Survey Research Methods (2016)
Vol. 10, No. 2, pp. 65-83
doi:10.18148/srm/2016.v10i2.6711

ISSN 1864-3361
http://www.surveymethods.org

An Exploration of Proxy- and Self-Reported Adolescent Health in Low-Resource Settings

Laura B. Nolan
Columbia University
New York, U.S.A.

Proxy reports in survey research are widely used when the index individual is unavailable or somehow incapacitated by age or disability. Proxy reports are plagued by concerns about accuracy, however, and self-reports are generally preferred when objective measurement is not possible. This paper uses the Young Lives Study of International Child Poverty to assess the validity and utility of adolescent self-reported health (SRH) and the conventional parent's proxy report. Using multivariate regression models and the framework of convergent validity, I find evidence for the validity of both proxy and self-reports, although proxy reports appear to be slightly more robustly associated with available physical health information. Exploratory multiple imputation simulations suggest that researchers should request *both* proxy and self-reports in household surveys; having both substantially improves the imputation of one if it is missing or implausible. Along with a moderate correlation between the two reports, these results suggest that proxy and self-reports of adolescent's general health status are not interchangeable and may complement one another.

Keywords: Health; Self-reported health; Proxy-reported Health

1 Introduction

Surveys collect proxy reports across a wide range of domains, from employment status to living situations to immigration status to health. Proxy reports can save time and money because they reduce the number of contact attempts required to complete a questionnaire (Cobb, 2012), but are burdened by concerns about inaccuracy (Becker, Rodkin, O'Connor, & Moorman, 2004; King, Cook, & Childs, 2012). The concordance between proxy and self-reports has thus been studied extensively, particularly in the domains of health, chronic disease and disability (Andresen, Fitch, McLendon, & Meyers, 2000; Elliott, Beckett, Chong, Hambarsoomians, & Hays, 2008), but the results – with respect to accuracy – have been decidedly mixed (Smith & Goldman, 2011; Todd & Goldman, 2013). This has made proxy reporting "by convenience" (when the index individual is in fact capable of providing their own response) less attractive to survey researchers, but proxy reporting "by necessity" remains widespread (Sakshaug, 2014). Still, in the absence of objective measures, self-reports are often assumed to be of higher quality than proxy reports, and are thus preferred.

Self-reported health (SRH), for example, enjoys widespread use in social science research (Baker, Stabile, & Deri, 2004; Johnston, Propper, & Shields, 2007; Strauss & Thomas, 1998) mainly because of its simplicity and strong association with important outcomes such as mortality (Singh-Manoux et al., 2006). Indeed, researchers have been particularly impressed by the predictive power of SRH even when controlling for socio-economic characteristics, objective health measures, and clinical medical risk factors that might affect health outcomes (Lee, 2014). SRH is also widely used in data collection efforts where investigators are limited with respect to time and/or the number of health-related questions they may ask on a survey, or where health is not the main focus of the study.

While most surveys using SRH focus on adulthood and old age, SRH may be a particularly informative mode of health assessment in young adulthood when clinical endpoints such as mortality are relatively uncommon (Bauldry, Shanahan, Boardman, Miech, & Macmillan, 2012), and biomarkers and other health measures can be costly to collect (Etile & Milcent, 2006). However, most household surveys defer to parents or other caregivers to provide proxy reports regarding children's and adolescents' general health (Garbarski, 2014), and all have focused on populations residing in developed countries. The Young Lives Study of International Child Poverty is one of the few data collection efforts in a low resource setting to elicit both adolescent SRH *and* the conventional parent's proxy report about the adolescent's general health. These data provide an opportunity to

Contact information: Laura B. Nolan, Columbia University, 1255 Amsterdam Ave., New York, NY 10027 (ln2338@columbia.edu)

examine the concordance between and the validity of proxy and self-reports of an important latent construct in survey research (health) among young people in a novel population. This paper addresses the following research questions:

1. Is adolescent SRH and/or parents' proxy report of the adolescent's health a valid measure in low resource settings? Do indicators of physical health predict adolescent SRH and/or parent's report of the adolescent's health?

2. Are proxy and self-reported adolescent health questions complements or substitutes? Is there a case for asking for both?

After determining the concordance between the two reports, I apply the framework of convergent validity to assess whether proxy and/or self-reports are valid indicators of an adolescent's health. Convergent validity is a subset of construct validity, which is the degree to which something measures what it is intended to measure. Convergent validity refers to whether measures of the same underlying, latent construct that are expected to be related are, in fact, related. A statistically significant association between the reports and other measures of health would be supportive of the reports' convergent validity. To further evaluate whether either report is particularly helpful for identifying adolescents in poor health, I compute the sensitivity and specificity of the two health assessments as they relate to stunting, a common and objectively measured indicator of poor child and adolescent nutritional and epidemiological environment.

The data and analytical strategy utilized in this paper loosely conform to the guidelines defining high-quality evaluations of proxy and self-reports set out by Cobb and Krosnick (2009): that both targets and proxies are interviewed, targets and proxies constitute representative samples of the same population, the questions asked of targets and proxies are identical, and an independent, external measure is used to assess accuracy. With these requirements fulfilled, I find that the results are promising: both adolescent SRH – and to a slightly greater extent, parent's proxy report – are associated with the available health indicators, and thus may provide substantial information regarding the physical aspects of an adolescent's health. Both reports exhibit high sensitivity, although their specificity is significantly lower. Finally, exploratory multiple imputation simulations suggest that each report improves the imputation of the other if it is missing or implausible. These results and the reports' moderate correlation with each other suggest that proxy and self-reported adolescent health are not interchangeable, and may in fact be complements; survey researchers are encouraged to collect *both* if possible.

1.1 Self-reported health

SRH provides a simple, direct, and global way of capturing perceptions of health (Idler & Benyamini, 1997; Idler, Russell, & Davis, 2000). While individuals may not accurately assess isolated health-related issues such as overweight (Ali, Minor, & Amialchuk, 2013; Clarke & Ryan, 2006), arthritis (Butler, Burkhauser, Mitchell, & Pincus, 1987), physical activity (Celis-Morales et al., 2012), and hypertension (Goldman, Lin, Weinstein, & Lin, 2003), general SRH has been shown to be a robust predictor of later health outcomes such as mortality (Idler & Kasl, 1991) and functional disability in adults (Idler et al., 2000). This may be related to the measure's incorporation of multiple dimensions of health, as well as self-assessment of severity, awareness of comorbidity, and past health trajectory (Kuhn, Rahman, & Menken, 2006). Indeed, SRH has displayed a robust association with a variety of indicators of physical health status such as bodily pain, presence of illness, constrained physical functioning, the use of health care services (van Doorslaer et al., 2000), and risk behaviors such as smoking, physical inactivity, lack of sleep, overweight, and alcohol consumption (see Au and Johnston (2014), Page et al. (2009), Vie, Hufthammer, Holmen, Meland, and Breidablik (2014) for excellent reviews of this literature).

Early SRH research was very optimistic regarding the validity and usefulness of the measure (Hurd & McGarry, 1995; Idler & Angel, 1990), finding, for example, that subjective probabilities of survival were surprisingly good approximations of population probabilities, and that the reliability of self-rated health was at least as good as the more specific questions (Lundberg & Manderbacka, 1996). More recent research has uncovered a wide variety of conceptual and methodological challenges in the investigation and use of SRH, including heterogeneity in reporting behavior by socioeconomic and demographic factors like sex and age (Bago d'Uva, Van Doorslaer, Lindeboom, & O'Donnell, 2008; Layes, Asada, & Kepart, 2012; Lindeboom & Doorslaer, 2004), the placement of survey questions in a survey questionnaire (Bowling & Windsor, 2008; Crossley & Kennedy, 2002; Lee & Grant, 2009), type of survey administration (Clarke & Ryan, 2006), and answer options (Jurges, Avendano, & Mackenbach, 2008).

