Cross National Comparison of Underestimation of Chronic Conditions in Surveys of Older Adults in the Developing World

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Introduction

Surveys of older adult health have, until recently, relied almost entirely on self-reported adult health questions to assess health status. Self-reported health questions can be problematic for a number of reasons because they assume that people have a good understanding of their own health either because they visit doctors on a regular basis or have access to good quality health care. Some studies show that, under certain conditions, underestimation provides slightly more conservative estimates of self-reported health but not dramatically so (Banks et al., 2006; Brenes, 2008; Goldman, Lin, Weinstein, & Lin, 2003). However, morbidity data from self-reported health obtained from surveys of older adults may be problematic in some settings. Information obtained from surveys asking if a medical doctor has ever diagnosed the respondent with a particular health condition may reflect respondents who infrequently go to a doctor or live in an area with restricted quality health care and therefore do not know if they have a particular condition rather than reflecting low prevalence of the disease. Morbidity data may also reflect the ability of a health care system to maintain life or the ability of a population to pay for better care to maintain life. Selectivity bias and cultural idiosyncrasies could also be problems in population data. The more recent inclusion of biomarkers in surveys of older adults in low and middle income countries is helpful in that, with biomarkers, it will be possible to more accurately understand the health status of adults. This will permit a more confident analysis of morbidity across time. Armed with this information, it will then be possible to better interpret the results from studies examining the effects of early life conditions on older adult health.

A preliminary analysis of a recently cross national data in low, middle and high income countries suggests that to some degree self-reported health questions have a certain amount of validity (McEniry, 2013). Strong associations appeared between self-reported heart disease and diabetes and conditions or behaviors which have been shown to be associated with these conditions: hypertension, stroke, poor self-reported health, and mortality. Yet the prevalence of heart disease clearly increased in some SAGE countries when using well-validated symptom questions for angina in conjunction with self-reports (Rose, 1962) suggesting that underestimation may be problematic. However, although the magnitude of the associations differed in some cases, the direction of associations were generally consistent with modeling based on either self-reported heart disease or a dependent variable based on symptom data (Table 1). More

investigation is warranted using biomarkers for heart disease and diabetes. The purpose of this paper is to further exam these results.

Methods

Data

Survey data come from a newly compiled cross national data set of low, middle and high income countries, RELATE (Research on Early Life and Aging Trends and Effects—see www.icpsr.umich.edu website). The data are drawn from comprehensive and representative surveys of older adults or household surveys at either the national, regional or major city level. From Latin America there are the Mexican Health and Aging Study (**MHAS**, first wave, n=13,463), Puerto Rican Elderly: Health Conditions (**PREHCO**, first wave, n=4,291), Study of Aging Survey on Health and Well Being of Elders (**SABE**, n=10,597) and Costa Rican Study of Longevity and Healthy Aging (**CRELES**, first wave, n=2,827). From Asia there are the China Health and Nutrition Study (**CHNS**, n=6,452), Chinese Longitudinal Healthy Longevity Survey (**CLHLS**, n=16,064), WHO Study on Global Ageing and Adult Health Study in China (**WHO-SAGE,** n=12,284), Indonesia Family Life Survey (**IFLS**, wave 2000, n=13,260), the Bangladesh Matlab Health and Socio-Economic Survey (**MHSS**, n= 3,721), WHO Study on Global Ageing and Adult Health Study in India (**WHO-SAGE**, first wave, n=6,559) and Social Environment and Biomarkers of Aging Study in Taiwan (**SEBAS**, n=1,023). From Africa there are the WHO Study on Global Ageing and Adult Health Survey in Ghana (**WHO-SAGE**, n=4,302) and South Africa (**WHO-SAGE**, first wave, n=3,830). From the developed world there are the Health and Retirement Study (**HRS**, wave 2000, n=12,527), Wisconsin Longitudinal Study (**WLS**, wave 2004, n=10,317), English Longitudinal Study of Ageing (**ELSA**, second wave, n=8,780) and Survey of Health, Ageing and Retirement-Netherlands (**SHARE-Netherlands**, first wave, n= 2,979).

