HEALTH AND WAGES: EVIDENCE ON MEN AND WOMEN IN BRAZIL

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PROBLEM OF INTEREST

- Interested in the effect of health on the wages of men and women in urban Brazil, health can be seen as an investment in human capital, and the wages are returns of human capital investment in labor market.
- How should health be measured? Since there are different dimensions of health and they may have different effects on the wages;
- Is there any difference between men and women?
- Is there any difference for individuals with different jobs?

HEALTH MEASUREMENTS

- Overall individual health conditions in Brazil: given income, the country's investment levels in human capital are low in Brazil, and a high fraction of people are in poor health.

- Height: cumulative measure reflecting both investments in nutrition during one's life (mostly childhood) and nonhealth human capital investments;
- Body mass index (BMI): analyze weight given height. BMI has been shown to be related to maximum physical capacity independent of energy intake (Spurr, 1983; Martorell and Arroyave, 1988);
- Per capita calorie intake: inputs into the production function for current health;
- Per capita protein intake: many jobs may not require physical effort, the relationship between nutrition intakes and wages may be non-linear;

- These indicators do not fully capture health, but they do measure different dimensions of it.

FURTHER ISSUES

- Effects may vary with the nature of the activity, comparisons are drawn between those who work in the market sector and those who are self-employed, treating sectoral choices as endogenous.
- Eg: physical jobs vs. white collars

- Contrasts between men and women.
- Job type preferences might be different for males and females; physical ability requires are higher for males.

MODEL

$$\ln w = \omega(X_i, X_h, \bar{X}_c, \mu_i), \qquad h^* > 0,$$

- Two key issues:
- health status is multi-dimensional and difficult to capture;
- the direction of causality between health and wages.

- X_i: a vector of community-level characteristics;
- X_c: prices, local demand and infrastructure, and a productivity-related individual-specific unobservable (X_c bar is a subset of X_c);
- X_h: health measures;
- μ_i: unobservables;

- Adopt an instrumental variables estimator, characteristics which affect health but wages are valid, since the measures of health used below are all related to food and nutrition, they used as instruments relative food prices.

DATA

- Estudo National da Despesa Familiar (ENDEF);
- Collected from Aug. 1974-Aug. 1975 in Brazil;
- Gathered detailed information from about 53000 households on incomes, expenditures, and socio-demographic characteristics;
- Respondents aged 25-50;
- Since self-employment income in difficult to measure, especially in rural sector, they restricted sample to urban sector, including 16169 men and 17925 women.

DATA

- Construct relative food prices:

- 1.create unit prices for foods from the expenditure and quantity data;
- 2.take median prices for 135 commodities for market areas defined by state and by whether the urban area is metropolitan;
- 3.create Tornquist indices for 15 commodity groups, including 11 food groups, ten of the food price indices are used as instruments for BMI and nutrient intakes.

EMPIRICAL RESULTS

- The coefficients of relative prices for BMI, calorie intakes and protein intakes are all significant, the instruments are valid since it has significant impact on health measurements and by assumption doesn't directly influence income.

Table 1
First-stage *F*-statistics for significance of identifying instruments

	Males			Females		
	BMI	Calorie intakes	Protein intakes	BMI	Calorie intakes	Protein intakes
Prices & nonlabor income	11.7	10.7	20.6	10.3	15.1	34.6
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Prices	13.5	14.1	23.7	14.4	18.0	29.7
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Nonlabor income	6.5	1.9	12.2	0.2	8.6	43.9
p-value	(0.00)	(0.12)	(0.00)	(0.92)	(0.00)	(0.00)
R^2	0.07	0.16	0.16	0.09	0.16	0.17

Table 2
Males in market sector: Impact of health characteristics on ln(wages)

