

OPPORTUNITIES FOR THE PREVENTION OF DEVELOPMENTAL DISABILITIES

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ESTIMATES OF THE PREVALENCE OF DEVELOPMENTAL DISABILITIES IN THE US

DISABILITY	PREVALENCE
SEVERE INTELLECTUAL DISABILITY	3 - 5 per 1,000 live births
MILD INTELLECTUAL DISABILITY	1 - 1.7% of the child population
AUTISM SPECTRUM DISORDER	Between 1% and 1.5% of US children now carry the diagnostic label of ASD
CEREBRAL PALSY	1.5 – 4 per 1,000 live births
ATTENTION DEFICIT/ HYPERACTIVITY DISORDER	5-7%
LEARNING DISABILITIES	9-10%
TOTAL (allowing for overlap among disabilities)	15% - 20%

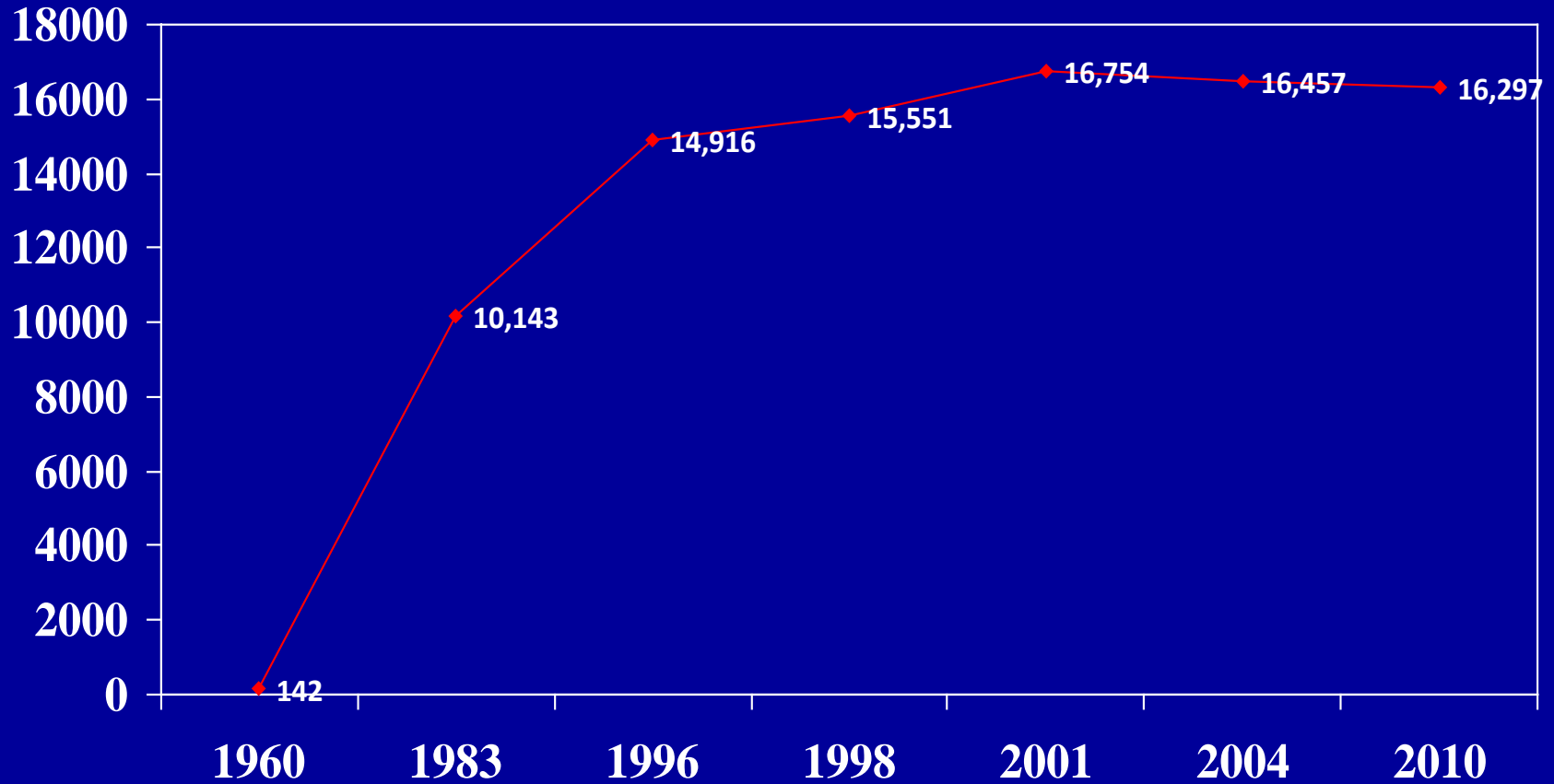
ABBREVIATIONS I WILL USE

NAME	ABBREVIATION
INTELLECTUAL DISABILITY	ID
CEREBRAL PALSY	CP
AUTISM SPECTRUM DISORDER	ASD
ATTENTION DEFICIT/HYPERACTIVITY DISORDER	ADHD
LEARNING DISABILITIES	LD
EXTREMELY PREMATURE (BEFORE 28 WEEKS)	ELGAN
EXTREMELY LOW BIRTHWEIGHT (< 1,000G)	ELBW

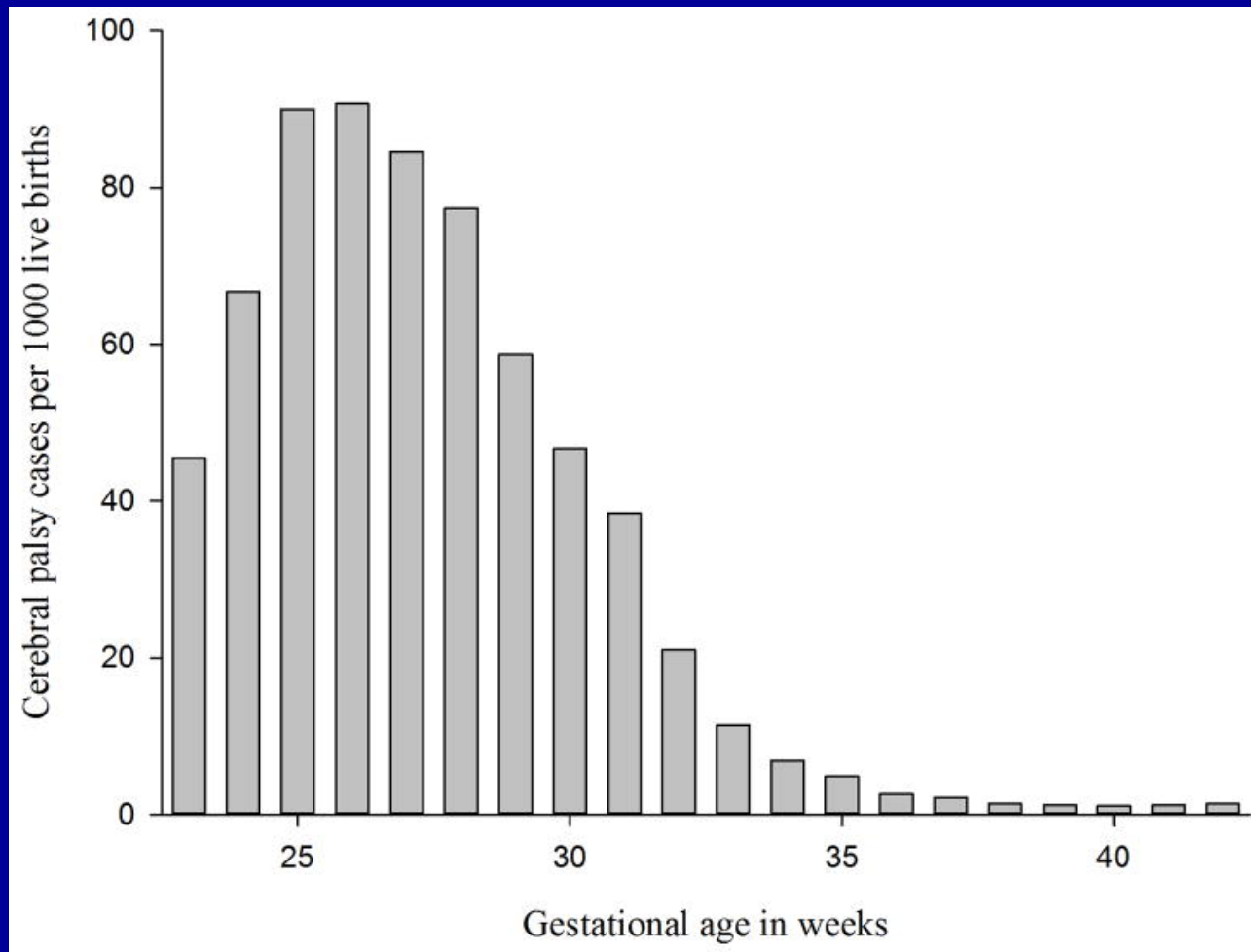
**AN IMPORTANT FACTOR IN THE
CHANGING EPIDEMIOLOGY OF
DEVELOPMENTAL DISABILITIES**

