

# Folic Acid and Neural Tube Defects

What do millers actually prevent?



**Anna Verster, Senior Advisor**

**on Flour Fortification**

**Smarter Futures**

With thanks to Graham Fieggen (Red Cross War Memorial Children's Hospital), Lieven Bauwens (IF) and Sarah Zimmerman (FFI)



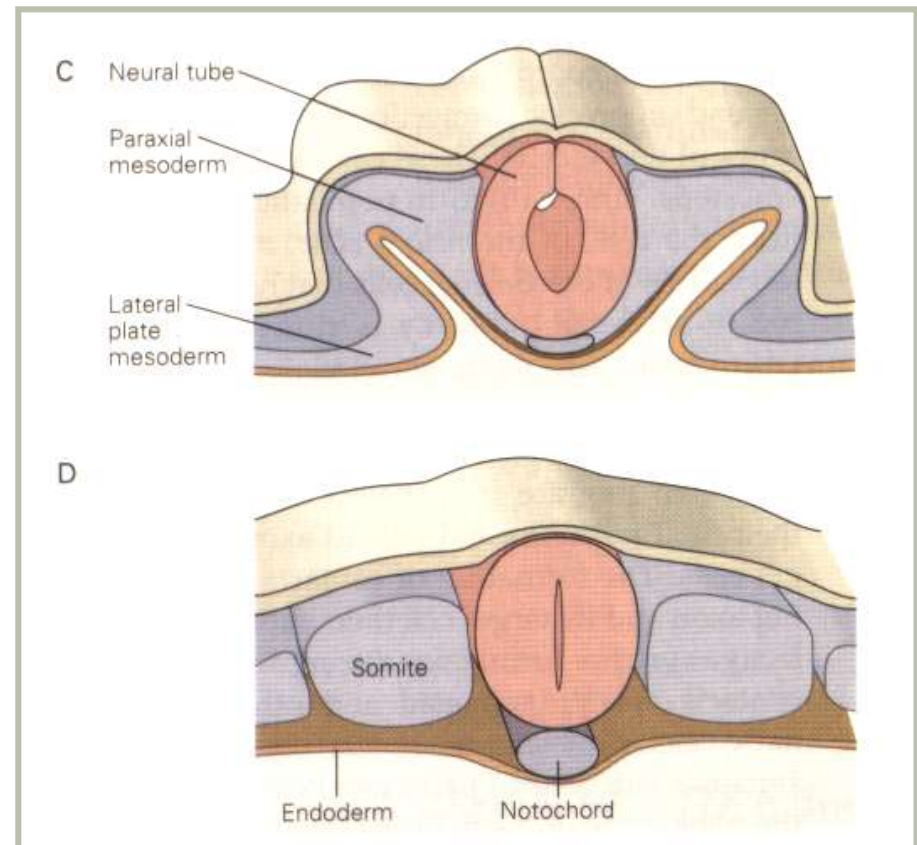
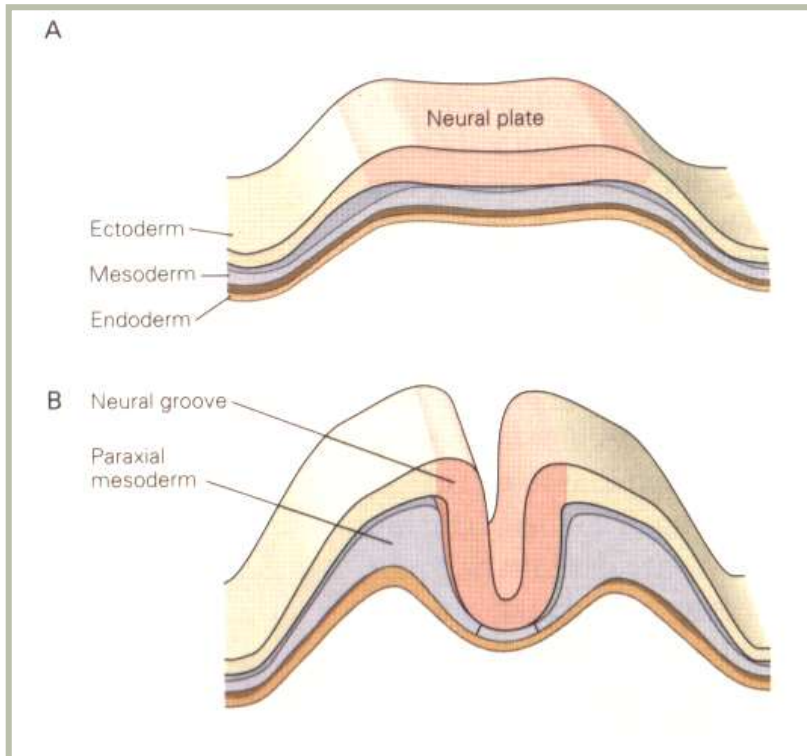
Ministerie van Buitenlandse Zaken

