1) Schooling and Gradients 2) Long-Run Impacts of Early-Life Nutrition

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1) Schooling and Gradients

Schooling thought to have important impacts on gradients.

Two simple empirical exercises to assess some dimensions of schooling impacts:

1. How much would more schooling targeted to poor reduce income inequality and poverty?
2. Do associations of schooling with health persist with within-MZ twin control for endowments?

1. How much would more schooling targeted to poor reduce income inequality and poverty?

- Income distribution of interest in itself.
- Also one channel through which schooling may affect health.
- Simulations for Chile, country with high inequality

Behrman, Jere R.,"How Much Might Human Capital Policies Affect Earnings Inequalities and Poverty?" *Estudios de Economia* 38:1 (June 2011), 9-42.

Semilog earnings & wage rate functions based on the 2004 SPS

Table 9. Weighted Semi-Log Earnings and Wage Functions for 51,244 Adults Age 21+ in 2004 Chilean SPS *

	Spline in Schooling			Pot Experience		Const	R sq
	Prim	**Sec**	**Ter**	**Level**	**Square**		**F**
ln Earnings	**0.040**	**0.102**	**0.235**	**0.040**	**-0.00048**	**12.412**	0.201
	5.31	*22.90*	*36.69*	*28.79*	*-22.50*	*286.00*	1009
xMale	**0.036**	**0.015**	**-0.038**			**0.169**	
	4.16	*2.84*	*-4.20*			*4.05*	
ln Wage	**0.039**	**0.104**	**0.227**	**0.022**	**-0.00030**	**5.481**	0.339
	9.06	*49.16*	*77.89*	*21.37*	*-16.44*	*220.08*	2810
xMale	**0.041**						
	30.42						

*t-statistics in italics beneath coefficient estimates; potential experience is age - schooling attainment - 6; the row with "xMale" includes all significant coefficients for the interaction between "male" and the right-side variable in that column

Simulation	Schooling Change	Target Pop	Added School Grades		Gini Coefficient Level	Gini Coefficient SE	Poverty Headcount "Low" Cutoff Level	"Low" Cutoff SE	"Higher" Cutoff Level	"Higher" Cutoff SE
base				Schooling	**0.23**	*0.001*	**0.18**	*0.002*	**0.30**	*0.002*
				Earnings	**0.53**	*0.003*	**0.20**	*0.002*	**0.36**	*0.002*
				Wage Rates	**0.49**	*0.003*	**0.17**	*0.002*	**0.33**	*0.002*
1	1 grade	Wage <400	17	Schooling	**0.24**	*0.001*	**0.17**	*0.002*	**0.29**	*0.002*
				Earnings	**0.53**	*0.003*	**0.19**	*0.002*	**0.34**	*0.002*
				Wage Rates	**0.48**	*0.004*	**0.15**	*0.002*	**0.33**	*0.330*
2	3 grades	Wage <400	51	Schooling	**0.22**	*0.001*	**0.14**	*0.002*	**0.26**	*0.002*
				Earnings	**0.51**	*0.003*	**0.18**	*0.002*	**0.32**	*0.002*
				Wage Rates	**0.47**	*0.004*	**0.11**	*0.001*	**0.32**	*0.002*
3	5 grades	Wage <400	85	Schooling	**0.21**	*0.001*	**0.13**	*0.002*	**0.23**	*0.002*
				Earnings	**0.50**	*0.003*	**0.16**	*0.002*	**0.30**	*0.002*
				Wage Rates	**0.46**	*0.004*	**0.08**	*0.001*	**0.29**	*0.002*
4	3 grades	wage <600	100	Schooling	**0.21**	*0.001*	**0.11**	*0.001*	**0.22**	*0.002*
				Earnings	**0.50**	*0.003*	**0.17**	*0.002*	**0.30**	*0.002*
				Wage Rates	**0.45**	*0.004*	**0.11**	*0.001*	**0.20**	*0.002*
5	3 grades	sch <=6	81	Schooling	**0.18**	*0.001*	**0.06**	*0.001*	**0.18**	*0.002*
				Earnings	**0.52**	*0.003*	**0.18**	*0.002*	**0.33**	*0.002*
				Wage Rates	**0.48**	*0.003*	**0.15**	*0.002*	**0.30**	*0.002*
6	3 grades	sch <=9	141	Schooling	**0.16**	*0.001*	**0.06**	*0.001*	**0.15**	*0.002*
				Earnings	**0.51**	*0.003*	**0.17**	*0.002*	**0.31**	*0.002*
				Wage Rates	**0.47**	*0.004*	**0.13**	*0.002*	**0.26**	*0.002*
7	to 6 grades	sch < 6	56	Schooling	**0.19**	*0.000*	**0.00**	*0.000*	**0.30**	*0.002*
				Earnings	**0.52**	*0.003*	**0.19**	*0.002*	**0.34**	*0.002*
				Wage Rates	**0.48**	*0.003*	**0.16**	*0.002*	**0.32**	*0.002*
8	to 9 grades	sch < 9	212	Schooling	**0.12**	*0.001*	**0.00**	*0.000*	**0.00**	*0.000*
				Earnings	**0.50**	*0.003*	**0.16**	*0.002*	**0.30**	*0.002*
				Wage Rates	**0.46**	*0.005*	**0.12**	*0.002*	**0.26**	*0.002*

