How Do Life Course Measures of Inequality Relate to Subjective vs. Objective Health Measures?

Sepideh Modrek
University of California at Berkeley
smodrek@berkeley.edu

William H. Dow
University of California at Berkeley
wdow@berkeley.edu

Extended Abstract:

Background

This study aims to look at the association of multiple measures of area level income inequality and health over a 30 year period and comparing subjective and objective measures of health in a particularly interesting setting, Costa Rica. Costa Rica's GDP/capita is quarter of that of the Unites States, yet it has a lower rate of infant mortality and a higher life expectancy than the US while spending a tenth per capita on health. It is also an anomaly amongst other Latin American countries in that it has a much higher HDI than its neighbors. Many different hypotheses have been put forward about why Costa Ricans are so healthy. Some argue that the universal health insurance and other health system traits explain these results. Others argue that it is because of the equalitarian social structure lack of wide spread inequality that lead to these outcomes. Yet, the gini coefficient for Costa Rica is quite similar to that of the US (46.5 versus 45 according to the CIA). Moreover, very few studies have looked at the relationship between inequality and health in a middle-income country. Exploiting a survey that combines physiological measures, or biomarkers, with traditional demographic and economic variables, we will look at the association of health and inequality in this unique setting.

Data

Data for this analysis come from three sources. The majority of data comes from the Costa Rican Study on Longevity and Healthy Aging (CRELES), an on-going longitudinal study of a nationally representative sample of about 9,000 adults aged 60 and over and residing in Costa Rica in the year 2000, with over-sampling of the oldest old and with an in-depth, longitudinal survey in a subsample of about 3,000 of them. All heath variables and most SES and demographic controls come from the subsample of this survey.

The area level inequality measures come from two different sources. The 10% subsample of the 1973 Census in Costa Rica was used to generate the 1973 canton level inequality measure, while the 2005 inequality measure comes from July 2005 Household Income Survey (Encuesta de Hogares: http://encuestas.ccp.ucr.ac.cr/cgi-bin/hogares.pl)

Dependent variables—health outcomes

We study two dependent variables:

1. Objective Health Measures:

    - Cardiovascular Health: This paper uses an abbreviated Allostatic Load (AL) construct that includes only AL measures that are closely related to cardiovascular health and metabolic syndrome.[1] They include high systolic and diastolic blood pressure, high waist to hip ratio, High cholesterol ratio (total cholesterol to HDL cholesterol), high Glycosilated hemoglobin, high HDL cholesterol, and low dehydroepiandosterone sulfate (DHEA-S). Since there is no standard for biomarker values that correspond to different risk levels especially across different populations, many define risk as above or below distribution percentiles (e.g. 10th, 25th, 75th, 90th). This paper presents results using the 25th and 75th percentile as cut-offs. Subjects can then be assigned 1 point on eight biomarkers if they have high-risk values, AL scores can range from 0-8. The log of the score is the dependent variable in a linear regression, thus the coefficients can be interpreted as elasticity.

2. Subjective Health Measure:
    - Self-Reported Health (SRH): Ordinal self-rated general health status. From the five possible answers we took the two lowest (mala and regular) as defining poor-SRH

Independent variables

1. Area level Inequality and Mean Income:
    - CV of inequality: The coefficient of variation (SD/Mean) on income was calculated for 1973 and 2005. The 1973 measure is at that canton level since we only have information on the canton of residence in 1973 and not the district.[2] The 2005 measure is calculated at the district level.
    - Mean Income: The mean of area level income in calculated at the canton level in 1973 and at the district level in 2005.

2. SES Control
    - Childhood Wealth: The CRELES asked specific information on childhood living standards. We use a binary variable whose value is one if as a child the individual had 3 of the four following items: shoes, a latrine in there home, a bed, or electricity.
    - Current Income: The CRELES provides an monthly income measure
    - Education: Educational attainment is measured in three naturally defined groups: (1) None, (2) Elementary (1 to six grades), and (3) some secondary (post-elementary) school or higher.

[1] Allostasis refers to the idea that the body must constantly adapt itself to changing environmental demands in order to achieve homeostasis. Allostatic load (AL) is meant to measure repeated "wear and tear" which may lead to dysregulation on the body. AL is considered a pre-cursor to an eventual disease state (McEwen 1998).
[2] There has been some minor changes in canton defintion since 1973.

- Urban: This is a binary variable indicating whether one lives in an urban area.