# Neural Tube Defects: what are they?

- NTD's occur when the neural tube of a fetus fails to close properly thus impairing the central nervous system.
- Spina bifida is one of the most common birth defects.
- Often **preventable**
- Initial management has a **profound** effect on survival and the disabilities that they may suffer
- Hope and support make this a manageable condition, which culminates in a productive and meaningful life for many...

# Normal embryology: Closure of the neural tube

Principles of Neural Science  
Kandel ER  
2000



This process is complete within the first month post-conception;

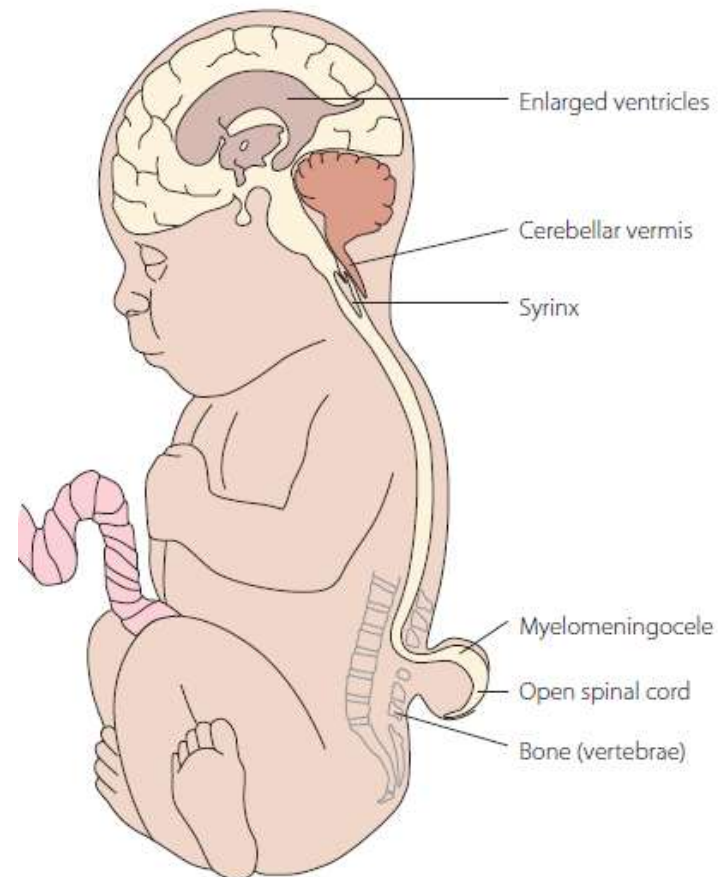
This has clear implications for the concept of prevention

# Important points to remember about neural tube closure

- Occurs by **day 28** post conception, **before a woman even knows that she is pregnant.**

This is critical for understanding strategies for prevention!

- Abnormalities cause conditions like spina bifida and hydrocephalus



# Spina Bifida

- ❑ The most common NTD is spina bifida in which the baby's spine does not form correctly.
- ❑ In mild cases, permanent loss of some sensation or movement occurs.
- ❑ Severe cases include paralysis and varying degrees of loss of bowel and bladder control.
- ❑ Children born with spina bifida will undergo a lifetime of surgeries and face many health issues.
- ❑ Spina bifida cannot be cured.



# Long term issues

## □ Neurosurgical

- ◆ **Hydrocephalus** - *A hydrodynamic disorder of Cerebral Spinal Fluid circulation leading to an increase in intracranial pressure*
- ◆ **Tethered spinal cord** – may lead later to:
  - ◆ Gait deterioration, progressive motor deterioration
  - ◆ Delayed toilet training or secondary Incontinence
  - ◆ Scoliosis
  - ◆ Back pain

## □ Orthopaedic

- ◆ Feet, ankles, knees, hips..
- ◆ Spinal deformity

## □ Urological

## □ Cognitive





# Anencephaly

- ❑ Another NTD is anencephaly in which the brain does not form properly.
- ❑ Pregnancies affected by anencephaly are often miscarried.
- ❑ Babies born with anencephaly die shortly after birth.