1.2 Adolescent's self-reported health and proxy reports

Although SRH has been studied extensively in adults and the elderly (Manor, Matthews, & Power, 2001), adolescent SRH has not received the same attention from researchers (Breidablik, Meland, & Lydersen, 2008; Page et al., 2009). Much of the literature on health-related self reports from young people involve their reporting either about their quality of life (Cremeens, Eiser, & Blades, 2006; Christine Eiser & Varni, 2013; Lin, Su, Wang, & Ma, 2013; Punpanich et

al., 2011; Rajmil, Lopez, Lopez-Aguila, & Alonso, 2013; Upton, Lawford, & Eiser, 2008) or about specific and separate psychosocial, social/familial, behavioral, symptomatic, or economic dimensions of wellbeing (Vinglis, Wade, & Adlaf, 1998). While previous research even with young children has indicated that they may posess the ability to "logically assess their own health status" (Riley, 2004; Wu, Ohinmaa, Johnson, & Veugelers, 2014) and comprehend the importance of functionality, lifestyle and mental health (Normandeau, Kalnins, Jutras, & Hanigan, 1998), age remains a concern regarding the capacity of individuals to integrate over relevant health-related information and to have developed the necessary language skills or cognitive abilities to interpret the survey questions (Waters, Stewart-Brown, & Fitzpatrick, 2003).

An additional barrier to the study of SRH in young people has been that surveys usually rely on a parent or caregiver to report about the adolescent's health; adult proxies are often easier to locate and follow up with than the young people themselves. While proxy reports are understandably preferred for very young people and individuals who are somehow incapacitated (Lee, Mathiowetz, & Tourangeau, 2004), it is generally thought that the best assessments of an individual's health will come from the person themselves (Moore, 1988). This may be particularly true for adolescents as they begin to engage in health behaviors and have experiences about which their parents or caregivers are ill-informed.

Relative to children, adolescents are more advanced in age and development, and thus may also be better equipped to report about their own health. While Johnson and Wang (2008) assert that adolescents' SRH may in fact provide an important "window into the internal lives of youth" and offer significant "insight into their health and wellbeing," Lee (2014) argues that the "utility of proxy responses to SRH will require additional research". Indeed, some evidence suggests that adolescents rate their health more poorly than their parents rate it, possibly reflecting their sensitivity to pain and/or mental health problems about which their parents are not aware (Page et al., 2009; Waters et al., 2003). Given that all previous research on this topic has been conducted exclusively in the US, Australia, and Europe, this paper presents the first step towards evaluating the validity and thus the utility in survey research of proxy and self-reported adolescent health in developing countries.

2 Data and Methods

2.1 Data

The Young Lives Study of International Child Poverty (henceforth referred to as "Young Lives") ... is a longitudinal study run by the University of Oxford in the UK and primarily funded by the Department for International Development (DFID). The data are publicly available from the UK Data Archive (UK Data Archive, 2016). Data collection began in 2002 to follow 12,000 children from Ethiopia, the state of Andhra Pradesh in India, Peru, and Vietnam for 15 years. Two age cohorts of children are followed in each country: 2,000 children born between 2001 and 2002 (the "younger" cohort), and 1,000 children born between 1994 and 1995 (the "older" cohort) (Young Lives, 2002). Data are currently publicly available from the first three waves of data collection in 2002, 2006, and 2009. There is very limited loss to follow up in the Young Lives data, particularly as compared to other longitudinal surveys undertaken in low resource contexts. As described by Barnett et al. (2012), attrition rates for the younger cohort ranged from 2.2 percent in Vietnam to 5.7 percent in Ethiopia, and from 2.4 percent in Vietnam to 5.0 percent in Peru for the older cohort.

The Young Lives research team has produced extensive reports on sampling and representativeness. In Ethiopia, India, and Vietnam, a multi-stage, purposive random sampling method was used to select the two age cohorts of children (Kumra, 2008; Nguyen, 2008; Outes-Leon & Sanchez, 2008); 20 sentinel surveillance sites were chosen in each country to ensure a balanced representation of its regional diversity as well as rural/urban differences, and children were randomly selected within these sites (Bourdillon, 2012). In Peru, researchers used a multi-stage, cluster-stratified random sampling method to select the two cohorts of children, randomizing households within a site as well as across 20 sentinel site locations (Escobal & Flores, 2008). In all countries, only one child was selected per household at baseline. In comparisons made between the Young Lives study sample and the nationally representative samples from the Demographic and Health Surveys temporally closest to Young Lives baseline data collection, Young Lives children are slightly poorer in Vietnam, slightly better off in Ethiopia and India, and comparable in Peru (Barnett et al., 2012).

I restrict the study sample to data from the older cohort in the second wave of data collection for the present analyses because 1) this is the only wave in which health reports were elicited from both parents and their children, and 2) the Young Lives "children" were on average 12 years old at the time of the survey, and thus likely to be sufficiently advanced in age and development to report about their own health. Eighty-nine adolescents are missing responses to the "child questionnaire" and are not included in the analyses, producing a wave 2 sample size of 3,645. An additional 104 adolescents (less than 3 percent of the sample) have missing values on at least one variable included in the analyses and have been also been excluded. The final analytical sample size is 3,541, or 955, 961, 667,[1] and 958 adolescent-parent dyads in each of the four countries (Ethiopia, India, Peru, and

[1]The sample size is lowest in Peru because fewer Young Lives respondents were enrolled at baseline (n = 714) than in any other country.

Vietnam), respectively.

2.2 Analysis overview

The way in which I evaluate the convergent validity of adolescent SRH and parent's reports of the adolescent's health is by exploring their association with other measures of the same underlying construct, namely indicators of physical heath. I do this by estimating regression models with the health reports – separately – on the left-hand side as outcome variables, and physical health indicators on the right-hand side as predictors. A statistically significant association between the health reports and physical health indicators would suggest that the health reports may indeed be valid measures of the – at least physical – health of adolescents. Further, the pattern of association between health reports and indicators of physical health, particularly where they differ between adolescents and parents, can illuminate the mechanisms underlying the production of these reports.

An additional secondary strategy I use to compare and evaluate proxy and self-reported adolescent health is by computing their sensitivity and specificity as compared to the only measured health indicator available in the Young Lives survey: stunting. While sensitivity and specificity are most commonly used in the evaluation of diagnostic and screening tests, these measures have also been applied to assess the performance of a binary classifier; it is this secondary application that I use in this paper. The next section describes the outcomes, predictor variables, and the regression specifications in more detail, and engages in a more in-depth discussion of sensitivity and specificity.

2.3 Outcome variables

The Young Lives SRH survey question explicitly directs the respondent to compare the adolescent to the adolescent's peers. While this SRH question is somewhat different from that which is generally used in this type of research, it makes explicit the non-random distribution in the population of the tendency to use a particular reference group when describing one's health (Krause & Jay, 1994). For example, older individuals may consider themselves in excellent health in spite of significant physical ailments because they are comparing themselves to their peers, some of whom may have died. Since respondents naturally report their health in reference to others' health, it is helpful to make their reference group explicit and consistent across respondents so that researchers can interpret study results accordingly. The SRH question for the adolescent is thus: "Compared to other children this age would you say your health is the same, better or worse?" And for the parent: "Compared to other children this age, would you say the child's health is the same, better or worse?"