3. Demographic Controls
    - Age, age squared, sex, age interacted with sex, marital status (whether or not currently married and including consensual unions), and being born in March or April, which earlier studies have shown increases the risk of death at old ages in Costa Rica (Rosero-Bixby, 2005) were included as controls.

Methods

We used log-log linear regression to estimate the effects of inequality on our objective health measure and a logistic regression to estimate the effects on inequality on our binary subjective health measure. Since income inequality is a contextual variable and measured for the group, the assumption is that our error is independently and identically distributed may be violated. Therefore we present both clustered standard errors as well as robust ones in the regressions. Also, since we have only 530 observations random effects models were run for our preferred specification to get more efficient estimate the effect of lagged and current area level inequality on subjective and objective measures of health. The models also control for confounding demographic and SES effects.

Results

Table 1 presents the means of variables of interest and compares them for our analytical sample and the entire sample. Our analytical sample included 532 or 530 adults, age 60 to 100, for whom complete information on all variables of interest was available. Comparing means we find that our sample is different from the entire population in that it is unhealthier, younger, wealthier, more educated and more urban than the entire population. Thus we are concerned with some selection issues in this sample.

Table 2 presents the regression results for our objective health measure and inequality. It seems that current inequality is robustly associated with health. The magnitude indicates that a 1% increase in the CV of inequality will lead to a 0.2% decrease in the ones allostatic load index. The magnitude is similar to that of having no formal education and robust across models and estimators. The relationship between lagged inequality and health is has a similar but insignificant magnitude as current inequality in the first four models. This maybe due to measurement error because lagged inequality is measured at the canton level as opposed to the district level. Using a more efficient estimator in the final specification, it is has a similar magnitude to current inequality and is also significant.

Table 3 presents the regression results for our subjective health measure and inequality. Again current area district level inequality is robustly associated with self-reported health. The magnitude implies that a 1-unit change in the CV of area inequality is associated with 3.5 higher odds of reporting that you are in poor health. The magnitude is large and consistent regardless of the controls and is either significant or marginally significant depending on the controls. The relationship between lagged inequality and health always insignificant.

Table 1: Summary Statistics for the full sample and the analytical sample

Table 1	Analytical Sample					Full Sample				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
SRH (1=bad)	530	0.468	0.499	0	1	2813	0.500	0.500	0	1
AL_load	532	2.143	1.164	1	6	2025	1.586	1.331	0	6
age	532	4.205	8.277	-10	30	2827	6.372	10.238	-10	39
age sq	532	86.058	134.140	0	900	2827	145.372	225.405	0	1521
male	532	0.485	0.500	0	1	2827	0.457	0.498	0	1
age x male	532	2.086	6.404	-10	30	2825	2.895	7.571	-10	39
married	532	0.477	0.500	0	1	2817	0.498	0.500	0	1
Month of birth	532	0.177	0.382	0	1	2751	0.171	0.376	0	1
No education	532	0.137	0.344	0	1	2825	0.187	0.390	0	1
Post secondary	532	0.171	0.377	0	1	2825	0.139	0.346	0	1
Childhood Wealth	532	0.233	0.423	0	1	2115	0.217	0.412	0	1
Urban	532	0.688	0.464	0	1	2827	0.602	0.490	0	1
Income_05	532	111.442	151.329	5	950	2609	74.921	115.885	0	998
CV Inequal 2005 dist	532	0.759	0.177	0	2	2474	0.755	0.212	0	2
CV Inequal 1973 canton	532	1.112	0.297	1	2	1670	1.111	0.293	1	2
Mean canton income 1973	532	655.938	223.205	1	1090	1670	625.040	215.207	1	1090
Mean dist income 2005	532	332034	141176	97262	1224600	2475	322850	146551	53650	1511904
Log(CV inequality 2005)	532	-0.305	0.253	-1.571	0.610	2474	-0.322	0.294	-1.645	0.643
Log(CV inequality 1973)	532	0.072	0.263	-0.657	0.806	1670	0.072	0.258	-0.657	0.907
Log(Mean income 05)	532	12.629	0.415	11.485	14.018	2475	12.587	0.452	10.890	14.229
Log(Mean income 1973)	532	6.323	1.020	-0.693	6.994	1670	6.307	0.868	-0.693	6.994

Table 2: Relationship of objective health and inequality. First four columns use OLS regression while the 5th column uses as random effects model. Robust standard errors are in grey. Clustered standard errors are listed below.