**IMPROVED SURVIVAL OF
PREMATURE INFANTS**

NUMBER OF CHILDREN < 1,000 G SURVIVING TO AGE ONE IN THE US 1960-2010



Data for 1960 based on white population only



Tronnes H, Wilcox AJ, Lie RT et al: Risk of cerebral palsy in relation to pregnancy disorders and preterm birth: a national cohort study. *Dev Med Child Neurol* 2014;56:779-85

PREVALENCE OF MAJOR DISABILITIES AMONG CHILDREN WHO HAD BEEN ELGAN/ELWB

- DISABLING CEREBRAL PALSY 8-10%
- SEVERE INTELLECTUAL DISABILITY 5-8%
- HEARING LOSS 1%
- VISION LOSS 3%
- EPILEPSY 2-3%
- AUTISM SPECTRUM DISORDER 5%
- ONE OR MORE OF ABOVE 20%

LESS SEVERE DEVELOPMENTAL DISABILITIES IN CHILDREN WHO HAD BEEN ELGAN/ELBW

ATTENTION DEFICIT/HYPERACTIVITY DISORDER	15-20%
MILD INTELLECTUAL DISABILITY	30%
HELD BACK IN SCHOOL OR NEEDS SPECIAL EDUCATION	50%

**EIGHT WAYS TO
PREVENT
DEVELOPMENTAL
DISABILITIES**

WHEN DO WE INTERVENE?

- BEFORE PREGNANCY (TWO INTERVENTIONS)
- IN PREGNANCY (TWO INTERVENTIONS)
- IN LABOR (ONE INTERVENTION)
- IMMEDIATELY AFTER BIRTH (TWO INTERVENTIONS)
- IN EARLY CHILDHOOD (ONE INTERVENTION)

TIME TO ACT	INTERVENTION	WHAT IS PREVENTED?
BEFORE PREGNANCY	1. RUBELLA IMMUNIZATION	Congenital rubella can damage the brain producing a variety of disabilities
	2. FOLIC ACID	Neural tube defects can lead to ID and CP
DURING PREGNANCY	3. PRENATAL SCREENING	Identifies chromosomal abnormalities and neural tube defects
	4. IODINE	Severe iodine lack leads to cretinism (ID, hearing loss and sometimes CP)
IN LABOR	5. MAGNESIUM SULFATE	Reduces the risk of CP in births < 32 weeks gestation
AT BIRTH	6. NEWBORN GENETIC SCREENING	Phenylketonuria and hypothyroidism are the screened conditions which cause ID
	7. HEAD OR BODY COOLING	Reduces the risk of CP in term newborns with perinatal asphyxia encephalopathy
IN EARLY CHILDHOOD	8. EDUCATION	Randomized trials of enhanced early education have shown improved school and cognitive performance in children, reducing the incidence of mild ID.

TWO INTERVENTIONS TO PREVENT MODERATE TO SEVERE INTELLECTUAL DISABILITY

Newborn genetic screening

Babies found to have phenylketonuria are put on a phenylalanine free diet, and babies with congenital hypothyroidism are treated with thyroid hormone. Both treatments reduce the prevalence of moderate to severe ID.

Følling, A: Zeitschrift für Physiologische Chemie. 1934: 227 (1-4): 169-181.

Grosse SD, Van Vliet G: Prevention of intellectual disability through screening for congenital hypothyroidism: how much and at what level? Arch Dis Child. 2011 Apr; 96(4):374-9.

Prenatal screening

Prenatal diagnosis can reduce the contribution of chromosomal abnormalities, neural tube defects and other conditions to moderate to severe ID.