Figure 1 shows the distribution of both proxy and self-reported adolescent health ratings. It appears that adolescents report having the same health as their peers somewhat more often – and having worse or better health somewhat less often (with the exception of Peru) – than their parents report they do. The distribution of parent's responses across the three categories is flatter and more spread out than adolescent responses, which are somewhat more condensed or compressed around "same". Further descriptive statistics (Table 1) indicate that the overlap in health ratings between adolescents and their parents may be less than Figure 1 suggests. While the vast majority of adolescents whose parents report they are in the same health as their peers provide a concordant report, 56% of the adolescents whose parents report them as being in worse health than their peers do not provide a concordant report. The same pattern emerges for parent's reports of better health; many adolescents whose parents report they are in better health than their peers report that they are in the same health. The polychoric correlation (the correlation between two observed ordinal variables that are theorized to represent normally distributed continuous latent variables) is 0.56, or moderate.[2]

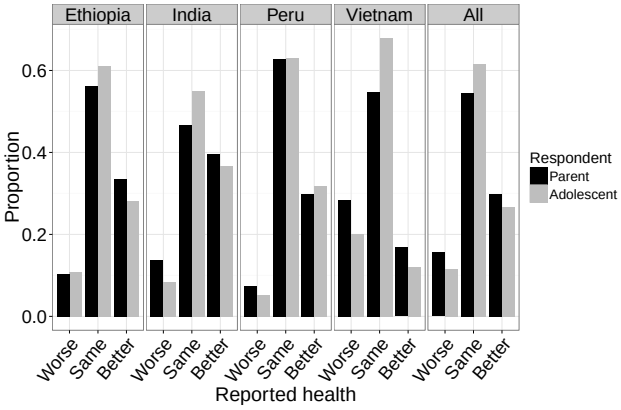

Figure 1. Proportion of parents and adolescents reporting each health category

In order to investigate the flexibility and robustness of their association with indicators of physical health, I specify adolescent and parent health reports in three ways in regression models:

1. Worse versus same, and better versus same health in two separate statistical models. In each model, same health (as their peers) is the reference category.

2. Worse versus same or better health in a single statistical model. In this case, same or better health (as their

[2]The polychoric correlation between adolescent's SRH and the parent's report of the adolescent's health is 0.57 for girls and 0.54 for boys. The concordance matricies for female and male adolescent's report and their parent's report are presented in the Appendix. There is no difference in the correlation between the health reports among biological mothers and those who are not the biological mother (ρ = 0.56 for both groups).

Table 1
Concordance between adolescent SRH and parent's reports

	Adolescent's Report							
	Worse		Same		Better		All	
Parent's Report	%	*n*	%	*n*	%	*n*	%	*n*
Worse	44	240	45	250	11	58	100	552
Same	7	127	76	1473	17	329	100	1927
Better	4	41	43	459	53	560	100	1060

peers) is the reference category.

3. Worse versus same and better versus same health in a single statistical model. In this case, same health (as their peers) is the reference category.

The second specification – worse as compared to the same or better health – is particularly important for identifying adolescents in poor health, and for characterizing the distribution of the burden of disease. The third and final specification has the advantage of using all information concurrently.

2.4 Explanatory variables

Parents report. I include an indicator for whether the adolescent had one or more serious illnesses or injuries in the last four years from which the parent thought the adolescent might die. A second health indicator is whether the adolescent has any long term health problems that affect his/her daily life. A third is whether the adolescent has difficulty with any aspects of physical functioning.[3] I also include an indicator for whether the parent reported there had been a food shortage in the household in the last 12 months. The most frequently occurring of these physical health indicators is experiencing a food shortage (20 percent of respondents), whereas the least common is having poor physical functioning, which is reported by about 4 percent of respondents (Table 2). We would hypothesize that a response of yes to each of these four covariates would be associated with higher odds of reporting worse health as compared to the adolescent's peers.

Adolescents report. I include an indicator variable reported by the adolescent for whether they had yet experienced puberty (menarche for girls and lowered voice for boys). Puberty may be delayed in malnourished adolescents, particularly young women. About 22 percent of respondents report they have experienced puberty (Table 2). We would hypothesize that having gone through puberty would be associated with reduced odds of reporting worse health as compared to the adolescent's peers, particularly for girls.

Measured. There is one objective, measured indicator of child and adolescent health included in the Young Lives Survey, and that is height for age. Height for age is a widely

Table 2
Descriptive statistics of the study population

Item	Percent	Min	Max
Health indicators			
1) Whether the adolescent had one or more serious illnesses/injuries in past year	15.5	0	1
2) Whether the adolescent has a long term health problem	8.4	0	1
3) Whether the adolescent has a poor physical functioning	3.8	0	1
4) Whether the adolescent's height is less than two standard deviations below the mean	31.2	0	1
5) Whether the adolescent's household experienced a food shortage in the last 12 months	19.5	0	1
6) Whether the adolescent has experienced puberty	21.7	0	1
Control variables			
1) Whether the adolescent is female	49.6	0	1
2) Parent's educational attainment		0	2
no school(0)	34.3		
some/all primary (1)	35.5		
> primary (2)	30.2		
3) Whether the adolescent is a full-time student	94.1	0	1
4) Average household wealth index (mean)	0.4	0.0	0.9

[3] Walking, moving his or her arms freely, or seeing/understanding/learning/speaking/feeding him/herself/learning to do things as well as other children his/her age.

used indicator of an individual's long term nutritional and epidemiological environment (Case, Fertig, & Paxson, 2005; Case & Paxson, 2010). Children who experience recurring bouts of disease and those who live in poor sanitary conditions are on average significantly shorter than their better off counterparts. I use a dichotomous version of this variable: whether the adolescent is stunted, defined as a height for age (measured with a height board made for the purpose) more than two standard deviations below the median of the reference population (WHO Multicentre Growth Reference Study Group, 2006).[4] Almost a third of adolescents (about 31 percent) were stunted in wave 2 of the Young Lives data collection (Table 2). We would hypothesize that stunting would be associated with higher odds of reporting worse health as compared to the adolescent's peers.

More generally, previous research has indicated that the context in which an item on a survey is asked can impact the respondent's answer (Lee & Schwarz, 2014). In the Young Lives survey instrument, parents are requested to report about the adolescent's general health *before* they answer the specific physical health questions; the adolescent is also weighed and measured for the stunting variable *after* the parent has reported about the adolescent's general health. Further, the adolescent's report about their own general health is located *before* they are asked about whether they have gone through puberty. In sum, the general health questions are located prior to the specific physical health questions in the Young Lives survey instrument. This substantially reduces concerns regarding "assimilation effects", where the relationship between a general health question and specific health items is stronger because the latter are located before – and thus may effect – the former in a survey instrument (Bowling & Windsor, 2008; Garbarski, Schaeffer, & Dykema, 2015). Further, both the proxy and self-reported health questions present the response options in the same order – Same, Better or Worse – further reducing concerns regarding their comparability.

