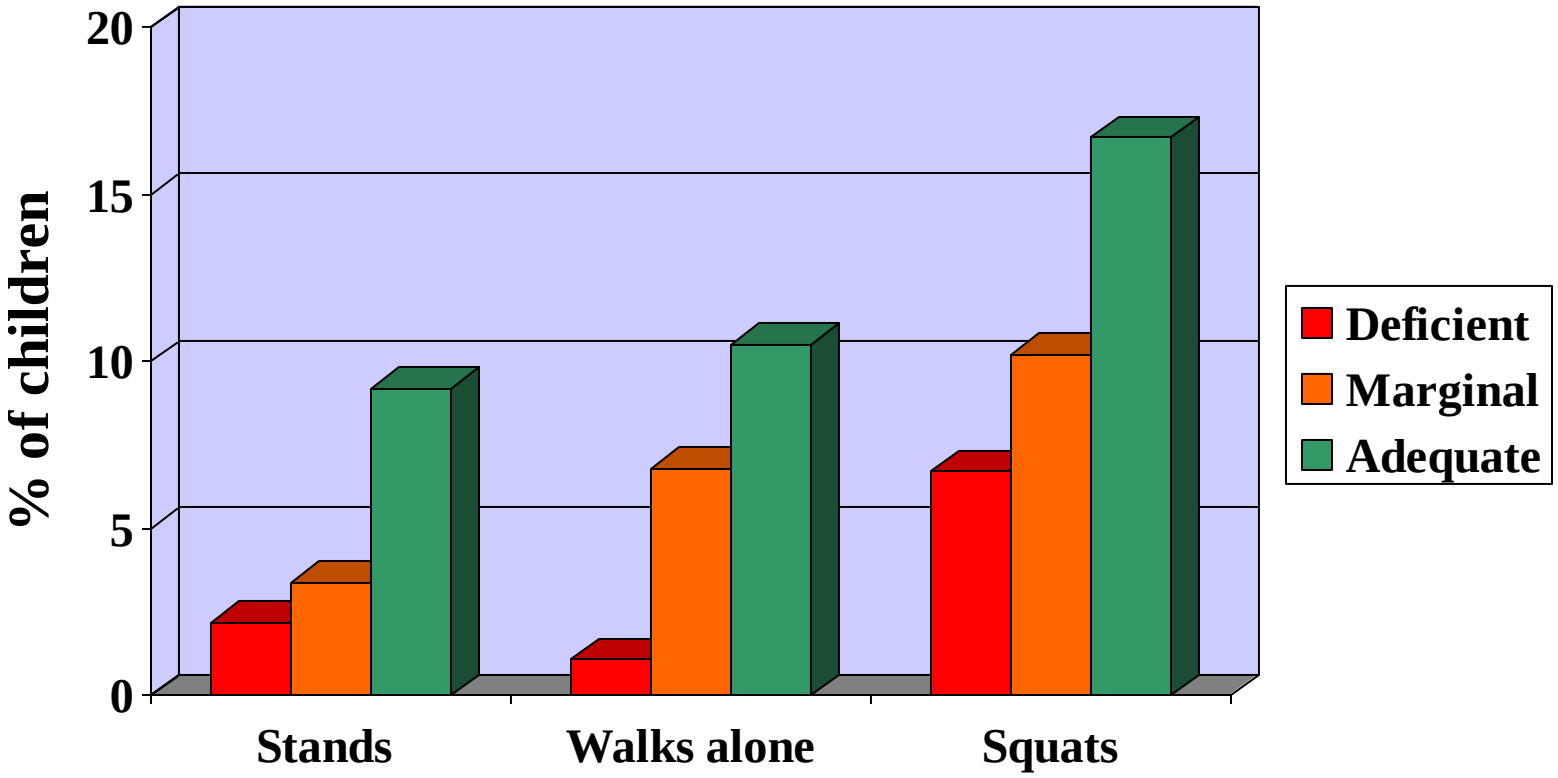
Deegan, 2007
Anaya, 2008

Vitamin B12 in breast milk, by country



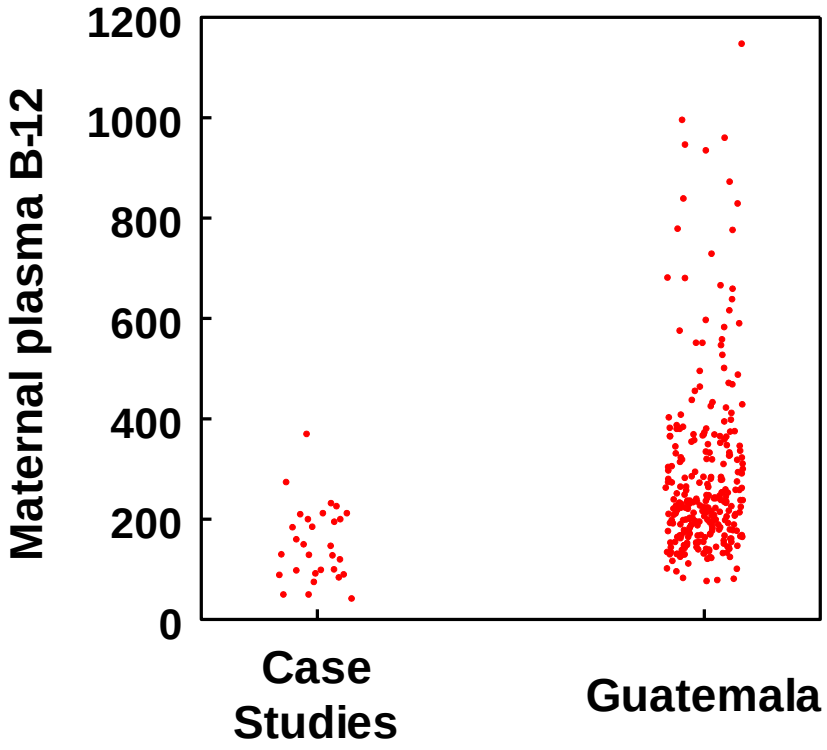
Cameroon: 67 pmol/L North, 287 pmol/L Cities