Soler-Casas A, Sánchez-Díaz A, Morales-Peydró C: The impact of prenatal diagnosis on the prevention of chromosomal mental retardation. Chromosomal alterations that can be detected by prenatal diagnosis. Rev Neurol. 2006 Jan 7; 42 Suppl 1:S27-32

AN INTERVENTION TO PREVENT MILD INTELLECTUAL DISABILITY

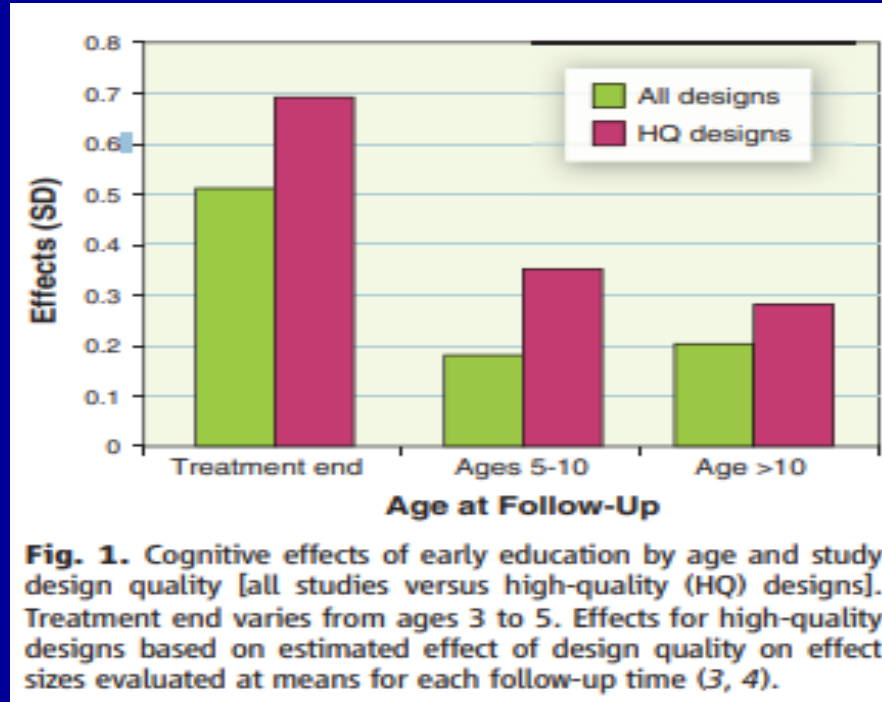
Early education and stimulation

Randomized trials of enhanced early education or even home visiting to work with mothers on infant and child stimulation have shown improved school and cognitive performance in at-risk children, reducing the incidence of mild ID.

Ramey CT, Ramey SL: Prevention of intellectual disabilities: early interventions to improve cognitive development. *Prev Med.* 1998 Mar-Apr;27(2):224-32.

Powell C, Grantham-McGregor S: Home visiting of varying frequency and child development. *Pediatrics.* 1989 Jul;84(1):157-64.