Socio-demographic variables. Previous research on SRH has indicated that individuals may evaluate their health differently according to a number of non-health characteristics, including age, gender (Benjamins, Hummer, Eberstein, & Nam, 2004), education, culture (Jylha, Guralnik, Ferrucci, Jokela, & Heikkinen, 1998), and personality, just to name a few (Bzostek, Goldman, & Pebley, 2007; Etile & Milcent, 2006; Groot, 2000; Jurges, 2007; Jylha, 2009; Layes et al., 2012). Health reports also vary by a family's socioeconomic status (Bago d'Uva et al., 2008; Dowd & Zajacova, 2007; Piko & Fitzpatrick, 2001); higher income individuals may be more likely to be diagnosed with health problems, potentially producing more negative reports than lower-income individuals who may actually be in poorer health. The models presented here thus control for a household wealth index, whether the adolescent is female, parent's educational attainment and adolescent school-going, and a fixed effect for each of the four countries.

The wealth index ranges from 0 to 1 and is computed as the sum of dichotomous indicators divided by the number of indicators. These indicators include a variety of consumer durables and housing characteristics.[5] I also include an indicator for whether the adolescent is female; it may be that parents have different health standards for female and male children, or that boys and girls systematically report about their health differently. Parent's educational attainment is coded as none (0), completed at least some primary school (1), and completed at least some school in addition to primary (2). I also include a dichotomous indicator of whether the adolescent is attending school regularly. Somewhat surprisingly given the low resource context, school attendance among adolescents is almost universal; school completion among parents is much more varied (Table 2).

All analyses include country fixed effects in order to control for differences in level of development, culture, etc.[6] While the very different contexts represented by the four countries suggests that modeling them separately might be informative, no clear patterns emerged when doing so. All adolescents are approximately 12 years old, and for most, the parent reporting is their mother. The proportion of parents who are the biological mother of the Young Lives adolescent ranges from 62 percent in Ethiopia to 92 percent in Vietnam. I initially included an indicator for whether the parent was the biological mother in regression models, but the variable was never found to be statistically significantly associated with health reports, so I have omitted it from the analyses presented here.[7]

[4]The World Health Organization's Multicentre Growth Reference Study (MGRS) based their reference growth charts on children from six sites around the world: Brazil (South America), Ghana (Africa), India (Asia), Norway (Europe), Oman (Middle East) and the USA (North America).

[5]The wealth index includes number of people per room, consumer durables such as radio, refrigerator, TV, bike, motor vehicle, etc.; whether the dwelling has electricity, cement walls, a sturdy roof, and the material of the floor; the main source of drinking water; type of toilet facility; and the type of fuel used for cooking.

[6]An important concern may be that in poorer and thus on average less healthy contexts, adolescents in poor health may evaluate their health as the same or better than their even less healthy peers. Put another way, unhealthy individuals surrounded by other unhealthy individuals may be more likely to (rightly) report themselves as in the same or better health as compared to their peers. While including a fixed effect for the country context in models controls for the level of disease, it does not control for differences in the way in which the context may affect health reports. To investigate the extent of this contextual challenge, I have run all of the analyses separately by country. While most results are consistent with the joint findings, there does not appear to be a pattern to the differences.

[7]As a second check on whether the results are different for bi-

2.5 Methods

As outlined previously, a significant association between the available physical health indicators and the health reports would suggest that the health reports may be valid indicators of the adolescent's health. I investigate, using both multinomial and regular logistic regression models, the association between the two health reports (separately) and the six physical health indicators, controlling for the wealth index, the sex of the adolescent, the parent's education attainment and the adolescent's school attendance.

The regular logistic regression models compare a) reports of worse (1) to the same (0) health as the adolescent's peers, b) reports of better (1) to the same (0) health, and c) reports of worse (1) to the same or better (0) health. This third specification is particularly important given the potential use of proxy and/or self-reports for identifying young people in poor health and in need of intervention. Equation 1 presents this third specification; the odds of reporting worse as compared to the same or better health:

$$\log\left(\frac{P(\text{worse health})}{1-P(\text{worse health})}\right) = \beta_0 + \beta_{1...6}\cdot\text{phys. hlth.} + \beta_{7...8}\cdot\text{educ} + \beta_9\cdot\text{wealth} + \beta_{10...12}\cdot\text{country} + \beta_{13}\cdot\text{female} \quad , \quad (1)$$

where "phys. hlth." are the physical health indicator variables, "educ" represents both parental educational attainment and adolescent school-going, "wealth" is the wealth index, "country" represents a fixed effect for each country, and "female" is an indicator of the sex of the adolescent.

In order to compare coefficients from the model of the adolescent's SRH and the parent's report of the adolescent's health more directly, I estimate the equations simultaneously. "Seemingly unrelated estimation" combines parameters and variance-covariance matricies from two models to perform a χ^2 Wald test of the equality of coefficients across them. This procedure estimates whether, for example, the coefficient on stunting in the adolescent SRH model is statistically significantly different from the coefficient on stunting in the model of the parent's report of the adolescent's health. I use the `systemfit` package in R for this computation (Henningsen & Hamann, 2015).

A final multinomial logistic regression model puts the health report response options together in one specification, comparing worse and better health to the same (reference) health. Multinomial logistic regression is used to model the odds of a categorical outcome with more than two response options, using all of the information contained in the outcome variable in one specification.[8] All regression specifications are multivariate and include all physical health indicators and sociodemographic variables.

In secondary analyses, I present the sensitivity and specificity of both adolescent SRH and parents' report of the adolescent's health, using stunting as the "gold standard" health measure. Sensitivity in this context refers to the proportion of adolescents who are stunted and who correctly identify themselves as being in worse health than their peers. Specificity is the proportion of adolescents who are not stunted and who correctly identify themselves as being in same or better health than their peers. Sensitivity can thus be interpreted as the avoidance of adolescents who are stunted reporting they are in the same or better health than their peers (i.e. avoiding false negatives), whereas specificity can be interpreted as the avoidance of adolescents who are *not* stunted reporting that they are in worse health than their peers (i.e. avoiding false positives).

Finally, to add nuance to recommendations regarding the collection of proxy versus self-reports, I perform a number of exploratory analyses using multiple imputation simulation procedures. These analyses expand on questions related to which health report a researcher should collect, whether the two reports are substitutes or complements, and whether researchers would be better off requesting both health reports even if they prefer one to the other. I explore two simulated scenarios: 1) parent's health report is missing, 2) adolescent SRH is missing. I set a range of each of the two health reports randomly to missing and then I impute the missing data using the `mi` package in R (Su, Gelman, Hill, & Yajima, 2011). This package approximates a Bayesian framework, running multiple chains and assessing their convergence after a prespecified number of iterations within each chain. I use the R default for both iterations and chains, which are 30 and 4, respectively.

I present the correlation between the imputed reports and the actual reports as a measure of imputation quality or success. I set the number of missings to range from 25 (less than 1 percent of the sample of 3,541) to 425 (12 percent of the sample) in increments of 50 in order to simulate low to high levels of missingness. All imputations incorporate all of the physical health and socio-economic variables[9] used in the regression analyses, but vary as to whether adolescent SRH or parent's report of the adolescent's health is included. All analyses are conducted in R version 3.1.0 (R Core Team, 2014).

---

ological mother-adolescent pairs, I estimated the same models for just this sub-population and found no difference between the results and those for the total population.

[8] Another option is to use an ordered logistic regression model. However, the proportional odds assumption does not hold for the outcome variables used in this study. Additionally, the multinomial regression model provides more flexibility with regard to the reference group, which ideally is "same" health, and not either of the two extremes of "worse" or "better".