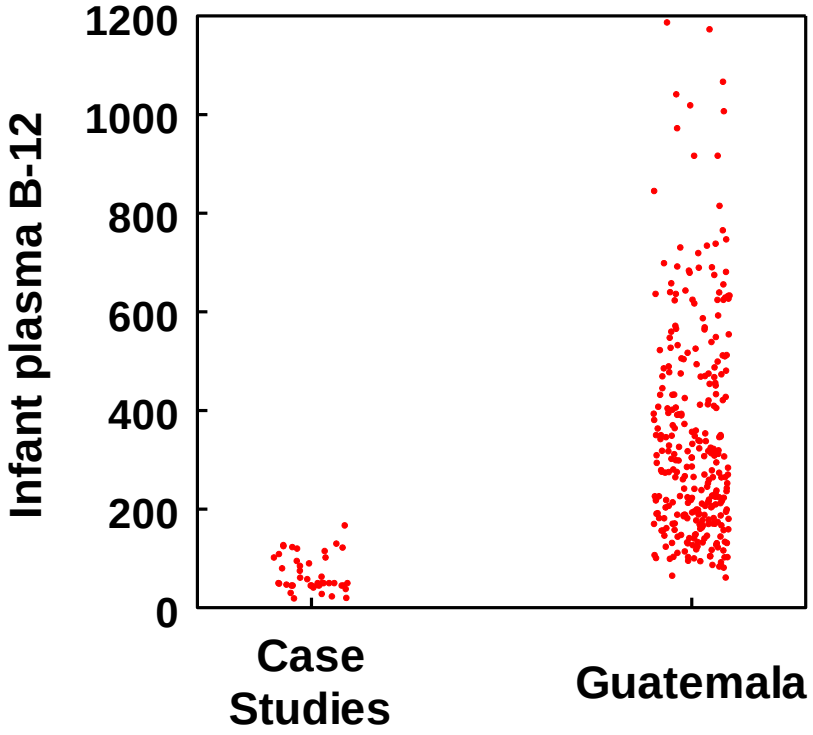
Guatemala: Infant B12 status predicts motor development (n=≈80/group)



Factor score: Deficient lower than Adequate ($P<0.01$) adjusted for SES, environment etc.