EFFECTS OF EARLY INTERVENTION ON IQ

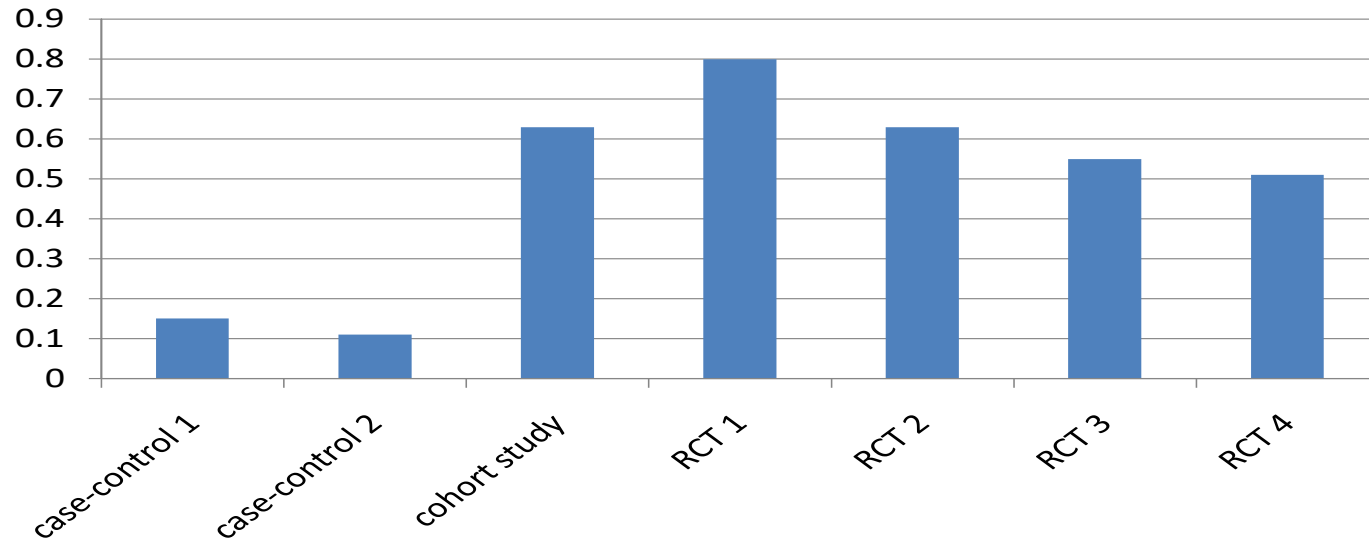


Barnett WS: Effectiveness of Early Educational Intervention. Science, August 19, 2011;333(6045):975-8

TWO INTERVENTIONS TO PREVENT CEREBRAL PALSY

Magnesium Sulfate in labor	Several trials confirm 30-35% reduction in CP in infants < 32 weeks gestation.
Doyle LW, Crowther CA, Middleton P: Antenatal magnesium sulfate and neurologic outcome in preterm infants: a systematic review. Obstetrics and Gynecology 2009 Jun;113(6):1327-33.	
Head or body cooling	Several trials confirm 25% reduction in CP in infants with neonatal encephalopathy and birth asphyxia.
Jacobs SE, Berg M, Hunt R: Cooling for newborns with hypoxic ischaemic encephalopathy. Cochrane Database Syst Rev. 2013 Jan 31;(1):CD003311.	

Odds Ratios relating Magnesium and CP: seven studies



OUTCOMES OF 7 HEAD/BODY COOLING TRIALS FOR NEONATAL ENCEPHALOPATHY

	Death RR	Disability RR	Combined RR
Azzopardi (2005)	0.94	0.76	0.86
Gluckman (2005)	0.87	0.75	0.82
Jacobs (2011)	0.64	1.13	0.77
Shankaran (2005)	0.66	0.84	0.73
Simbruner (2010)	0.62	0.47	0.57
Zhou (2010)	0.70	0.54	0.63
Zhu (2009)	0.76	0.49	0.52
POOLED (without adjustment)	0.75	0.73	0.74

INTERVENTIONS TO PREVENT MULTIPLE DISABILITIES

Rubella Immunization

Congenital rubella causes microcephaly, ID, hearing & vision loss, and, occasionally CP

Yoshimura M, Tohyama J, Maegaki Y: Computed tomography and magnetic resonance imaging of the brain in congenital rubella syndrome. No To Hattatsu. 1996 Sep;28(5):385-90.

Folic Acid

Periconceptional intake of folic acid can reduce the risk of neural tube defects by 60-70%. Some 15-20% of affected children have ID and close to 10% have CP. Folic acid may also prevent ASD.

Sutton M, Daly LE, Kirke PN. Survival and disability in a cohort of neural tube defect births in Dublin, Ireland. Birth Defects Res A Clin Mol Teratol. 2008 Oct;82(10):701-9.

Ozaras N, Yalcin S, Ofluoglu D: Are some cases of spina bifida combined with cerebral palsy? A study of 28 cases. Eura Medicophys. 2005 Sep;41(3):239-42.

Surén P, Roth C, Bresnahan M: Association between maternal use of folic acid supplements and risk of autism spectrum disorders in children. 2013 Feb 13;309(6):570-7.

Iodine

Endemic cretinism leading to severe ID, and sometimes to CP, remains a public health issue in several regions of the world.

