

## Poverty and Obesity among Chronically Under-Nourished Preschool Children: What Explains the Paradox?

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## Outline

- Definition
- Motivation and goals
- Nutrition and health situation of the under-fives
- Empirical strategy and data
- Results
- Conclusions



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## Definition of Nutrition Indicator

- Wasting = WFH < -2SD. This indicates *recent* loss of weight from insufficient food intake or acute illness.
- Stunt = HAZ < -2SD indicates *chronic* food deprived or *chronic* illnesses
- Under-weight = WAZ < -2SD indicates insufficient food intake / illness either from *acute* or *chronic* cause.
- Obesity=BMI-for-age Z-score > 2SD ~ 97 percentile of BMI-for-age.



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## Motivation & Goals

- Malnutrition and overnutrition among the under-fives are associated with significant impaired developmental functioning resulting in ineffective investment in education and human capital which in turn weaken household's adaptive and coping capacity, and, hence, resilience.
- Poor health and nutrition status is a pathway through which poverty from one generation gets transmitted to the next.
- The World Bank argued that reducing malnutrition is a key to reduce poverty (Gillespie, McLachlan *et al.* 2003).



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## Motivation & Goals

- Our examination of the health and nutrition status among small children and infants found that Zambia simultaneously has had high prevalence of undernutrition and overnutrition.
- 80% of those individuals who were categorized as obese were also stunting.
- Our goal is to identify factors explaining this peculiar phenomenon, which may provide insight into forming appropriate policies to address both nutritional issues.



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## Zambia at a Glance



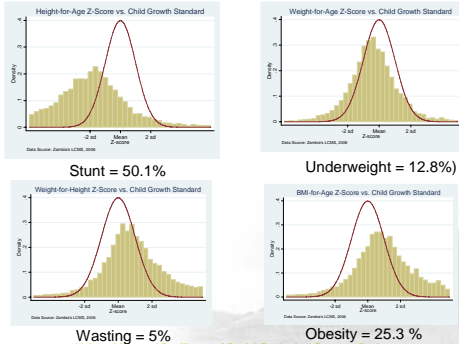
- Zambia was once one of the richest country in sub-Saharan Africa. Now, Zambia is one of the world's poorest countries. In 2007, her GDP per capita ranks the 151st from 179 countries (IMF, 2008).
- Real GDP per capita in 2006 was only 70 percent of that in 1976.
- Infant mortality rate (IMR) that was once dropped from 150 in 1950 to 89 in 1985 is now at 102 in 2006 (UNICEF, 2007).
- Zambia is undergoing de-urbanization process: 40% urban in 1990 to 34% urban in 2006.
- 85% of usually working population are in agricultural sector which is comprised largely of small scale farmers.



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## Nutrition & Health Situation



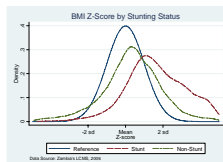
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## Characteristics of the Obese

Average Characteristics	Non-Obese	Obese
BMI-for-age z-score	0.19	3.19***
Height-for-age z-score	-1.20	-3.42***
Weight-for-age z-score	-0.69	0.06***
Age	28.80	26.91**
Child is male	0.48	0.48
Mother's years of education	5.74	5.57
Household head's years of schooling	7.08	6.82*
Have access to safe drinking water	0.32	0.29*
Early water/solid food introduction	0.35	0.36
Per capita expenditure	56,876	53,705
Share of non-food consumption expenditure	0.36	0.36
Urban area	0.29	0.25**
Distance to health center	7.07	7.29

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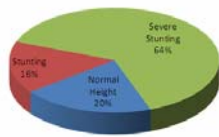
## Closer Look at Obesity



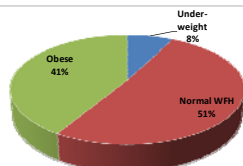
Obesity Prevalence of Stunted Children: = 37.4%