2. Do associations of schooling with health persist with within-MZ twin control for endowments?

- Denmark, relatively equal income distribution and health system access.

Behrman, Jere R., Hans-Peter Kohler, Vibeke Myrup Jensen, Dorthe Pedersen, Inge Petersen, Paul Bingley and Kaare Christensen, 2011, "Does More Schooling Reduce Hospitalization and Delay Mortality? New Evidence Based on Danish Twins," *Demography* (DOI) 10.1007/s13524-011-0052-1.

$$H_{ij} = \beta_S S_{ij} + h_j + a_{ij} + v_{ij}, \tag{1}$$

$$S_{ij} = \alpha_h h_j + \alpha_a a_{ij} + \alpha_s a_{kj} + u_{ij}, \tag{2}$$

Table 5 Estimates of schooling coefficients for days hospitalized

		Standard			Within Twins		Within/Standard	
Dependent Variable		5%	MZ	DZ	MZ	DZ	MZ	DZ
Number of Hospital Days per Year	Coefficient	−0.056	−0.060	−0.053	0.005	−0.008	−0.083	0.145
	SE	0.005	0.020	0.012	0.034	0.028		
	t Statistic	−12.09	−3.06	−4.31	0.15	−0.28		
Number of Hospital Days per Year, up to 2 Years Prior to Death (or end of observation period)	Coefficient	−0.042	−0.050	−0.041	0.000	−0.027	0.010	0.650
	SE	0.003	0.012	0.008	0.025	0.014		
	t Statistic	−13.10	−4.03	−4.92	−0.02	−1.84		

Table 6 Linear probability estimates of schooling coefficients for mortality prior to 2003

		Standard			Within Twins		Within/Standard	
Gender, cohort		5%	MZ	DZ	MZ	DZ	MZ	DZ
Males, 1921–1935	Coefficient	−0.0084	−0.0108	−0.0076	0.0051	−0.0071	−0.471	0.935
	SE	0.0010	0.0046	0.0031	0.0084	0.0052		
	t Statistic	−8.58	−2.33	−2.47	0.60	−1.35		
Males, 1936–1950	Coefficient	−0.0070	−0.0056	−0.0091	−0.0012	−0.0035	0.218	0.383
	SE	0.0006	0.0022	0.0016	0.0040	0.0027		
	t Statistic	−11.44	−2.53	−5.75	−0.31	−1.28		
Females, 1921–1935	Coefficient	−0.0085	−0.0099	−0.0060	0.0127	−0.0006	−1.282	0.095
	SE	0.0010	0.0039	0.0031	0.0079	0.0055		
	t Statistic	−8.09	−2.52	−1.93	1.61	−0.10		
Females, 1936–1950	Coefficient	−0.0047	−0.0032	−0.0047	−0.0015	−0.0059	0.476	1.248
	SE	0.0005	0.0021	0.0014	0.0038	0.0026		
	t Statistic	−8.71	−1.52	−3.30	−0.40	−2.27		

Table 7 Estimated percentage changes with 1 SD increase in schooling attainment

	5% Sample	MZ Twins Within	DZ Twins Within
Hospital Days/Exposure	−9.8	1.0	−1.5
Hospital Days/Exposure < 2y Death	−7.4	−0.1	−5.0
Mortality by 2003			
Males, 1921–1935	−6.8	5.2	−6.0
Males, 1936–1950	−20.7	−4.5	−10.1
Females, 1921–1935	−8.4	16.3	−0.6
Females, 1936–1950	−19.6	−7.3	−27.6

Note: Based on means and SDs from Table 1 and estimates from Tables 5 and 6.