Overlap between maternal and plasma B12 values in clinical cases of infant deficiency, and at 12 months in Guatemala





Other potential perinatal roles for B12

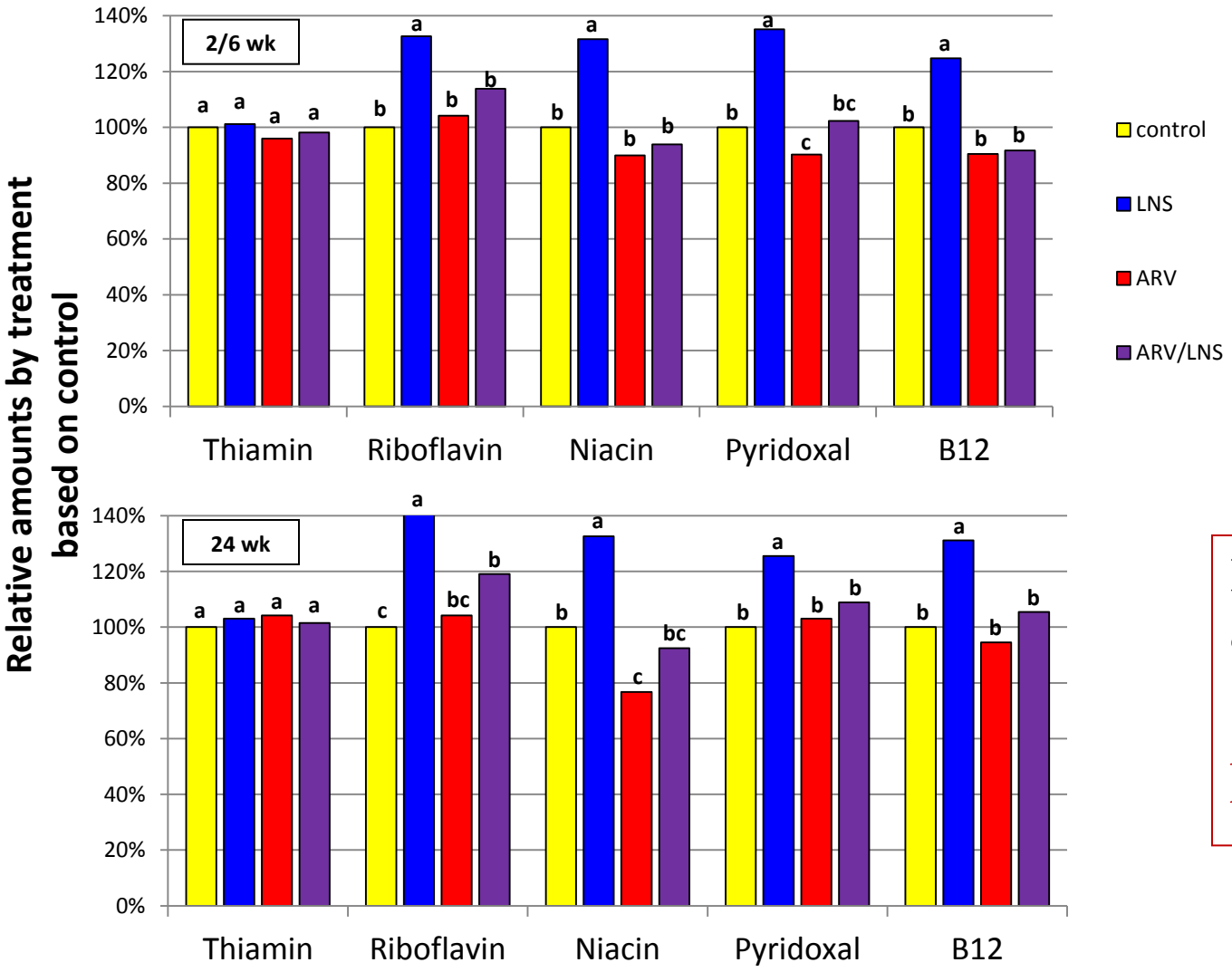
- NTD prevention
- Pre-eclampsia (homocysteine)
- Birthweight
- Epigenetic effects
- Postnatal insulin resistance
- Infant development