Obesity Prevalence of Non-Stunted Children: = 11.4%

### • By Height-for-Age

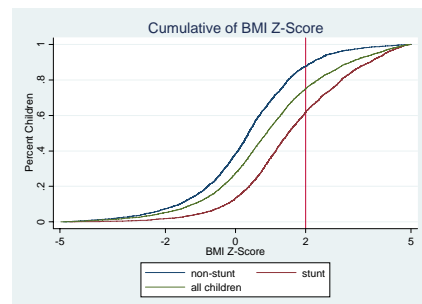


### • By Weight-for-Age/Weight-for-Height



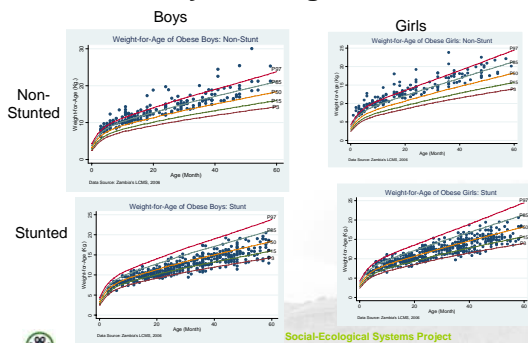
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## Prevalence of Child Obesity by Population Sub-Group



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## Weight-for-Age Distribution of the Obese by Stunting Status



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## Hypotheses Explaining Coexistence of Stunting and Overweight

- Seasonality growth hypothesis.
- Weaning practice and early solid food introduction hypothesis.
- Nutrition transition hypothesis (globalization of nutrition).
- Age overstatement hypothesis.

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## Empirical Strategy

Energy Balance = Energy Intake – Energy Expenditure

$$Weight_i = \alpha_0 + \alpha_1 C_i + \alpha_2 E_i + \epsilon_i \quad (1)$$

$$C_i = \beta_0 + \beta_1 X_i^C + \beta_2 X_i^P + \beta_3 Z_i + \mu_i \quad (2)$$

$$E_i = \gamma_0 + \gamma_1 X_i^C + \gamma_2 X_i^P + \gamma_3 Z_i + v_i \quad (3)$$

A reduced form model of child weight:

$$Weight_i = \delta_0 + \delta_1 X_i^C + \delta_2 X_i^P + \delta_3 Z_i + \xi_i \quad (4)$$

A reduced form probability model of child weight:

$$P(Weight_i > w_i^*) = \theta_0 + \theta_1 X_i^C + \theta_2 X_i^P + \theta_3 Z_i + \theta_i \quad (5)$$

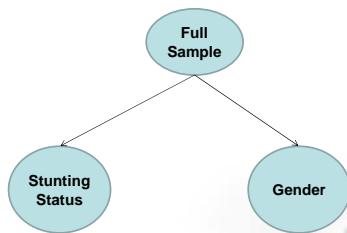


## Estimation Methods

- Bivariate probit and linear probability model using seemingly unrelated regression
- Quantile regression (Koenker and Bassett, 1978)
  - From 5<sup>th</sup> percentile-95<sup>th</sup> percentile
  - 10<sup>th</sup> percentile increment



## Quantile Regression: Estimation Strategy



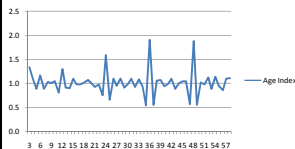
## Data & the Regression Equation

- Data: Living condition monitoring survey , Zambia, 2006
- LHS variable is obesity dummy = 1 if obese, and 0 otherwise in probability model
- LHS variable is BMIZ for quantile regression
- RHS variables are:
  - log of age in month,
  - sex = 1 if boy,
  - number of siblings to capture effect of household resource dilution
  - mother's education attainment 0-4, 5-7, 8-12 and 12+. The 0-4 is the reference group,
  - HH head's years of education
  - log of consumption per capita to proxy for income
  - TV and satellite TV expenditure to proxy for child physical activity,
  - early introduction of solid food and access to safe drinking water to proxy for child rearing and health practice ,
  - urban dummy = 1 if urban and 0 otherwise,
  - environmental factors include distance to health center to proxy for access to health care, smoking household
  - age heaping index to measure misreported age.