Glinoe D: Feto-maternal repercussions of iodine deficiency during pregnancy. An update. Ann Endocrinol (Paris). 2003 Feb;64(1):37-44

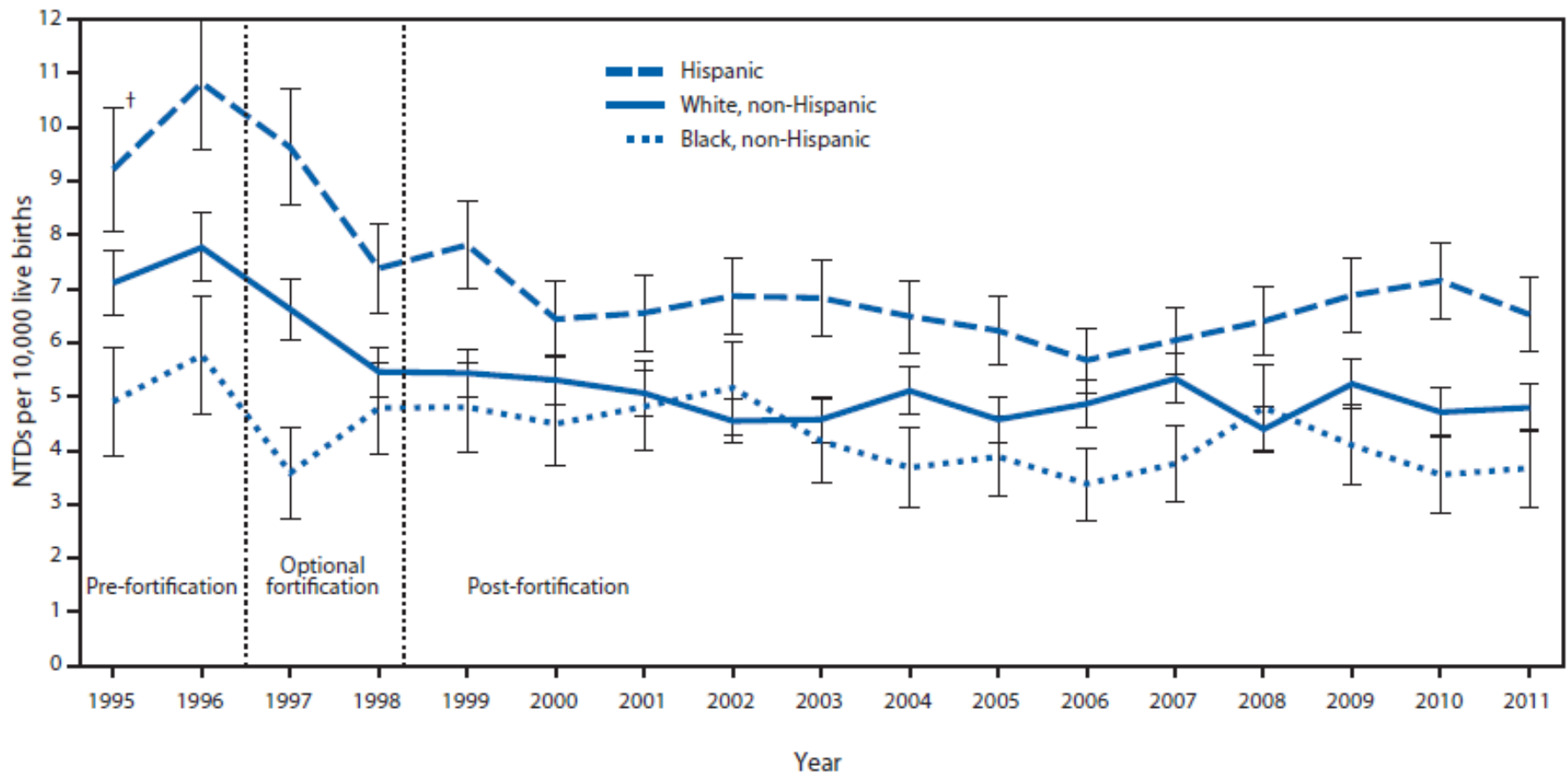
FOLATE AND NEURAL TUBE DEFECTS

Folic Acid	Other vitamins	N of Pregnancies	NTD cases	NTD Prevalence	Odds Ratio
+	-	298	2	6/593 = 1.0%	OR = 0.28 (0.12-0.71)
+	+	295	4		
-	+	302	8	21/602 = 3.5%	
-	-	300	13		

Source: Prevention of neural tube defects: results of the Medical Research Council Vitamin Study. MRC Vitamin Study Research Group. Lancet 1991;338:131-7 (July 20).