Rush et al. Eur J Clin Nutr 2014

Serum B12 vs outcomes ("+" = intervention)

	V. deficient <100 pmol/L	Deficient <150 pmol/L	Marginal <221 pmol/L
Anemia	++	+/-	No
Neuropathy	++	+	No
↑ Hcy, MMA	++	++	++
Breast milk	++	++	+
Child devpt	++	Assoc.	Assoc.
Cognition	++	+/-	Assoc.
Depression	Assoc.	Assoc.	Assoc.
Bone mineral	+	Assoc.	Assoc.
NTD	?	?	Assoc.

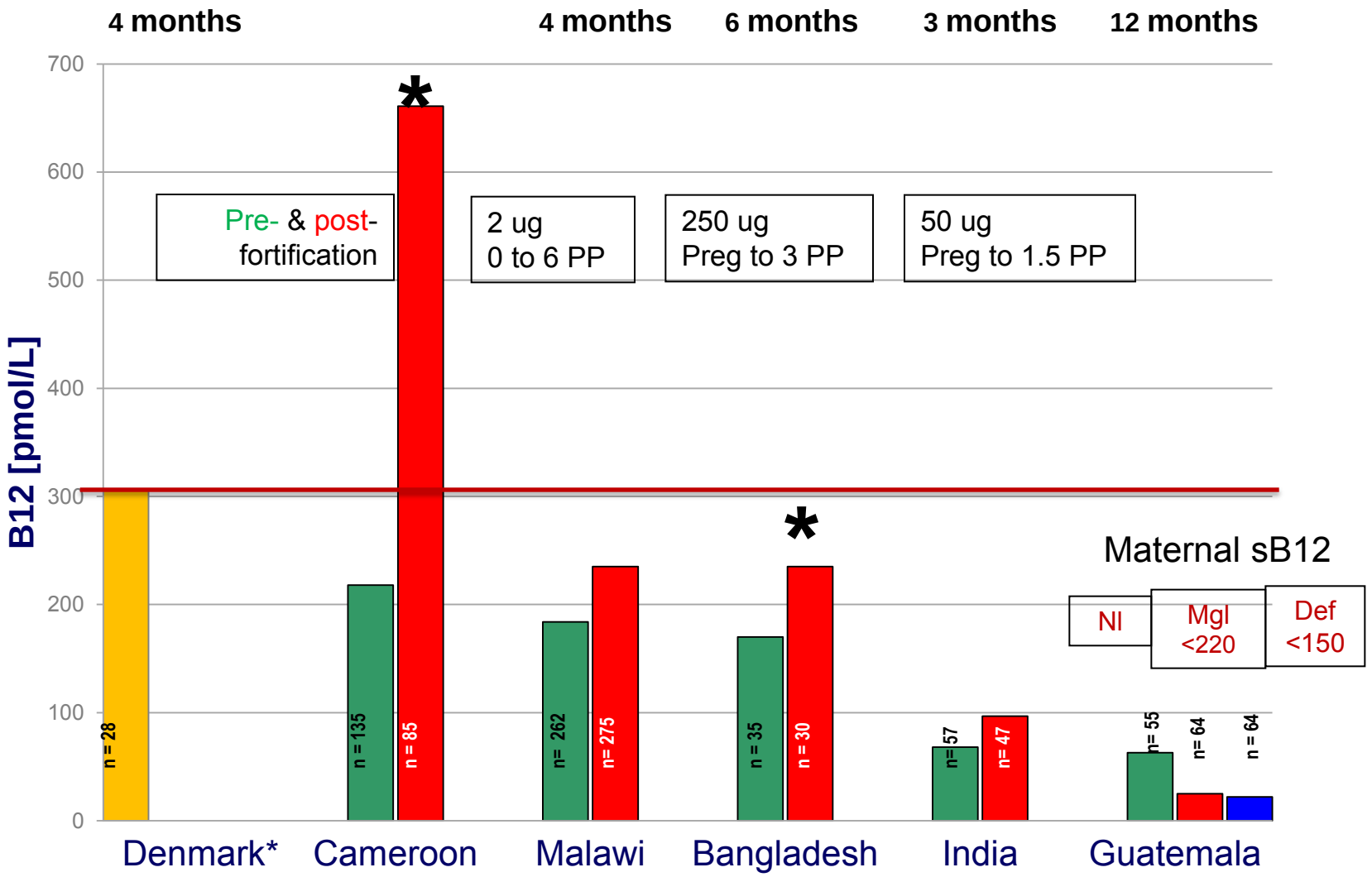
BAN project: RCT of LNS (1 x RDA) and ARVs for first 6 months lactation. % of control values