2) Long-Run Impacts of Early-Life Nutrition

1) Low Birth Weight

Behrman, Jere R. and Mark R. Rosenzweig, 2004, "Returns to Birthweight," *Review of Economics and Statistics* 86:2 (May), 586-601.

a) Comparison of effects controlling for "endowments"

b) Twin fixed effects do not necessarily mean reduction in coefficients

Variable	Schooling			BMI ($\times 10^{-3}$)		
	OLS	OLS	Within-MZ	OLS	OLS	Within-MZ
Fetal growth	0.313 (2.06)[a]	0.385 (2.76)[a]	0.657 (3.11)[b]	1.06 (2.04)[a]	0.903 (1.76)[a]	0.292 (0.39)[b]

Height			ln Wage		
OLS	OLS	Within-MZ	OLS	OLS	Within-MZ
1.52 (8.06)[a]	1.50 (8.07)[a]	1.48 (8.72)[b]	0.0269 (0.81)[a]	0.0329 (1.01)[a]	0.190 (2.47)[b]

2) Long-Run Impacts of Early Life Nutritional Supplementation in Malnourished Population

Community randomized supplementation trial (1969-1977) in 2 more populous and 2 less populous villages in El Progreso, **Guatemala**

Two villages (1 large, 1 small) received **atole**, a high protein-energy supplement; the other two (1 large, 1 small) received **fresco**, a less nutritive drink

Supplements were available to all twice daily throughout study at central locations in each village

Original study enrolled all children under age of 7 y in 1969 as well as newborns in1969-1977 (children were followed until 7 y of age or study end)

Formulae and nutrient content of the supplements per cup (180 ml)

	Atole	Fresco
Ingredients (g/180 ml)		
Incaparina	13.5	-
Dry skim milk	21.6	-
Sugar	9.0	13.3
Flavoring agent	-	2.1
Nutrients		
Energy (kcal/180 ml)	163	59
Protein (g/180 ml)	11.5	-

Both supplements contained vitamins and minerals equally per unit volume.

Supplement delivery

Key Subsequent Data Rounds

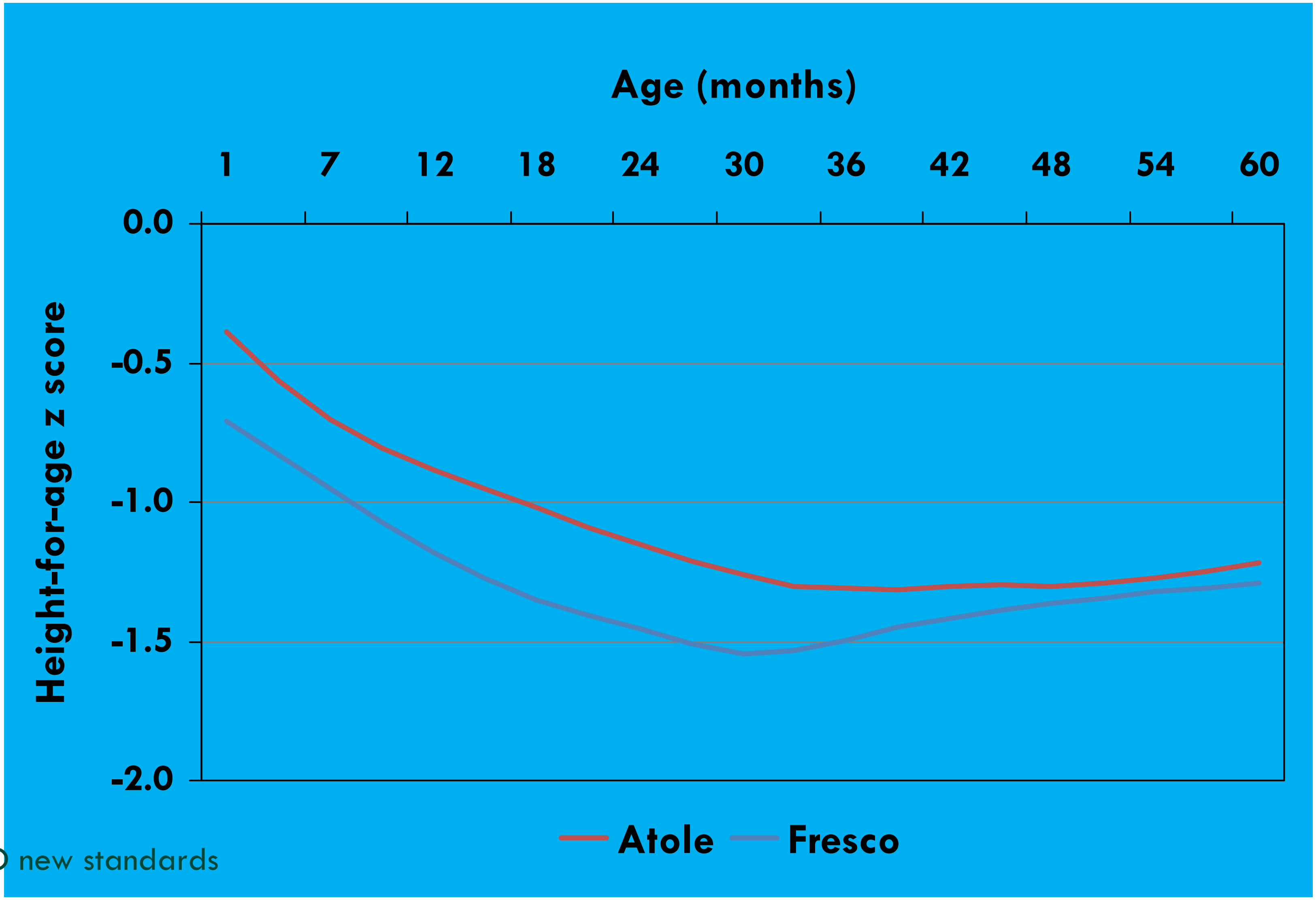
1988 Follow-up Study(FUS): Target population individuals in 1969-77 data collection, who were 11 to 26 y of age in 1988, in original villages and migrants to Guatemala City and to provincial capital.