Covariates	No health (1)	Height only (2)	Add BMI (3)	Add calories (4)	Add protein (5)	All health (6)
ln(height)	.	2.431 (0.17)	2.407 (0.17)	2.832 (0.44)	1.437 (0.29)	3.921 (0.98)
ln(body mass index)	.	.	2.223 (1.08)	.	.	4.740 (2.29)
ln(per capita calories)	.	.	.	88.763 (35.94)	.	163.759 (74.75)
– squared	.	.	.	– 5.860 (2.37)	.	– 10.964 (4.96)
ln(per capita protein)	.	.	.	.	27.537 (13.67)	– 28.848 (29.73)
– squared	.	.	.	.	– 2.049 (1.06)	2.301 (2.29)
Education						
(1) literate	0.398 (0.02)	0.391 (0.02)	0.338 (0.03)	0.262 (0.07)	0.201 (0.06)	0.223 (0.08)
(1) elementary	0.830 (0.03)	0.803 (0.02)	0.709 (0.05)	0.636 (0.09)	0.484 (0.08)	0.515 (0.10)
(1) secondary +	1.867 (0.03)	1.791 (0.03)	1.642 (0.09)	1.606 (0.12)	1.372 (0.10)	1.338 (0.13)
Hazard rate	0.337 (0.12)	0.140 (0.12)	0.041 (0.13)	0.222 (0.13)	0.215 (0.14)	0.104 (0.20)
Tests for						
Endogeneity	.	.	329.34 (0.00)	123.60 (0.00)	297.74 (0.00)	882.07 (0.00)
Overidentification	.	.	27.98 (0.00)	19.61 (0.00)	17.85 (0.00)	6.17 (0.00)
Joint significance						
Education *p*-value	6019.83 (0.00)	5643.11 (0.00)	675.28 (0.00)	692.87 (0.00)	483.49 (0.00)	146.75 (0.00)
Calories *p*-value	.	.	.	6.10 (0.05)	.	7.78 (0.02)
Protein *p*-value	.	.	.	.	21.59 (0.00)	9.68 (0.01)
Nutrients *p*-value	.	.	.	6.10 (0.05)	21.59 (0.00)	25.33 (0.00)
BMI & Intakes *p*-value	.	.	.	.	.	27.02 (0.00)
All health *p*-value	.	202.47 (0.00)	196.64 (0.00)	140.57 (0.00)	183.71 (0.00)	108.54 (0.00)
All covs *p*-value	64166.54 (0.00)	68825.11 (0.00)	65027.27 (0.00)	47622.54 (0.00)	61065.45 (0.00)	26345.47 (0.00)

Column 2-6 include height since this measurement can be seen as exogenous and they add BMI, calories intake, and protein intake one by one.

Height, BMI, calories intake, and protein intake all have positive effect on ln(wages), the negative coefficients for quadratic terms indicates that the marginal effect is falling.

The inverse effect of protein intake after including all health measurements indicates that the effect of protein intakes works through ways like BMI and calories intake, after controlling that, extra protein intake might have a negative effect.

Table 2
Males in market sector: Impact of health characteristics on ln(wages)

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ln(per capita calories)	.	.	.	88.763 (35.94)	.	163.759 (74.75)
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ln(per capita protein)	.	.	.	.	27.537 (13.67)	– 28.848 (29.73)
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Hazard rate	0.337 (0.12)	0.140 (0.12)	0.041 (0.13)	0.222 (0.13)	0.215 (0.14)	0.104 (0.20)
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Joint significance						
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Calories *p*-value	.	.	.	6.10 (0.05)	.	7.78 (0.02)
Protein *p*-value	.	.	.	.	21.59 (0.00)	9.68 (0.01)
Nutrients *p*-value	.	.	.	6.10 (0.05)	21.59 (0.00)	25.33 (0.00)
BMI & Intakes *p*-value	.	.	.	.	.	27.02 (0.00)
All health *p*-value	.	202.47 (0.00)	196.64 (0.00)	140.57 (0.00)	183.71 (0.00)	108.54 (0.00)
All covs *p*-value	64166.54 (0.00)	68825.11 (0.00)	65027.27 (0.00)	47622.54 (0.00)	61065.45 (0.00)	26345.47 (0.00)

A 1% increase in the height is associated with a 2.4% increase in his wage.

The elasticity for BMI is 2.2. The effect of going from the bottom decile of predicted BMI 20, to the top decile 24, is associated with an increase in log wages of 0.4.

At the bottom quartile of per capita calories (1700) the elasticity is 1.6, but it diminishes rapidly and turns negative around 1950 calories per day.

A 1% increase in protein is associated with a 1.9% rise in wages and the elasticity falls to about 0.2 at the top quartile.

MALES IN MARKET SECTOR

Dependent
Log(wages)

Covariates	Baseline (1)
ln(height)	3.921
	(0.98)
ln(body mass index)	4.740
	(2.29)
ln(per capita calories)	163.759
	(74.75)
– squared	– 10.964
	(4.96)
ln(per capita protein)	– 28.848
	(29.73)
– squared	2.301
	(2.29)
Hazard rate	0.104
	(0.20)

the elasticities of wages for height, BMI index and per capita calories are positive, while the elasticity for per capita protein intake is negative, in consistent with earlier results.