[9] This controls for the fact that missing data in the Young Lives survey is not entirely random.

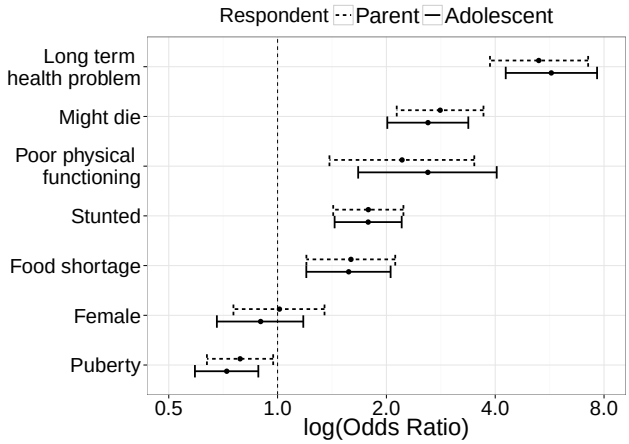

Figure 2. Log Odds ratios and 95 percent confidence intervals from logistic regression of worse as compared to same health report

Note: includes country fixed effect, wealth index, parent/adolescent education

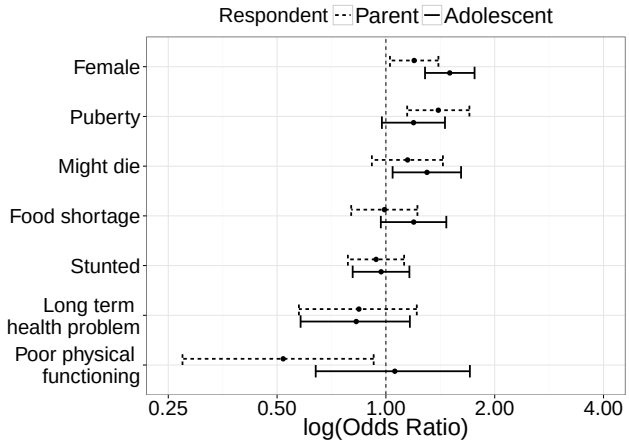

Figure 3. Log Odds ratios and 95 percent confidence intervals from logistic regression of better as compared to same health report

Note: includes country fixed effect, wealth index, parent/adolescent education

3 Results

3.1 Predicting health reports

Odds ratios from regular logistic regression models of the association between the health reports and a variety of physical health indicators are presented in Figures 2-4. These are forest plots that have been rotated 90 degrees, and present the odds ratios (on the x axis on the log scale) and 95% confidence intervals associated with the physical health indicators as well as the adolescent's sex. I present the odds ratios from regressions of parent's report and adolescent SRH in the same figure for easy comparison. Except for adolescent sex, the coefficients on the control variables are not shown in these figures; they are either statistically insignificant or go in the expected direction – worse health is associated with lower levels of education, for example. Full regression tables including fit statistics for these models are presented in Appendix Tables A3 and A4.

All physical health indicators – with the exception of puberty – are associated with higher odds of reporting worse as compared to the same health by the parent; the same can be said for adolescent SRH, with the exception of having poor physical functioning (Figure 2). Whether the adolescent has a long term health condition, has had a recent serious illness or injury, has experienced a food shortage, and whether (s)he is stunted are all characteristics associated with significantly higher odds of reporting worse as compared to the same health as their peers. More specifically, having a long term health problem is associated with four times the odds (OR: 3.99, CI: 2.88, 5.52) of an adolescent reporting they have worse as compared to the same health as their peers. Whether the adolescent has poor or disabling physical functioning is associated with higher odds of reporting worse health by parents only (OR: 2.21, CI:1.39, 3.50). This may be due to adolescents becoming accustomed to their limitations, and not considering them to be a health problem. Finally, parents of female adolescents have somewhat lower odds of reporting the adolescent is in worse health than their peers (OR: 0.79, CI: 0.64, 0.97), suggesting that perceptions of what constitutes good health may differ for male and female adolescents.

When comparing better to the same health reports, we do not see the same association between health reports and the physical health indicators (Figure 3). This may be due to sample size issues; very few adolescents who report having same or better health than their peers have any of the physical health problems. While this limits the precision with which we can estimate the odds ratios associated with each health indicator, it can also be viewed as support for the validity of SRH and parent's report of the adolescent's health. We should be very concerned – and possibly recommend not using the health reports at all – if many adolescents reporting same or better health than their peers had physical health problems. I discuss these and other results further in the conclusions section.

Because one of the important functions of valid survey measures of health is to identify individuals in poor health, Figure 4 presents odds ratios from a logistic regression model of worse as compared to the same or better (reference) health report. Again, almost all physical health indicators are significantly associated with the parent's report of the adolescent's health. These results are nearly identical to those from the model of worse as compared to the same health, again due to there being few physical health problems among adolescents who report they have the same or better health than

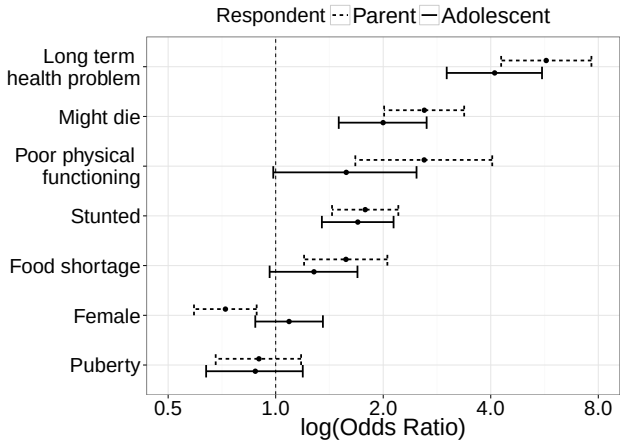

Figure 4. Log Odds ratios and 95 percent confidence intervals from logistic regression of worse as compared to same or better health report

Note: includes country fixed effect, wealth index, parent/adolescent education

their peers. Adolescents with a long term health problem, those with a recent serious illness or injury from which their parent thought they might die, and those that are stunted have statistically significantly higher odds of both parent- and adolescent-reported worse health. Interestingly, the coefficients on stunting – the only objectively measured health indicator – are closest in magnitude across the two models. Adolescents who have experienced a food shortage in the last 12 months and those who have poor physical functioning also have higher odds of being reported as in worse health, but only by their parent. While I find again that parents report female adolescents as having lower odds of worse as compared to the same or better health than their peers, the results for boys and girls do not differ when they are modeled separately, with the exception of the coefficients on puberty.[10]

In this third and preferred model – of worse as compared to same or better health – I find, using seemingly unrelated estimation, that the coefficients for whether the adolescent had an illness or injury from which the parent thought the adolescent might die, and whether the adolescent has a long term health problem are statistically significantly different at the 5% level (χ^2 statistics are 4.32 and 11.27, and p-values are 0.038 and 0.001, respectively). The coefficients for whether the adolescent is a female are also statistically significantly different between the two models (χ^2 statistic = 8.10, p-value = 0.004). The coefficients on poor physical functioning appear in Figure 4 to be quite different, but the χ^2 statistic is 3.71 with a p-value of 0.054; this may be due to the relatively few adolescents with poor physical functioning.