2002-4 Human Capital Study (HCS): Target population individuals in 1969-77 data collection, who were 25-42 y of age, known or thought to be alive in Guatemala.

2006-7 Intergenerational Transfers Study (IGT): Target population individuals in 1969-77 data collection and HCS, who were 29-45 y of age, in or near original villages or Guatemala City with surviving parents.

Proportions lost to follow-up similar between individuals from the **atole** and **fresco** villages

Height-for-age z score* for children 0-5y in 2006-7 by maternal exposure to supplementation



* WHO new standards

Kernel-weighted local polynomial smooth

Impact on education of exposure to improved nutrition from 0–3 y of age*

Schooling attainment: Effects found for women only

- Improved by 1.2 grades (0.36 SD)

Reading: For men and women (25-42y), improved Inter-American Reading scores by 0.28 SD

Cognition: For men and women (25-42y), improved Raven's Progressive Matrices scores by 0.24 SD

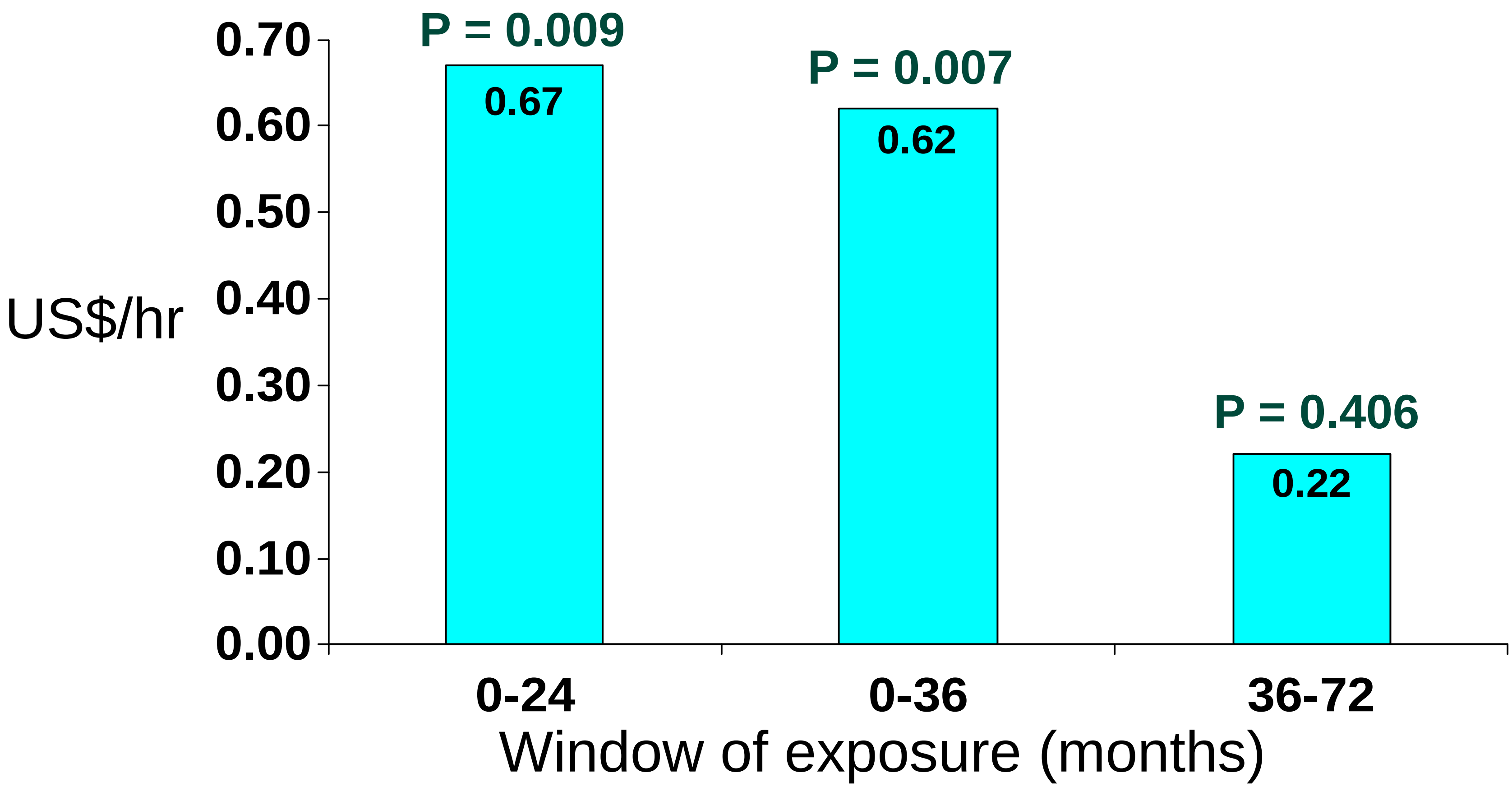
Maluccio J, Hoddinott J, Behrman JR, Martorell R, Quisumbing A, and Stein A. 2009 "The impact of improving nutrition during early childhood on education among Guatemalan adults ," Economic Journal 119 (April), 734–763.

Improved nutrition in early childhood and adult economic activity*