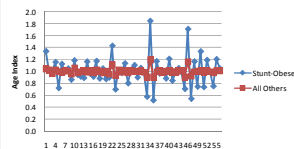


## Age Exaggeration Hypothesis

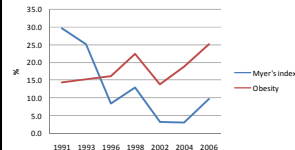
Age Index of All Children Combined



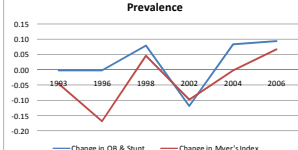
Age Index by Stunting-Obesity Status



Age Heaping and Prevalence of Child Obesity



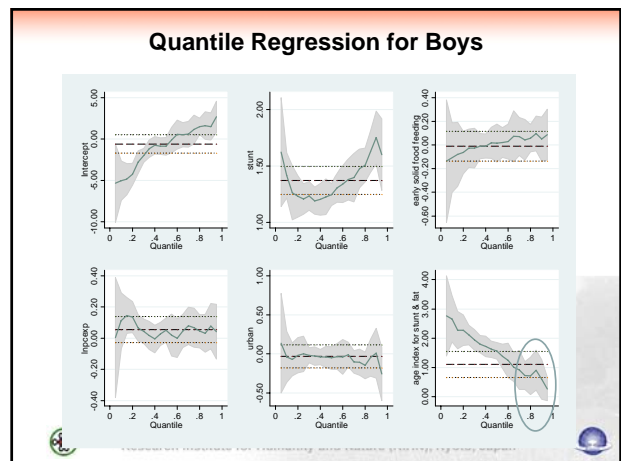
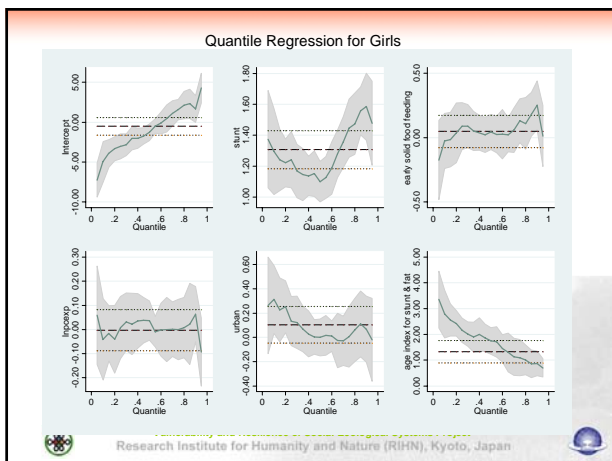
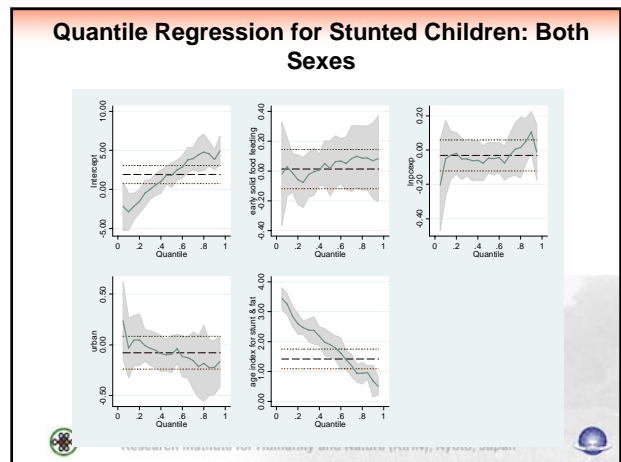
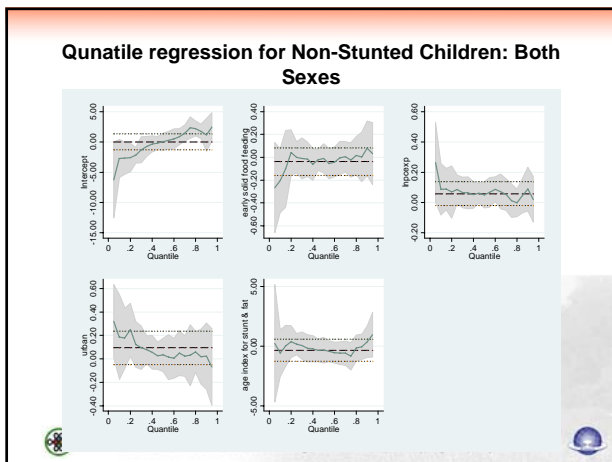
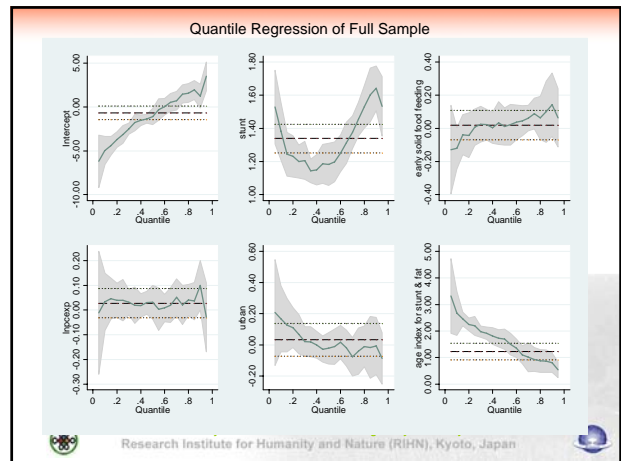
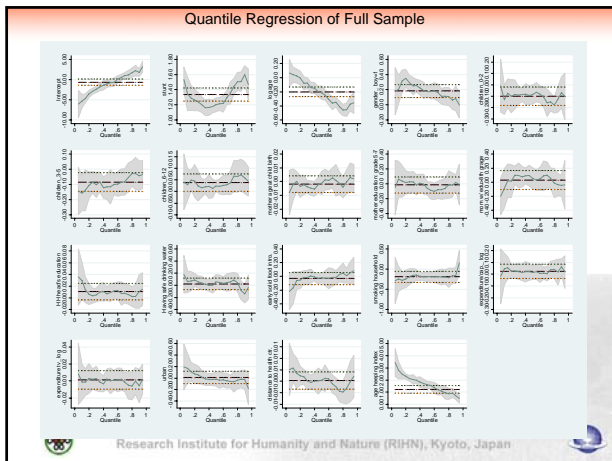
Changes in Myer's Index and Stunt-Obesity Prevalence