LNS increased all but thiamin

ARVs abolished this effect

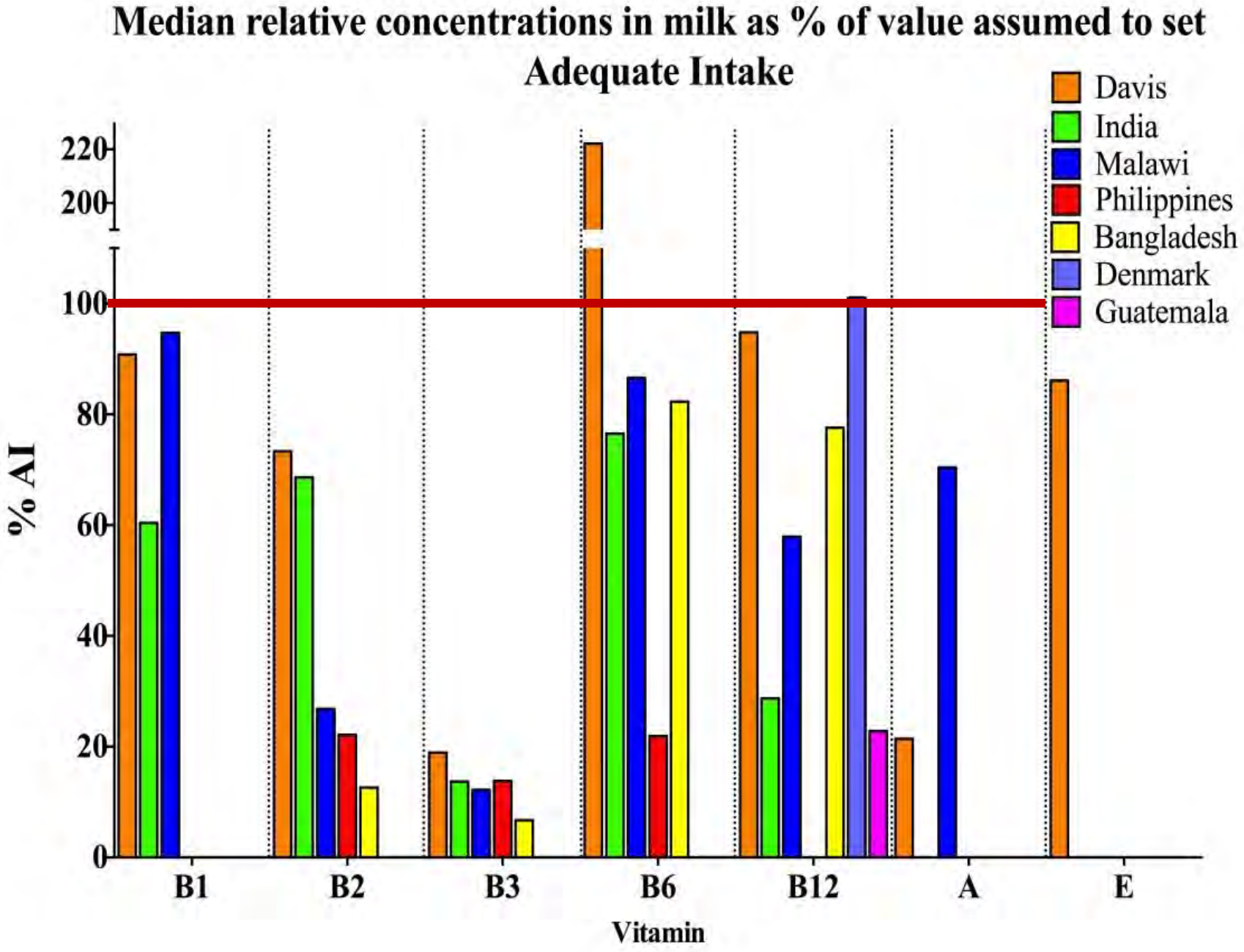
DOSE vs B12 in breast milk, by country



No dose normalizes milk B12

Unsupplemented

+B12


Median relative concentrations in milk as % of value assumed to set Adequate Intake
Davis
India
Malawi
Philippines
Bangladesh
Denmark
Guatemala
220
200
100
80
60
40
20
0
% AI
B1
B2
B3
B6
B12
A
E
Vitamin

Nerve conduction latency vs. serum folate

Chilean elderly (high FA in flour)

B12 deficient

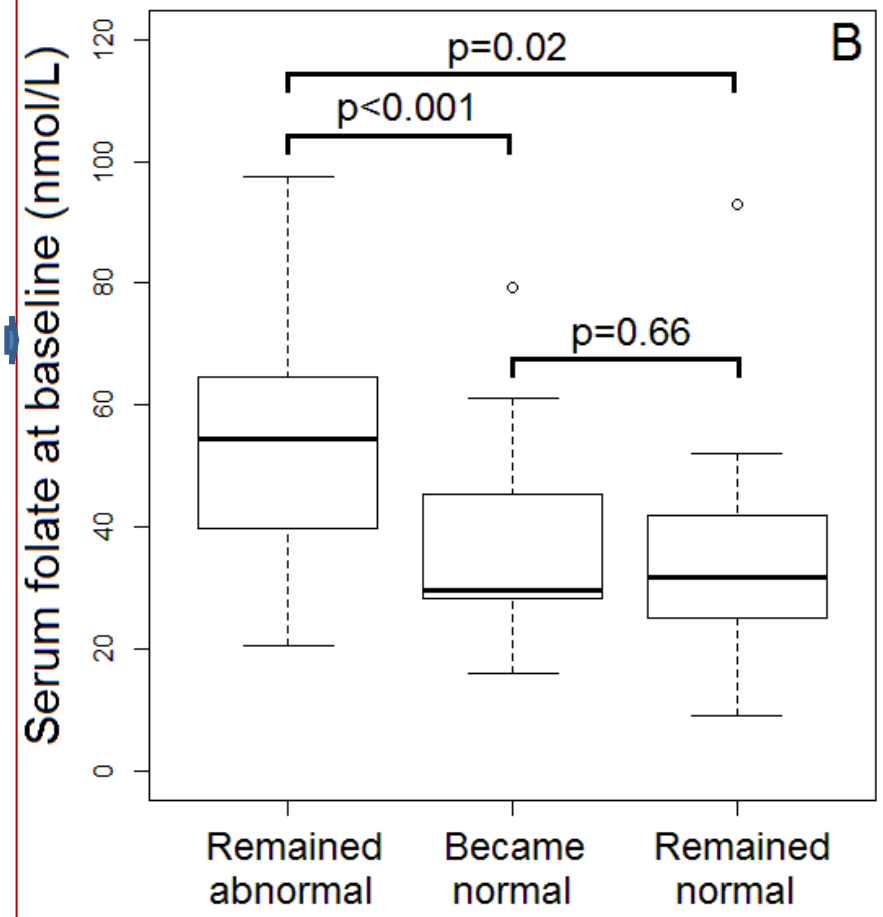
Nerve conduction baseline, 3 mo

Injected with B12

Higher serum folate at baseline → nerve function stays abnormal

and biomarkers of B12 status were more abnormal

Higher serum folate makes B12 deficiency worse



Brito et al (in preparation)

Conclusions

- B12 deficiency very common in Guatemala.
- Mothers, infants especially vulnerable.
- Supplements and LNS in pregnancy and lactation helpful but probably not enough.
- ↑Milk, eggs, poultry etc. where possible.
- Fortification likely best strategy:
  - Absorption highest from small amounts
  - Mothers will enter pregnancy with stores
  - Affects males and females across the life span
  - Good to provide with folic acid in flour