Photo courtesy of the Centers for Disease Control and Prevention, National Center on Birth Defects and Developmental Disabilities

# NTD's are only the ears of the hippo....

Other adverse health outcomes:

Certainly: Folic Acid deficiency and related anemia

Probably: stroke, heart disease

Possibly: Low birth weight, pre-term birth, cancer, other birth defects, cleft palate ...

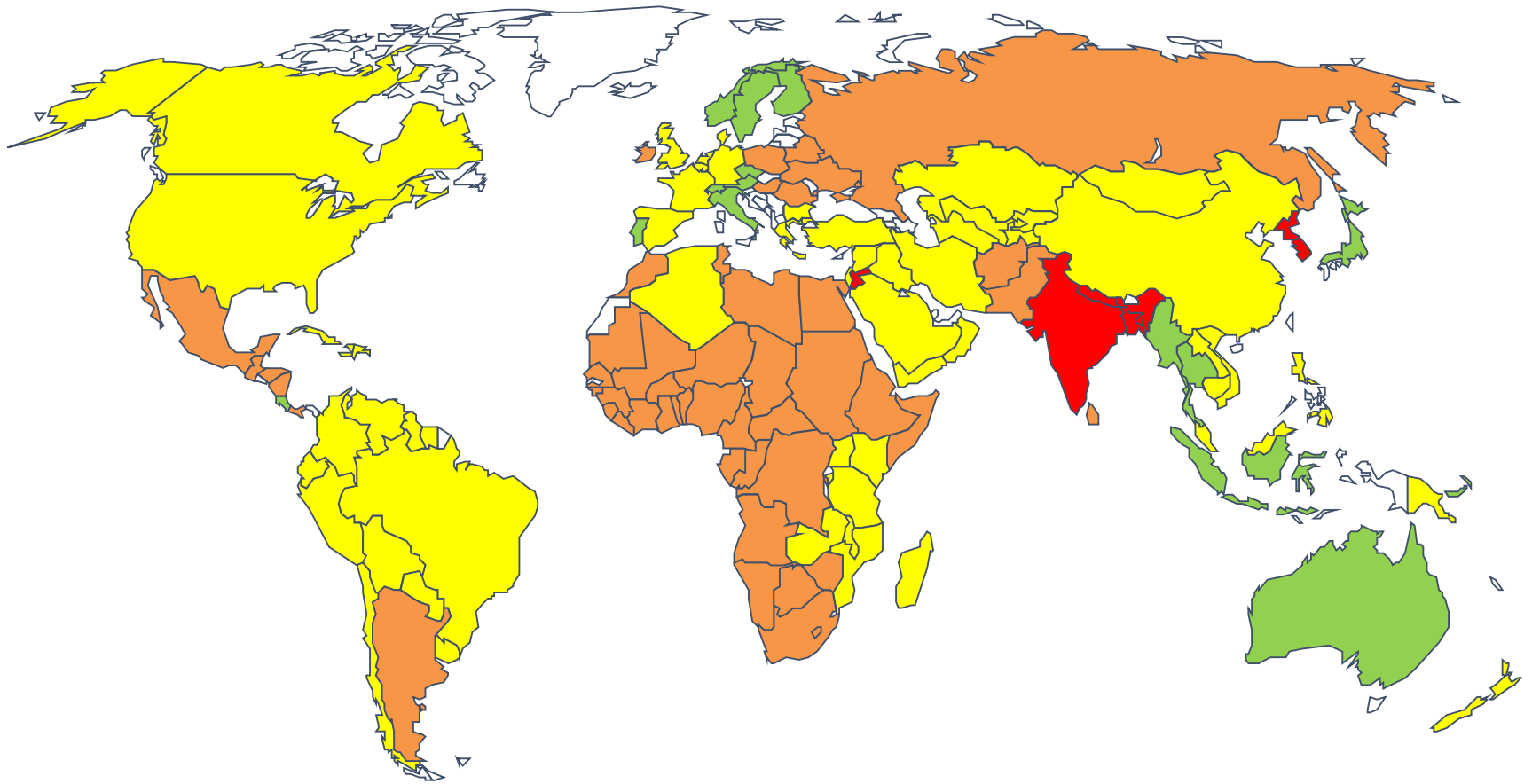
Recurrence?