- Exposure to improved nutrition before, but not after 3 years, improved wage rates (income/hour) for men but not women.
- Exposure from 0–2 years had the greatest impact
  - Annual hours worked reduced by 222 (CI: -572 to 128)
  - Annual incomes were increased by $870 (CI: -$216, $1955)
  - Wages were increased by US $ 0.67 (CI: 0.16,1.17) or 0.45 SD

*Hoddinott J, Maluccio JA, Behrman JR, Flores R, and Martorell R. Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults. Lancet 2008; 371:411-16.

Exposure to improved nutrition in early childhood and income (in US$) earned per hour; n=602 men; age 25-42 y*



**Hoddinott J, Maluccio JA, Behrman JR, Flores R, and Martorell R. Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults. Lancet 2008; 371:411-16.*

Exposure to early childhood nutritional supplements & intergenerational effects*

Exposure for females, but not for males, affected their children 0-12 y. Significant increases in:

- Birth weight of 116 g (CI: 17 g to 215 g)
- Height 1.3 cm (CI 0.4 cm to 2.2 cm)
- Head circumference 0.63 cm (CI 0.37 cm to 0.89 cm)
- But NOT in weight, BMI, arm circumference, triceps and subscapular skinfold thicknesses

(Estimates robust to alternative treatments of standard errors and attrition.)