Table 3 presents odds ratios and 95% confidence intervals from multinomial logistic regression models that combine all three responses in one empirical specification. The results are quite consistent with the separate regular logistic regression models, with the significant association between the major physical health indicators and the health reports suggesting their convergent validity as measures of the adolescent's physical health.

3.2 Sensitivity and specificity

A final way in which to compare and evaluate the validity of the proxy and self-reports is using their sensitivity and specificity. I compute these values using the only measured indicator of health that is available in the Young Lives survey as the "gold standard": stunting. Thus, a "true positive" would be represented by an adolescent who is stunted reporting they are in worse health than their peers (the more true positives, the higher the sensitivity), while a false positive would be represented by an adolescent who is *not* stunted reporting they are in worse health than their peers. The more true negatives, the higher the specificity. I find high sensitivity of both adolescent SRH and parent's report of the adolescent's health – 0.91 and 0.87, respectively – but very low specificity – 0.16 and 0.22, respectively.[11] This indicates that both health reports are excellent at identifying adolescents who are stunted and thus in poor general health (with adolescent SRH having a slight advantage), but that they also incorrectly identify some adolescents who are not in poor health – i.e. those who are not stunted – as being in poor health.

3.3 Multiple imputation simulations

Finally, in the event that either the proxy or self-report is missing or implausible, each may be helpful for imputing the other. Multiple imputation simulations in which parent's reports are set randomly to missing that include adolescent SRH in the imputation process almost invariably produce a higher correlation with the actual reports than those that do not use adolescent SRH (Figure 5). Parent's reports are also effective in improving the imputation of missing adolescent SRH, with the exception of instances of very low levels of missing data (Figure 6).

4 Conclusions

The results suggest a moderate correlation between proxy and self-reported adolescent health in the Young Lives survey. The association between most of the available indicators of physical health and both adolescent SRH and parent's reports of the adolescent's health suggest their convergent validity, and that both health reports may provide

[10] See Figures A1 and A2 in the Appendix for models of worse as compared to same or better health separately for boys and girls.

[11] Specificity is improved when breaking the classification problem into worse as compared to same health – 0.22 for adolescent SRH and 0.29 for parent's report – but sensitivity declines for parent's report to 0.81.

Table 3
Odds ratios and 95 percent confidence intervals from multinomial logistic regression models of health reports (reference group is a report of the same health as the adolescent's peers)

	Adolescent SRH		Parent Report	
	Worse	Better	Worse	Better
Might die	2.18***	1.30*	2.73***	1.15
	(1.63, 2.92)	(1.05, 1.62)	(2.09, 3.58)	(0.92, 1.44)
Long term health problem	3.88***	0.80	5.36***	0.81
	(2.82, 5.33)	(0.57, 1.13)	(3.93, 7.30)	(0.57, 1.18)
Poor physical functioning	1.59	1.04	2.24***	0.53*
	(0.99, 2.56)	(0.64,1.69)	(1.42, 3.52)	(0.29, 0.96)
Stunted	1.69***	0.98	1.75***	0.94
	(1.33, 2.14)	(0.82, 1.17)	(1.40, 2.18)	(0.79, 1.12)
Food shortage	1.35*	1.19	1.57**	0.99
	(1.01, 1.81)	(0.97, 1.46)	(1.20, 2.07)	(0.80, 1.22)
Puberty	0.92	1.21	1.00	1.42***
	(0.67, 1.27)	(0.99, 1.48)	(0.76, 1.33)	(1.16, 1.72)
Female	1.21	1.50***	0.77**	1.20**
	(0.97, 1.52)	(1.29, 1.76)	(0.62, 0.94)	(1.03, 1.40)
Wealth index	0.45*	0.84	0.72	1.52
	(0.22, 0.92)	(0.52, 1.34)	(0.38, 1.39)	(0.96, 2.42)
Parent's educational attainment (ref.: no school)				
Parent some primary	1.01	1.36**	1.13	1.41**
	(0.74, 1.37)	(1.10, 1.68)	(0.85, 1.51)	(1.14, 1.73)
Parent more than primary	0.88	1.16	0.99	1.45**
	(0.62, 1.25)	(0.92, 1.47)	(0.71, 1.37)	(1.15, 1.82)
Adolescent in school	0.71	0.88	1.28	1.08
	(0.46, 1.11)	(0.63, 1.23)	(0.81, 2.01)	(0.77, 1.51)
Constant	0.16	0.36	0.08	0.37
	(0.09, 0.27)	(0.24, 0.53)	(0.04, 0.13)	(0.25, 0.54)

Note: All models include country fixed effects
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

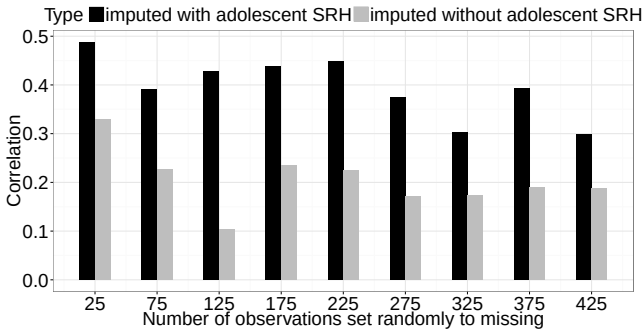

Figure 5. Spearman rank correlation between actual and imputed parent's health report (n = 3,541)

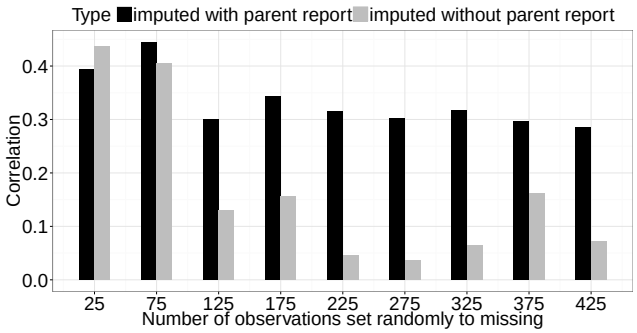

Figure 6. Spearman rank correlation between actual and imputed adolescent's SRH (n = 3,541)

meaningful information about adolescent's general health. Parent's proxy reports display a slightly stronger association with the available physical health indicators. The magnitudes of the coefficients for whether the adolescent had an illness or injury from which the parent thought they might die, and whether the adolescent had a long term health problem are statistically significantly larger in the models of the parent's report of the adolescent's health, although they are statistically significantly associated with both health reports.

While there is relatively little literature on this topic with which to compare these results, Boardman (2006) does describe two interpretations of what adolescent SRH may represent: either a spontaneous health assessment or an enduring self-concept. His results for younger adolescents are consistent with an enduring self-concept interpretation – that changes in physical well-being such as the onset of a disease or the transition away from a particular illness may not make the expected impact on an individual's perceptions of his or her overall health. While this study is not designed to distinguish between these two approaches, adolescents may indeed present a more rigid health assessment than their parents, which Boardman hypothesizes may be due to identity and body changes during this stage in the life course.

The differences between the regression results for proxy and self-reported health can suggest mechanisms through which the reports are produced, and the ways in which this process might differ across respondents. While it cannot be ruled out that the coefficients in the parent's regression models are larger in magnitude because a number of the physical health variables were reported by the parent, it may be the case that parents either more reliably remember health events than the adolescents, and/or they give more weight to illness, injury and long term health problems in their general assessment of the adolescent's health than the adolescents themselves do.