Photo from Animal Planet



# Prevalence of NTDs, 2001



Legend: Rates per 1000 births: data from March of Dimes

Color	Rate Range (per 1000 births)
Green	≤ 1.0
Yellow	1.1-2.0
Orange	2.1-3.0
Red	> 3.0

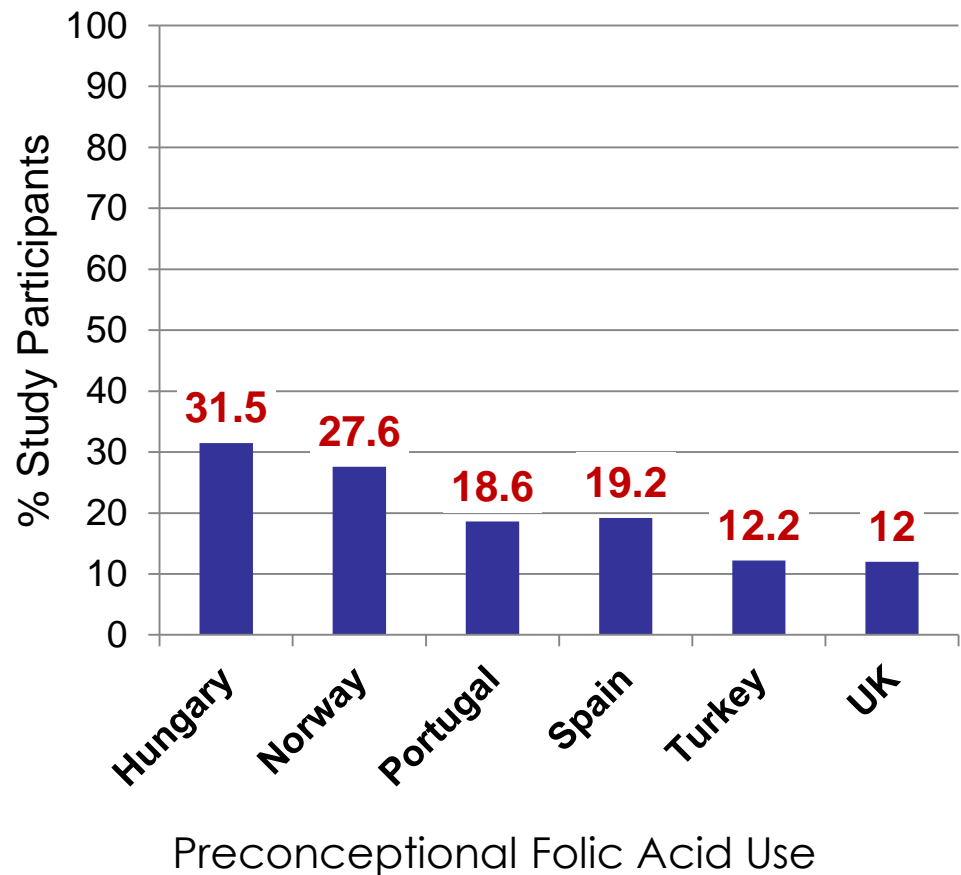
# Until 25 years ago we did not know that NTD's can be prevented...

- Folic acid is a B vitamin that our bodies need to make new cells.
- In 1991, a study done in the United Kingdom showed that **400 microgram of folic acid daily taken from 8 weeks before conception** till 12 weeks into the pregnancy can help reduce the risk of NTD's by up to 70%
- This important discovery made it possible to **prevent** these debilitating birth defects
- Pregnant women all over the world are given iron and folic acid tablets during pregnancy, mostly in the 3d trimester
- That is **too late** for preventing NTD's

# Folic acid fortification, supplements or dietary diversification?

Supplements have limitations:

- Cost and inconsistent use
- Minority of women use folic acid supplements at the correct time for preventing NTDs (even when the pregnancy is a planned one) – important relation with socio-economic background



# Folic acid fortification, supplements or dietary diversification?

## Dietary Diversification:

- ❑ it is virtually impossible to obtain enough folic acid through natural foods, even in high-earning and educated populations.
- ❑ Women who plan to become pregnant need 400ug of folic acid daily.
- ❑ To obtain this naturally they would need to eat 44 ripe tomatoes, 14 cups of broccoli or four slices of fried beef liver every day.



Photo Ella ten Have

# Flour Fortification with folic acid is the best solution

- Effective, simple and inexpensive
- Requires no change in dietary patterns or individual decision
- Non-discriminating
- The discovery that folic acid can prevent NTD's led Oman to start fortification of flour with folic acid in 1996, soon followed by the US and Canada.



- The impact was immediate!