Table 2

Dependent Variable: Log(Allostatic Load)	Inequality and Area Income	Demographic Controls	SES Controls	Both controls	Random Effects
Log(Income 2005)			-0.040	-0.060	-0.04
			-0.030	(0.03)+	-0.03
			-0.030	(0.03)+	
Childhood Wealth Dummy			0.020	0.030	0
			-0.070	-0.070	-0.06
			-0.050	-0.050	
Log(CV of canton level inequality 1973)	-0.130	-0.130	-0.129	-0.136	-0.22476
	-0.111	-0.111	-0.114	-0.115	(0.09216)*
	-0.092	-0.088	-0.083	(0.08031)+	
Log (CV of district level inequality 2005)	-0.200	-0.180	-0.200	-0.180	-0.19
	(0.09)*	(0.09)*	(0.09)*	(0.09)+	(0.09)*
	(0.10)+	(0.10)+	(0.11)+	-0.110	
Log(mean of 2005 district level income)	0.110	0.100	0.110	0.110	0.06
	-0.070	-0.070	-0.080	-0.080	-0.07
	-0.080	-0.080	-0.090	-0.100	
Log(mean of 1973 district level income)	-0.050	-0.040	-0.050	-0.050	-0.02
	(0.02)*	(0.02)+	(0.02)*	(0.03)+	-0.02
	(0.01)**	(0.01)**	(0.01)**	(0.01)**	
Education (None)			-0.100	-0.140	-0.15
			-0.080	(0.08)+	(0.07)*
			-0.070	(0.07)*	
Education (Secondary)			0.040	0.040	-0.04
			-0.080	-0.080	-0.07
			-0.080	-0.080	
Currently in an urban location			0.020	0.010	0.01
			-0.060	-0.060	-0.06
			-0.070	-0.070	
age		0.010		0.010	0
		(0.01)+		(0.01)+	-0.01
		(0.00)*		(0.00)*	
age squared		0.000		0.000	0
		0.000		0.000	0
		0.000		0.000	
Sex (Male)		0.030		0.070	0.05
		-0.060		-0.060	-0.06
		-0.050		-0.050	
Age x Male		-0.020		-0.020	-0.01
		(0.01)**		(0.01)**	(0.01)*
		(0.01)**		(0.01)**	
Married		0.030		0.040	0.01
		-0.060		-0.060	-0.05
		-0.070		-0.070	
Born in higher risk months March Apr		0.010		0.010	0.02
		-0.070		-0.070	-0.06
		-0.080		-0.080	
Constant	-0.560	-0.430	-0.290	-0.280	0.12
	-0.880	-0.880	-0.970	-0.970	-0.85
	-1.000	-1.060	-1.140	-1.210	
Observations	532	532	532	532	532
R-squared	0.030	0.050	0.040	0.060	
Number of canton					45

Robust standard errors in parentheses
Clustered (by canton) standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Table 3: Relationship between subjective health and inequality. The first 4 columns estimate the relationship using logistic regression while the last column used a random effects logistic regression.

Dependent Variable: SRH	Inequality and Area Income	Demographic Controls	SES Controls	Both controls	Random Effects
Income 2005			1	1	1
			(0.00)+	(0.00)+	(0.00)+
Childhood Wealth Dummy			0.79	0.8	0.81
			-0.23	-0.23	-0.21
CV of canton level inequality 1973	0.8534	0.87165	0.84296	0.83518	0.64042
	-0.30598	-0.31506	-0.31595	-0.31481	-0.20708
CV of district level inequality 2005	3.84	3.55	3.69	3.46	3.68
	(2.51)*	(2.28)*	(2.47)+	(2.28)+	(2.01)*
mean of 2005 district level income	1	1	1	1	1
	(0.00)+	(0.00)*	0	0	0
mean of 1973 district level income	1	1	1	1	1
	(0.00)**	(0.00)**	0	0	0
Education (None)			1.4	1.48	1.21
			-0.42	-0.46	-0.34
Education (Secondary)			0.65	0.64	0.48
			-0.24	-0.24	(0.15)*
Currently in an urban location			0.73	0.75	0.66
			-0.21	-0.21	(0.16)+
age		1.02		1.01	1.02
		-0.02		-0.02	-0.02
age squared		1		1	1
		0		0	0
Sex (Male)		0.8		0.86	0.95
		-0.19		-0.22	-0.22
Age x Male		1.01		1	0.97
		-0.03		-0.03	-0.02
Married		1.23		1.37	1.33
		-0.31		-0.36	-0.29
Born in higher risk months March Apr		0.89		0.88	0.85
		-0.26		-0.27	-0.21
Constant					
Observations	530	530	530	530	530
Number of canton					45

Clustered (by canton) standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%