The difference between the coefficients for females in the two models is more easily interpretable: female adolescents have lower odds of their parent reporting they are in worse health than their peers, but female and male adolescents do not report their own health differently. A larger proportion of male adolescents' parents reported they had an illness or injury from which they thought they might die than female adolescents' parents. This suggests that male adolescents, who may venture out of the home more and thus be prone to injury and illness, are indeed in somewhat worse health than their peers, but do not report themselves as such. Male adolescents thus appear to be more optimistic in their health assessment than their parents. There could, of course, be additional differences between boys and girls in unmeasured covariates.

The results for sensitivity and specificity suggest somewhat of a tradeoff between the two reports, with adolescent SRH displaying slightly higher sensitivity, and the parent's report of the adolescent's health displaying slightly higher specificity (as they relate to stunting). Finally, exploratory multiple imputation simulations suggest that eliciting *both* proxy and self-reports significantly improves the imputation of either measure in the event that it is missing or implausible. Taken together, the results should temper assumptions regarding the superiority of either a parent or guardian's report (due to age or experience) or the adolescent's self-report (as the index individual). The findings suggest that the two reports are not interchangeable and may be complementary.

5 Discussion

Due to their simplicity and ease of collection, single question general health reports are widely used, particularly when survey, time, or other resources are limited, or when a specific facet of health is not the original or main objective of a data collection effort. Proxy reports from parents or guardians are almost invariably sought rather than reports from a non-adult index individual, but this choice has not previously been examined empirically in a low resource setting. This study is the first to evaluate and to directly compare adolescent SRH and the conventional proxy parent's report of the adolescent's health in developing countries. It is very unusual – and to my knowledge unprecedented – for both proxy and self-reports about health to be asked in the same survey in these contexts.

There are a number of limitations to this study. First, the physical health indicators with which the health reports are associated in regression analyses are just a subset of the information that respondents may be drawing upon to assess their general health status. These physical health indicators are, however, overlapping with those used in the few previous studies of adolescent SRH, which included problems walking or doing usual activities (Wu et al., 2014), having a diagnosed health problem, illness or disability (Breidablik et al., 2008; Waters et al., 2003) and the ability to undertake vigorous physical activity (Page et al., 2009), among others. While the physical health indicators available in the Young Lives survey are somewhat different, the Young Lives study population is very different from the study populations in other papers on this topic, all of which were from developed countries. Adolescents in developing countries face a very different and arguably more intense barrage of health insults than their developed country counterparts; they also may be more physically active, on average, and experience more severe resource constraints. It is thus not clear that even if the same physical health covariates that were used in the few previous studies of adolescent SRH were available in the Young Lives Survey, that we would wish to use them. The contexts in which the Young Lives data and data from previous studies on this topic were collected are very different, somewhat alleviating concerns regarding the need to use the same physical health indicators here as in other studies.

A second limitation is that most of the health measures that are included in the analyses are themselves self-reported. One may argue that it is unfair to compare the association between parent-reported physical health indicators and parent-reported health of the adolescent on the one hand, and adolescent SRH on the other. However, the robust association between most of the parent-reported physical health indicators and adolescent SRH should allay these concerns somewhat. Further, as previously described, the specific health questions are asked after the general health question in the Young Lives survey instrument, reducing concerns that parent's reports may be affected by their response to other health-related questions. It would be ideal, however, to also have the physical health indicators reported by the adolescent. It is also unfortunate that there are no other objectively measured physical health indicators available for the Young Lives older cohort to further establish the link between the health reports and physical health.[12] The closeness in the magnitude of the coefficients on stunting across models of adolescent SRH and parent's reports suggest that collecting more objectively measured health indicators may be important for future research. However, while access to biomarkers or other measured indicators of health would have been helpful, biomarkers included in household surveys are generally snapshot – not global – indicators of health, and their relationship with SRH is not necessarily as clear as one might expect; the cost of collecting biomarkers may also be a barrier.

A third limitation is that this paper uses health reports only from Young Lives respondents aged 12 on average at the time of the survey (i.e. the older cohort in wave 2) because it is only in this sub-sample that health reports were elicited from both parents and their children. Twelve year-olds are also sufficiently advanced in age and development to report about their own health. This unfortunately makes it impossible to assess health reports over time or to assess whether the results would be similar if the study was done with younger or older adolescents. Fourth, the general health question in the Young Lives survey is different from the standard 5-option question. While the use of an explicit reference group ("other children your [your child's] age") standardizes to whom the respondents are comparing themselves, the use of a non-standard question somewhat limits the comparisons to other studies of SRH. Finally, while the scope of this paper has been limited to the physical information associated with the two reports of the adolescent's general health, previous research on SRH suggests that the measure likely refers to a wider range of domains relevant to health than simply the physical (Lee, 2014). Further research on adolescent SRH should investigate its possible association with non-physical aspects of health such as mental health and social adjustment. Previous research suggests that parent-child agreement on questions regarding emotional or social wellbeing may be particularly low (C Eiser & Morse, 2001). Indeed, although SRH may principally reflect physical health problems (Krause & Jay, 1994), its multidimensionality may be particularly well suited to the characterization of adolescent health.

Studies of SRH more generally find that psychosocial factors (Benyamini, Leventhal, & Leventhal, 2000), trust and participation in groups and institutions, and collective efficacy (Browning & Cagney, 2002) may be embedded in individuals' SRH reports. This may be particularly true for adolescents, who have been found to understand their health as not just a physical phenomenon, but also reflecting personal, social-environmental, behavioral and psychological factors (Vinglis, Wade, & Seeley, 2000). Indeed, Waters et al. (2003), which focused on a sample of Australian adolescents, found that adolescent's SRH was more highly correlated with body pain and mental health than their parent's proxy report. In Page et al. (2009), the authors found that adolescent SRH was associated with a variety of feelings (hopelessness, shyness, self-rated happiness), as well as perceptions of physical attractiveness. In Breidablik et al. (2008), Norwegian adolescents' SRH was associated with a variety of "medical, social, and personal factors" such as self-esteem, mental health, and body concern. While the non-physical indicators are measured differently in each of these studies, taken together, they do suggest that non-physical feelings and characteristics may affect adolescent's health reports. This would certainly be a fruitful area of future research.

In spite of these limitations, this paper makes a contribution to the survey research literature by comparing and assessing the validity and utility of a proxy and self-reported measure of an important latent construct (health) in a novel setting (developing countries). The findings indicate that while not interchangeable, both adolescent SRH and parent's proxy report of the adolescent's health provide meaningful information about the state of the adolescent's physical health; each can also be used to improve the imputation of the other if one is is missing or implausible. The two health measures appear to be compliments rather than substitutes; the results should call into question assumptions regarding the superiority of either a parent or guardian's report or that of the index individual.

6 Acknowledgements

This work was supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health (Award Numbers

[12] I investigated whether either health report predicted whether the adolescent would be stunted in the next wave of data collection (when the Young Lives adolescents were 15, on average). Since stunting is a cumulative and often stable condition, particularly as growth slows in later adolescence, stunting at wave 2 (when the Young Lives adolescents are 12) predicts stunting at wave 3 better than do either of the health reports.