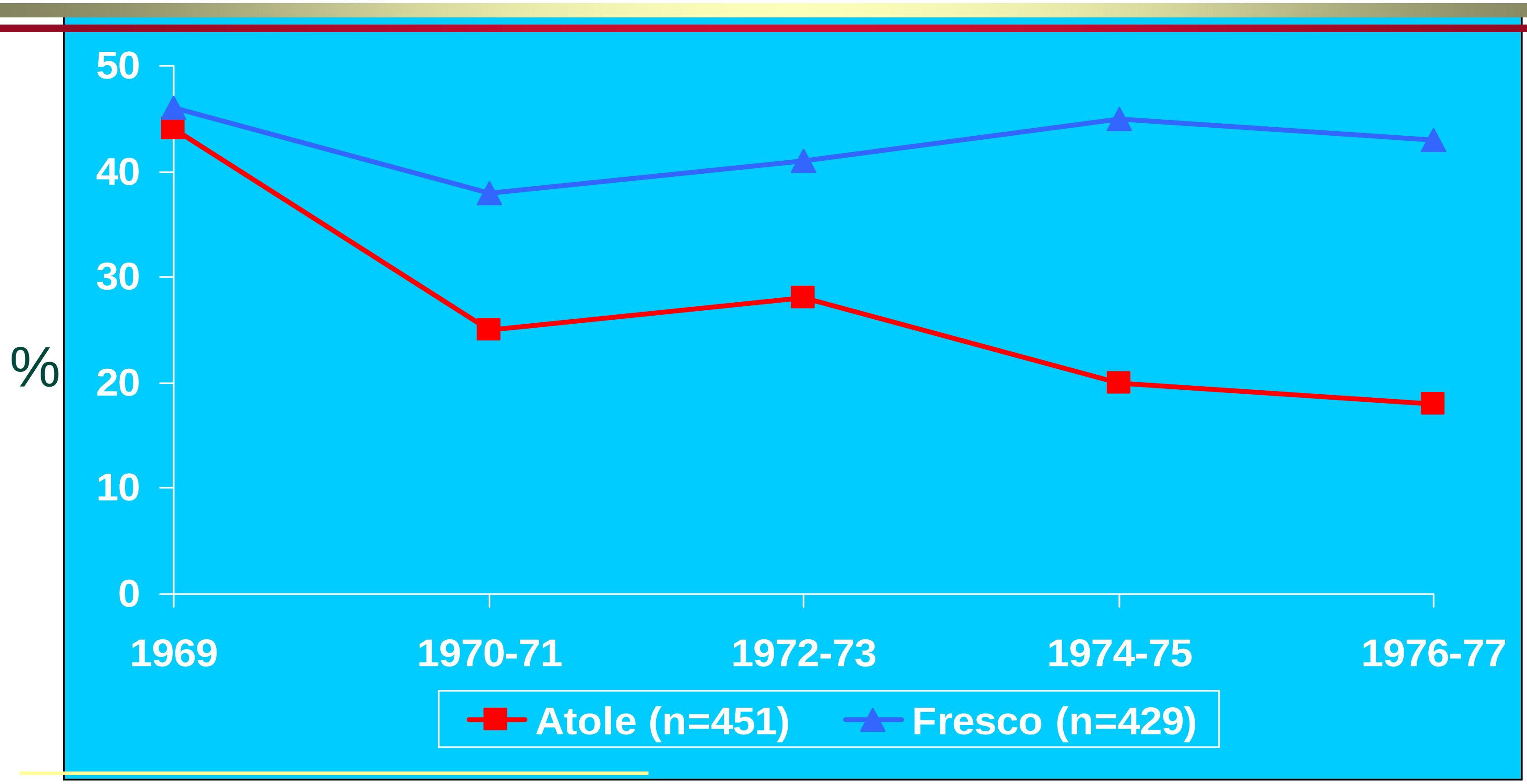
**Behrman JR, Calderon MC, Preston S, Hoddinott J, Martorell R and Stein A. 2009. "Nutritional Supplementation of Girls Influences the Growth of their Children: Prospective Study in Guatemala," American Journal of Clinical Nutrition .*

Boys versus girls

	Birth weight (grams)	Height (cm)	Head circumference (cm)	Height-for-age z score	Weight-for-age z score
			Boys [n=400]		
Mother's exposure to Atole	**123**	**2.04**	**0.56**	**0.38**	0.21
p-value	**0.05**	**p<0.01**	**p<0.01**	**p<0.01**	0.10
			Girls [n=391]		
Mother's exposure to Atole	106	0.60	**0.69**	0.14	0.20
p-value	0.11	0.34	**p<0.01**	0.21	0.11

Reduced-form estimates of impact of better supplementation in early life

% of children < 3 y with severe stunting (< -3 Z):



Martorell R. Overview of long-term nutrition intervention studies carried out in Guatemala (1968-1989). Food and Nutrition Bulletin 14(3):270-277, 1992.