Measures

Adult health.— Elderly adult health was defined by dichotomous variables using self-reported heart disease and self-reported diabetes. The self-reports are based on questions asked of the respondent about whether a doctor had ever diagnosed them with heart disease or diabetes. In the SAGE data, there were questions asked of the respondent which captured symptoms for heart disease (angina) based on the Rose questionnaire (Rose, 1962) and these questions are used to arrive at prevalence rates for heart disease. Obesity was calculated using body mass index (BMI) based on height and weight measurements (BMI greater than or equal to 30). A harmonized measure of difficulties with activities of daily living (ADLs) and poor self-reported health were also used as adult health outcomes (McEniry, 2013). Although self-reported health may be problematic in cross national comparisons, it is also true that self-reported health is strongly associated with mortality. Given that several countries did not have mortality data, a dichotomized variable was created as a proxy for mortality to indicate if the respondent had self-identified as having the worst category of health.

Predictor Variables.—All statistical models control for age and gender. We also include years of education, adult low height, ever smoked, if exercise as an adult and obesity (BMI>=30). Smoking was defined according to whether a respondent ever smoked, smoked in the past or currently smokes based on self-reports.

Sample selection

We select surveys from the RELATE data which have measured blood pressure and have biomarkers collected through blood samples by which to ascertain the risk of heart disease and diabetes. These biomarkers were obtained through blood samples based on overnight fasting and are publicly available. The selected surveys also have panel data: CRELES, CHNS, IFLS, CLHLS, SAGE, HRS, ELSA, and SEBAS. The CRELES study collected an array of biomarkers (Brenes, 2008). The CHNS study has recently released biomarker data from 2009 on fasting blood measures which includes measures for heart disease and diabetes collected in 2009 (Yan et al., 2012). The IFLS collected biomarkers including hemoglobin levels, blood pressure and total and HDL cholesterol in 2007. The SAGE survey is a model for cross national surveys across diverse geographic regions (He, Muenchrath, & Kowal, 2012) and, we anticipate that we will be able to use second wave data and biomarkers based on blood samples when they become available; they do have other biomarkers such as blood pressure and BMI in addition to symptom data based on the Rose questionnaire (Rose, 1962). Blood pressure is available in the China-CLHLS study. The HRS collected biomarkers in 2006 and 2008 in a random subsample with a follow-up in 2010 and 2012 and we analyze available data from 2006 and 2008. ELSA collected biomarkers in 2004 and 2008. We use biomarker data from the Taiwan SEBAS study of 2000.

Analysis

Biomarkers such as glucose and hemoglobin, cholesterol, C-reactive protein (CRP) in addition to measured blood pressure and BMI provide an indication of risk for chronic conditions such as diabetes and heart disease (Crimmins, Kim, & Vasunilashorn, 2010; Yan et al., 2012). We use the biomarker data to develop multiple measures to assess biological risk for heart disease and diabetes using cut off points reported in the literature (Yan et al., 2012; Kim & Crimmins, 2013). The first step is to determine the degree to which misclassification occurs and in particular the degree to which people who report no condition actually have the condition. We gauge the degree to which underestimation is occurring by comparing self-reports with measured risk and determine differences among respondents according to selected demographic characteristics. We use the measures of biological risk to also gauge mortality risk for those with heart disease and diabetes. The second step will be to repeat analyses previously done examining the effects of early life conditions on self-reported heart disease and diabetes (McEniry, 2013) but using the biological measures of risk of heart disease and diabetes and the imputed data. These multivariate models estimate the likelihood of adult heart disease and diabetes as a function of poor early life conditions (caloric intake, birthplace, parental SES, height, knee height, poor childhood health), adult SES (education, income) and adult lifestyle (exercise, smoking, drinking, caloric intake). With a presumably better measure of older adult health status using biomarkers reflecting a more accurate assessment of adult heart disease and diabetes and with imputed data, we are in the position to gain more insight from longitudinal analyses. To gain extra mileage with panel data, we have several options. We construct country-specific models using either logistic regression to estimate the probability of the differences in being in a certain health condition in time one and in time two using the

same covariates of interest. For example, we take all respondents who were alive at times one and two and define a dichotomous variable according to whether there was a change/no change in reporting poor health from time one to time two. We then estimate the probability of the differences between being in poor health in time one and being in poor health in time two using covariates of interest. Yet another option is to select in each country those respondents who did not report diabetes (or heart disease or obesity) at baseline using the same independent variables of interest. We can also select all those respondents at time one who reported diabetes (heart disease) and model the logit of the probability of developing a known co-morbidity (e.g. heart disease, renal failure, and circulatory problems).