## Prevalence Model of Child Obesity

Explanatory Variables	Bivariate Probit		Seemingly Unrelated Reg	
	Obese Only	Obese & Stunt	Obese Only	Obese & Stunt
Early solid food introduction	-0.0234	-0.0679	-0.0011	-0.0178
Urban	0.0753	-0.1819 **	0.0082	-0.0424 **
Age heaping index	0.2916	1.1686 ***	-0.0248	0.4558 ***





### Quantile Regression Parameter Estimates of Selected Variables

Explanatory Variables	Quantile Regression					
	5 <sup>th</sup> Percentile	25 <sup>th</sup> Percentile	Median	OLS	75 <sup>th</sup> Percentile	95 <sup>th</sup> Percentile
Early solid food introduction	-0.2223	-0.0131	-0.0211	-0.1406 **	0.0300	0.0844
Boys	-0.2099	-0.0537	-0.0757	-0.1218	-0.0243	-0.0455
Girls	-0.3498 *	0.0679	0.0216	-0.1639 *	0.0626	0.0809
Urban	0.1945	0.0566	-0.0192	0.0200	-0.0677	-0.1794
Boys	-0.1820	-0.0151	0.0166	-0.1936 *	-0.1066	-0.4611 ***
Girls	0.4498 *	0.1619	-0.0095	0.2425 *	-0.0671	-0.0748
Age heaping index	3.4365 ***	2.1303 ***	1.6072 ***	1.0437 ***	0.9561 ***	0.4791 ***
Boys	3.5070 ***	2.0901 ***	1.4666 ***	0.9181 ***	0.7588 ***	0.3229 ***
Girls	3.2366 ***	2.0395 ***	1.8954 ***	1.1485 ***	1.1989 ***	0.6843 ***



### Summary of Key Findings

- Hypothesis testing of child obesity model is sensitive to methods used.
- Our evidence does not support the seasonal growth, early solid food introduction and nutrition transition hypothesis but strongly supports the age overstatement hypothesis.
- Our evidence tentatively suggests that the cultural factor of matrilineal bridal system may have been a driving force of age overstatement.
- The existence of age overstatement implies that prevalence of obesity, under-weight and stunt are overstated.
- Future survey must pay special attention in getting accurate ages.
- Impact of obesity is in a long-term but under-nutrition's impact is in a near term. It is safe for the Zambian government to focus limited resources on combating child under-nutrition while, at the same time, monitoring child obesity situation.