Males and females: Self-employed and market sector workers

Covariates	Males, self-employed		Females, market sector		Females, self-employed	
	Hgt & BMI (1)	All health (2)	Hgt & BMI (1)	All health (2)	Hgt & BMI (1)	All health (2)
ln(height)	3.085	3.580	2.089	2.458	2.003	− 1.002
	(0.41)	(1.50)	(0.32)	(0.67)	(1.49)	(3.40)
ln(body mass index)	4.943	5.177	1.292	− 0.412	0.516	− 3.918
	(1.52)	(2.78)	(0.78)	(1.44)	(3.43)	(6.37)
ln(per capita calories)	.	113.431	.	186.68	.	68.686
		(101.85)		(75.11)		(244.57)
– squared	.	− 7.547	.	− 12.415	.	− 4.405
		(6.76)		(4.94)		(16.06)
ln(per capita protein)	.	− 10.910	.	− 54.237	.	− 51.579
		(40.51)		(30.62)		(103.81)
– squared	.	0.901	.	4.303	.	4.124
		(3.12)		(2.37)		(103.81)
Education						
(1) literate	0.520	0.400	0.447	0.368	0.409	0.344
	(0.07)	(0.12)	(0.05)	(0.10)	(0.20)	(0.50)
(1) elementary	0.958	0.759	0.976	0.801	0.774	0.461
	(0.09)	(0.17)	(0.05)	(0.15)	(0.17)	(0.74)
(1) secondary	1.762	1.469	2.081	1.716	1.720	1.039
	(0.13)	(0.21)	(0.08)	(0.26)	(0.31)	(0.90)
Hazard rate	− 0.496	− 0.532	0.155	− 0.177	1.109	1.023
	(0.18)	(0.22)	(0.11)	(0.19)	(0.80)	(1.17)
Endogeneity	205.68	404.09	12.30	148.88	36.00	149.77
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Overidentification	4.60	2.66	4.74	1.23	3.87	1.21
p-value	(0.00)	(0.00)	(0.00)	(0.24)	(0.00)	(0.26)
Joint significance						
Education	226.56	71.28	875.82	44.01	42.02	2.64
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.45)
Calories	.	1.33	.	14.50	.	0.29
p-value		(0.51)		(0.00)		(0.87)
Protein	.	2.54	.	17.16	.	1.35
p-value		(0.28)		(0.00)		(0.51)
Nutrients	.	6.57	.	21.26	.	1.97
p-value		(0.16)		(0.00)		(0.74)
BMI & Intakes	.	16.54	.	22.71	.	1.98
p-value		(0.01)		(0.00)		(0.85)
All health	70.57	62.83	48.16	60.57	2.23	3.98
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.33)	(0.68)
All covs	16553.74	12889.18	16730.04	12599.46	399.23	309.67
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Sample size	4403		4948		2653	

The coefficients for height and BMI are larger for employed men and smaller for females, indicate that the returns to strength for males are higher, and the physical ability is more important for men.

The effects of calories and protein intakes for market sector females are larger than the effects for self-employed males and females, suggesting that higher nutrition diet might have positive effect on wages for females, and the over amount intake of protein would have serious negative effect.

Table 5
Males and females: Effect of health on ln(wages) by level of education

	Males: Education level				Females: Education level			
	Illiterate (1)	Literate (2)	Completed elementary (3)	Completed secondary (4)	Illiterate (1)	Literate (2)	Completed elementary (3)	Completed secondary (4)
ln(market wage)								
ln(height)	1.265	1.940	2.096	4.164	1.842	2.605	1.081	1.580
	(2.48)	(6.86)	(5.17)	(7.42)	(2.49)	(4.11)	(1.36)	(2.95)
ln(body mass index)	3.100	1.148	− 0.460	1.302	2.611	2.925	− 2.676	− 0.693
	(2.51)	(1.22)	(0.31)	(0.41)	(2.17)	(2.53)	(1.03)	(0.53)
χ^2(Hgt & BMI)	10.32	47.35	26.79	75.95	8.53	16.96	8.73	12.93
p-value	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)
χ^2(All covs)	2070.16	19003.02	15767.92	22143.89	223.33	1033.62	1878.42	12758.38
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Sample size	1159	4161	2977	2378	658	1488	1088	1714
ln(self-employment wage)								
ln(height)	4.023	2.627	3.080	2.376	0.770	2.302		3.263
	(3.45)	(4.70)	(3.93)	(2.52)	(0.68)	(2.74)		(2.68)
ln(body mass index)	5.590	3.126	2.221	3.633	2.916	1.487		− 3.477
	(2.30)	(2.11)	(0.97)	(1.03)	(1.49)	(0.77)		(0.03)
χ^2(Hgt & BMI)	16.72	24.14	17.31	9.15	2.55	7.80		11.72
p-value	(0.00)	(0.00)	(0.00)	(0.01)	(0.28)	(0.02)		(0.00)
χ^2(All covs)	358.42	4051.00	4638.68	5910.62	97.60	252.34		669.84
p-value	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)		(0.00)
Sample size	550	1943	1121	789	568	1225		860

Among men in the market sector, the return to stature tends to rise with education. Among women working in the market sector, there is no clear pattern in the return to stature across the education distribution.

- Comment:
- Classic case with health and income; similar studies with beauty premium----would you earn higher when you are prettier?

- Critiques:
- The sample used for estimating effect of health on ln(wages) by level of education and by gender is quite small and may not be representative.
- Instead of elasticity format, it makes more sense to use plain health measurement and log form of wages, “one’s income would go up by y% when he is 1cm higher”. But elasticity is more precise and does rely on the value of variables.