Preliminary work during summer 2013

Preliminary analysis during the summer 2013 using biomarker data collected from blood samples from Costa Rica, China, Indonesia using the US, England and Taiwan as benchmarks, showed differences between self-reports for heart disease and diabetes and related biomarkers suggesting that underestimation of heart disease and diabetes is very variable across countries but that it is of potential concern (Table 2). However, a series of basic logistic regression predicting heart disease or diabetes with biomarkers and self-reports using height, adult SES, smoking, exercise, obesity reconfirm the idea from Table 1 that even with gross underestimation of chronic conditions the direction of the association in models may not change although the magnitude of the association may changes. In our proposed paper we will expand upon this early analysis and discuss the degree to which inferences can be made about the determinants of older adult health even in the face of underestimation of chronic conditions.

Selected References

Banks, J., Marmot, M., Oldfield, Z., & Smith, J. (2006). Disease and disadvantage in the United States and in England. *Journal of the American Medical Association, 295*(17), 2037-2045.

Brenes, G. (2008). The effect of early life events on the burden of diabetes mellitus among Costa Rican elderly: estimates and projections. PhD Dissertation. University of Wisconsin—Madison.

Crimmins, E., Kim, J.K., & Vasunilashorn, S. (2010). New Approaches to Understanding Trends and Differences in Population Health and Mortality. *Demography*, 47(Suppl), S41-S64.

Goldman, N., Lin, I., Weinstein, M., & Lin, Y. (2003). Evaluating the quality of self-reports of hypertension and diabetes. *Journal of Clinical Epidemiology, 56,* 148-154.

He, W., Muenchrath, M.N., Kowal, P. U.S. Census Bureau. 2012. Shades of gray: A cross-country study of health and well-being of the older populations in SAGE countries, 2007-2010. U.S. government Printing Office, Washington, D.C.

Kim, J.K., & Crimmins, E.M. (2013). Cross-country comparison of changes in health in U.S., England, Mexico, Taiwan and Indonesia. Unpublished paper.

McEniry, M. Research on Early Life and Aging and Trends and Effects (RELATE). University of Michigan: Institute for Social Research, ICPSR [distributor] Released June 2013 .

McEniry, M. (In press). Early life conditions and rapid demographic changes in the developing world: Consequences for older adult health. Dordrecht, Netherlands: Springer Science and Business Media.

Rose, G.A. (1962). The Diagnosis of Ischaemic Heart Pain and Intermittent Claudication in Field Surveys. *Bulletin of the World Health Organization, 27,* 645-658.

Yan, Shengkai, J. Li, S. Li, B. Zhang, S. Du, P. Gordon-Larsen, L. Adair, B.M. Popkin (2012) The expanding burden of cardiometabolic risk in China: the China Health and Nutrition Survey. Obesity Reviews 13 (9): 810-21. PMCID: PMC34296

Table 1: Comparison Between Self-Reports, Symptom, and Biomarker Data

Panel A: Heart Disease in SAGE	**Self-Reports**	**Self-Reports and Symptoms**
Age	1.02***	1.01**
Female	1.36***	1.38***
Education (years)	1.06***	1.01
Obesity	1.21*	1.19*
Functionality	1.32***	1.72***
Diabetes	1.91***	1.46***
Poor health	2.56***	2.22***
Ever smoke	1.02	1.00
Exercises	0.89	0.99
China	3.93***	1.22*
Ghana (reference)	1.00	1.00
India	1.61***	1.69***
Mexico	0.44***	0.64***
Russian Federation	13.97***	6.57***
South Africa	1.15	0.51***
Log likelihood	-3886	-5436
Total observations	12235	12235

Panel B: Diabetes in Costa Rica	**Self-Reports**	**Glucose**	**Hemoglobin**
Age	0.97***	0.98***	0.98***
Female	1.25	1.38**	1.25
Education (years)	0.99	1.01	1.00
Obesity	2.16***	2.18***	2.46***
Functionality	1.37**	1.30*	1.44***
Poor health	1.70***	1.37**	1.57***
Ever smoke	0.85	1.01	0.87
Exercises	0.70*	0.75*	0.73*
Log likelihood	-1005	-1206	-1084
Total observations	2197	2197	2197

Source: SAGE surveys, 2007-08, for those born prior to 1945, unweighted; CRELES survey7.

* $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$.