- In September 1992, CDC recommended that all women of childbearing age capable of becoming pregnant should consume 0.4 mg of folic acid per day to reduce the risk of NTD's.
- Beginning in 1998, the US mandated fortification of enriched cereal grain products with 140 μg of folic acid per 100 g. Canada, but not the UK, has also adopted mandatory folate fortification of grain.

BIRTH PREVALENCE OF NEURAL TUBE DEFECTS IN 19 POPULATION-BASED BIRTH DEFECTS SURVEILLANCE PROGRAMS IN US 1995 - 2011



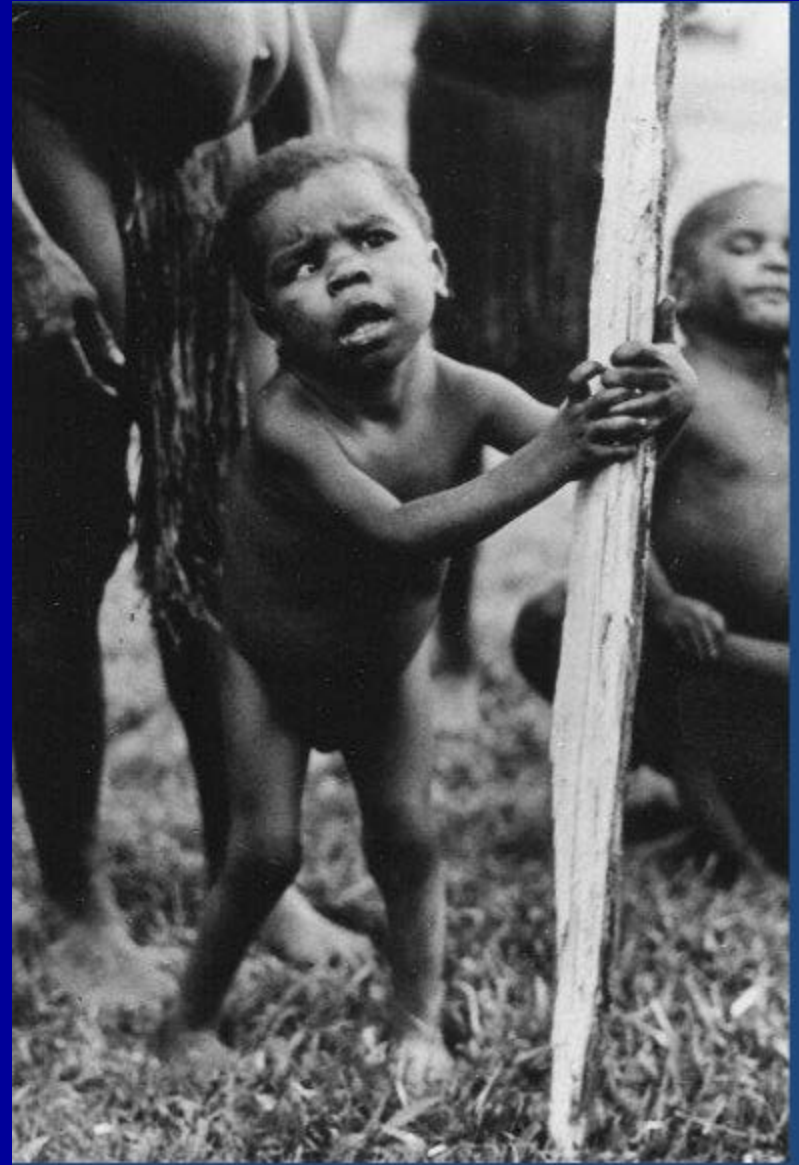
Source: MMWR: 2015; 64 (01); 1-5, January 16

THE CLASSIC TRIAD OF NEUROLOGIC ENDEMIC CREBINISM IN PAPUA-NEW GUINEA

1. SPASTIC DIPLEGIA
2. INTELLECTUAL DISABILITY
3. SENSORINEURAL HEARING LOSS

Severe Iodine deficiency combined with increased fetal/maternal demand produces maternal hypothyroidism during 2nd/3rd trimester of pregnancy.

Whether the child is hypothyroid or not depends on post-natal iodine supply.



TO SUMMARIZE

- Several opportunities exist for the prevention of developmental disabilities
- The time to intervene varies from pre-conception to early childhood
- Those of us who work in the world of developmental disability should forge links with general practitioners, obstetricians and pediatricians to remind them of these opportunities