Reduction in NTD's in Oman

# Flour fortification reduces Neural Tube Defects by about half!

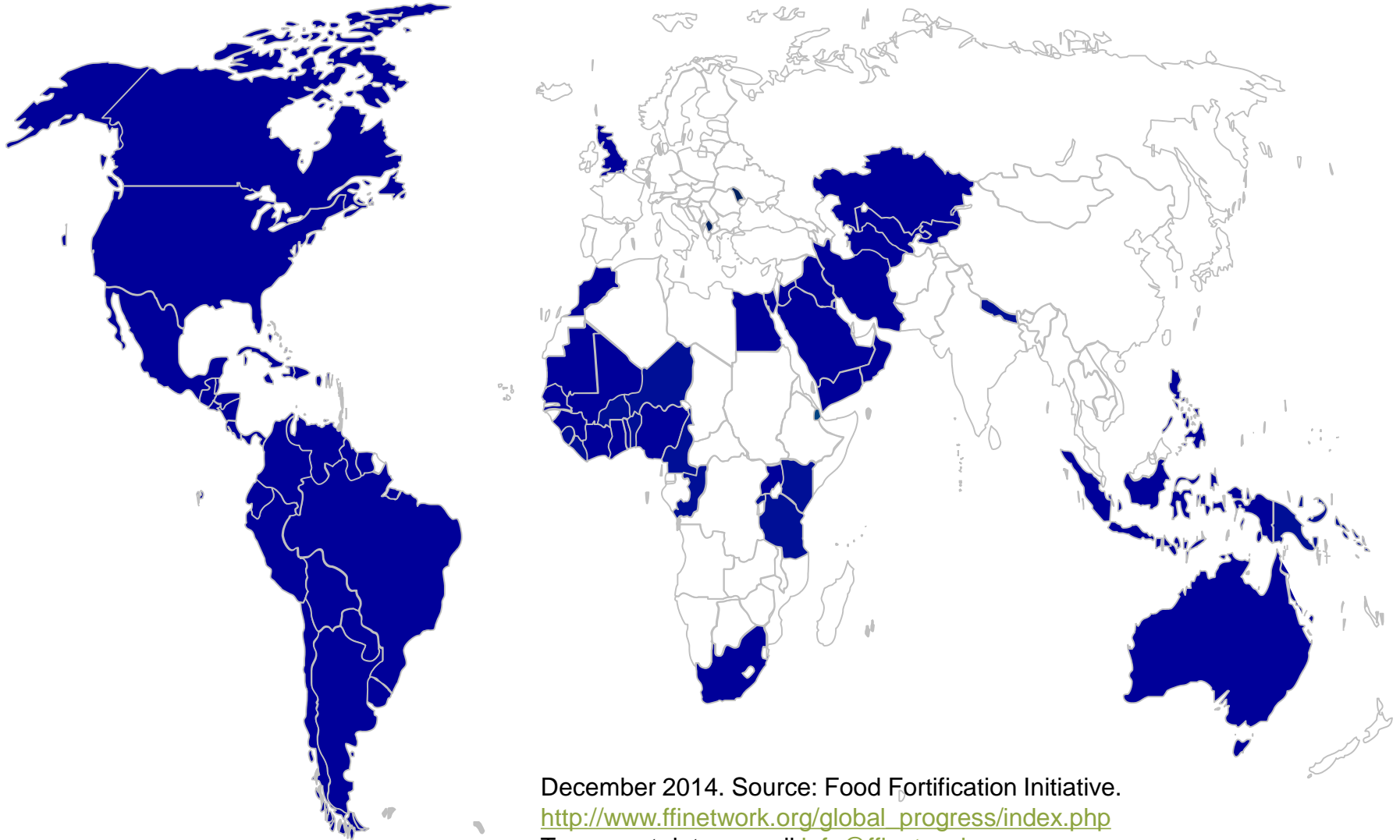
Eight studies from Argentina, Canada, Chile, South Africa, and the United States:

- **31% to 78% reduced risk** of neural tube defects after fortifying flour with folic acid
- **Overall reduction of 46%**





# Today 81 countries worldwide are fortifying flour with folic acid and iron



December 2014. Source: Food Fortification Initiative.  
[http://www.ffinetwork.org/global\\_progress/index.php](http://www.ffinetwork.org/global_progress/index.php)  
To request data, e-mail [info@ffinetwork.org](mailto:info@ffinetwork.org)

# Summary

- An estimated **300,000 neural tube defects** (NTDs) occur every year globally
- Fortifying flour with folic acid is an effective way to prevent NTDs
- Countries that made fortification mandatory have experienced between 31 and 78% reductions in NTD prevalence
- Globally an estimated **38,417** birth defects were prevented in 2012 where flour was fortified with folic acid. That is an average of **105 a day**
- Countries can avert millions of dollars in healthcare expenditures when spina bifida is prevented
- Millers are **key partners** in preventing Neural Tube Defects