Note: Panel A shows the odds of reporting heart disease using self-reports and symptom questions and Panel B shows the odds of diabetes using self-reports and biomarker data. Prevalence of angina using self-reports versus self-reports with symptoms (weighted): China (14%, 15%), Ghana (5%, 15%), India (7%, 23%), Mexico (2%, 10%), Russian Federation (51%, 57%), South Africa (6%, 10%).

CRELES used two biomarkers to measure diabetes: glycosylated hemoglobin levels ($HbA_{1C} \geq 7\%$) and fasting serum glucose levels (SG≥200 mg/dL). See Brenes (2008) for more information.

Table 2: Percent at risk using biomarkers collected in blood samples and self-reports

Males - percent at risk	CR	HRS	Taiwan	ELSA	CHNS	Indonesia
Diabetes risk measures						
hba1c						
60-64	19	19	18	9	15	
65-69	18	19	9	14	14	
70-74	22	22	15	11	11	
75-79	24	19	12	12	6	
80+	16	19	12	10		
glucose						
60-64	22		18	6	16	
65-69	22		7	4	13	
70-74	24		15	3	10	
75-79	23		11	9	6	
80+	14		16			
Heart disease risk measures						
TG						
60-64	50		24	48	30	
65-69	41		19	46	25	
70-74	41		19	47	12	
75-79	37		13	36	12	
80+	31		12	38		
TC						
60-64	51	38	42	71	32	29
65-69	52	33	40	64	32	27
70-74	54	28	44	62	16	26
75-79	56	29	38	51	24	20
80+	48	25	31	40		22
LDL						
60-64	46			57	27	
65-69	45			51	30	
70-74	51			48	18	
75-79	53			42	29	
80+	47			29		
HDL						
60-64	60	29	36	11	14	62
65-69	52	31	30	16	15	60
70-74	48	36	28	16	10	70
75-79	46	30	35	17	0	69
80+	43	23	25	18		56
CRP						
60-64	49	33		29	32	
65-69	51	34		30	37	
70-74	52	35		38	30	
75-79	59	39		40	18	
80+	68	31		38		
Self reports						
Heart disease						
60-64	11	21	13	23	1	5
65-69	9	25	12	27	2	5
70-74	11	35	20	34	3	4
75-79	15	36	18	38	1	2
80+	14	38	13	41		0
Diabetes						
60-64	16	16	16	8	3	4
65-69	18	19	5	12	1	5
70-74	21	20	13	15	5	1
75-79	18	20	11	15	1	0
80+	10	16	13	11		0

Females - percent at risk	CR	HRS	Taiwan	ELSA	CHNS	Indonesia
Diabetes risk measures						
hba1c						
60-64	32	18	30	8	19	
65-69	30	20	21	6	22	
70-74	30	15	28	9	17	
75-79	30	20	31	9	11	
80+	19	14	28	8		
glucose						
60-64	35		22	1	11	
65-69	29		22	4	16	
70-74	32		28	3	10	
75-79	35		29	2	14	
80+	21		28			
Heart disease risk measures						
TG						
60-64	50		17	40	33	
65-69	48		33	39	42	
70-74	43		35	44	23	
75-79	49		39	39	21	
80+	42		20	44		
TC						
60-64	69	51	58	82	53	45
65-69	67	53	55	82	49	46
70-74	70	46	64	75	52	46
75-79	65	45	56	76	46	49
80+	60	39	48	74		46
LDL						
60-64	64			68	48	
65-69	65			68	42	
70-74	64			59	50	
75-79	58			60	46	
80+	52			57		
HDL						
60-64	70	34	54	14	32	64
65-69	65	33	49	14	30	56
70-74	58	35	46	16	23	62
75-79	69	36	60	14	32	57
80+	58	36	53	17		71
CRP						
60-64	65	43		35	28	
65-69	63	40		36	25	
70-74	69	39		45	31	
75-79	71	38		42	27	
80+	62	31		38		
Self reports						
Heart disease						
60-64	8	15	11	16	2	3
65-69	11	19	16	21	2	2
70-74	14	23	25	26	1	5
75-79	17	26	32	33	2	2
80+	17	32	23	38		0
Diabetes						
60-64	28	14	19	7	5	4
65-69	24	17	21	7	4	3
70-74	28	16	28	10	10	2
75-79	26	17	27	11	4	0
80+	16	14	28	10		0

Note: ELSA did not collect glucose samples for those aged 80+
Note: CHNS had a very few respondents aged 80+. As such, 80+ categories for CHNS are not reported