P32CHD04879 and T32HD007163 at Princeton University, and Award Number P2CHD058486 at the Columbia Population Research Center). The content is solely the responsibility of the author and does not necessarily represent the official views of the Eunice Kennedy Shriver National Institute of Child Health & Human Development or the National Institutes of Health. Many thanks to Jane Waldfogel, Irwin Garfinkel, Chris Wimer, Janet Currie, Doug Massey, Noreen Goldman, Germán Rodriguez, and Tom Espenshade. Thank you also to seminar participants at Mathematica Policy Research, the Harvard Center for Population Studies, Princeton University's Office of Population Research, and to panel participants and attendees at the 2016 Population Association of America Annual Meeting.

References

Ali, M. M., Minor, T., & Amialchuk, A. (2013). Estimating the biases associated with self-perceived, self-reported, and measured BMI on mental health. Available at http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0081021.

Andresen, E. M., Fitch, C. A., McLendon, P. M., & Meyers, A. R. (2000). Reliability and validity of disability questions for U.S. census 2000. *American Journal of Public Health*, *90*(8), 1297–1299.

Au, N. & Johnston, D. W. (2014). Self-assessed health: what does it mean and what does it hide? *Social Science and Medicine*, *121*, 21–28.

Bago d'Uva, T., Van Doorslaer, E., Lindeboom, M., & O'Donnell, O. (2008). Does reporting heterogeneity bias the measurement of health disparities? *Health Economics*, *17*(3), 351–75.

Baker, M., Stabile, M., & Deri, C. (2004). What do self-reported, objective, measures of health measure? *The Journal of Human Resources*, *39*(4), 1067–1093.

Barnett, I., Ariana, P., Petrou, S., Penny, M. E., Duc, L. T., Galab, S., … Boyden, J. (2012). Cohort profile: the Young Lives Study. *International Journal of Epidemiology*.

Bauldry, S., Shanahan, M. J., Boardman, J. D., Miech, R. A., & Macmillan, R. (2012). A life course model of self-rated health through adolescence and young adulthood. *Social Science and Medicine*, *75*, 1311–1320.

Becker, C., Rodkin, S., O'Connor, K., & Moorman, J. (2004). How accurate are proxy reports: results of a verification study. Paper presented at the annual meeting of the American Association for Public Opinion Research, Pointe Hilton Tapatio Cliffs, Phoenix, Arizona.

Benjamins, M. R., Hummer, R. A., Eberstein, I. W., & Nam, C. B. (2004). Self-reported health and adult mortality risk: an analysis of cause-specific mortality. *Social Science and Medicine*, *59*(6), 1297–306.

Benyamini, Y., Leventhal, E. A., & Leventhal, H. (2000). Gender differences in processing information for making self-assessments of health. *Psychosomatic Medicine*, *62*(3), 354–64.

Boardman, J. D. (2006). Self-rated health among US adolescents. *Journal of Adolescent Health*, *38*(4), 401–408.

Bourdillon, M. (2012). Introduction. In J. Boyden & M. Bourdillon (Eds.), *Childhood poverty: multidisciplinary approaches* (pp. 1–12). Pallgrave Macmillon: Palgrave.

Bowling, A. & Windsor, J. (2008). The effects of question order and response-choice on self-rated health status in the English Longitudinal Study of Ageing (ELSA). *Journal of Epidemiology and Community Health*, *62*, 81–85.

Breidablik, H. J., Meland, E., & Lydersen, S. (2008). Self-rated health in adolescence: a multifactorial composite. *Scandinavian Journal of Public Health*, *36*, 12–20.

Browning, C. R. & Cagney, K. A. (2002). Neighborhood structural disadvantage, collective efficacy, and self-rated physical health in an urban setting. *Journal of Health and Social Behavior*, *43*(4), 383–399.

Butler, J., Burkhauser, R. V., Mitchell, J. M., & Pincus, T. P. (1987). Measurement error in self-reported health variables. *The Review of Economics and Statistics*, *69*(4), 644–650.

Bzostek, S., Goldman, N., & Pebley, A. (2007). Why do Hispanics in the U.S.A. report poor health? *Social Science and Medicine*, *65*(5), 990–1003.

Case, A., Fertig, A., & Paxson, C. (2005). The lasting impact of childhood health and circumstance. *Journal of Health Economics*, *24*, 365–389.

Case, A. & Paxson, C. (2010). Causes and consequences of early-life health. *Demography*, *47*, 65–85.

Celis-Morales, C. A., Perez-Bravo, F., Ibanez, L., Salas, C., Bailey, M. E. S., & Gill, J. M. R. (2012). Objective vs. self-reported physical activity and sedentary time: effects of measurement method on relationships with risk biomarkers. *PloS One*, *7*(5).

Clarke, P. M. & Ryan, C. (2006). Self-reported health: reliability and consequences for health inequality measurement. *Health Economics*, *15*(6), 645–52.

Cobb, C. (2012). Proxy reporting. In *The Future of Survey Research: Challenges and Opportunities. A Report to the National Science Foundation*. The National Science Foundation Advisory Committee for the Social, Behavioral and Economic Sciences Subcommittee on Advancing SBE Survey Research:

Cobb, C. & Krosnick, J. A. (2009). Experimental test of the accuracy of proxy reports compared to target report with third-party validity. Presented at the American Association for Public Opinion Research Annual Meeting, Hollywood, Florida.

Cremeens, J., Eiser, C., & Blades, M. (2006). Factors influencing agreement between child self-report and parent proxy-reports on the Pediatric Quality of Life Inventory 4.0 (PedsQLTM) generic core scales. *Health and Quality of Life Outcomes*, *4*(58).

Crossley, T. F. & Kennedy, S. (2002). The reliability of self-assessed health status. *Journal of Health Economics*, *21*(4), 643–58.

Dowd, J. B. & Zajacova, A. (2007). Does the predictive power of self-rated health for subsequent mortality risk vary by socioeconomic status in the US? *International Journal of Epidemiology*, *36*(6), 1214–21.

Eiser, C. [C] & Morse, R. (2001). Quality-of-life measures in chronic diseases of childhood. *Health Technology Assessment*, *5*(4), 1–157.

Eiser, C. [Christine] & Varni, J. W. (2013). Health-related quality of life and symptom reporting: similarities and differences between children and their parents. *European Journal of Pediatrics*, *172*, 1299–1304.

Elliott, M. N., Beckett, M. K., Chong, K., Hambarsoomians, K., & Hays, R. D. (2008). How do proxy responses and proxy-assisted responses differ from what Medicare beneficiaries might have reported about their health care? *Health Services Research*, *4*(3), 833–848.

Escobal, J. A. & Flores, E. (2008). An assessment of the Young Lives sampling approach in Peru. Young Lives Technical Note No. 3, Available at http://r4d.dfid.gov.uk/PDF/Outputs/YoungLives/TN03-PeruSample.pdf.

Etile, F. & Milcent, C. (2006). Income-related reporting heterogeneity in self-assessed health: evidence from france. *Health Economics*, *15*, 965–981.

Garbarski, D. (2014). Comparing self and maternal reports of adolescents' general health status: do self and proxy reports differ in their relationships with covariates? *Quality of Life Research*, *23*, 1953–1965.

Garbarski, D., Schaeffer, N. C., & Dykema, J. (2015). The effects of response option order and question order on self-rated health. *Quality of Life Research*, *24*, 1443–1453.

Goldman, N., Lin, I. F., Weinstein, M., & Lin, Y. H. (2003). Evaluating the quality of self-reports of hypertension and diabetes. *Journal of Clinical Epidemiology*, *56*(2), 148–54.

Groot, W. (2000). Adaptation and scale of reference bias in self-assessments of quality of life. *Journal of Health Economics*, *19*, 403–420.

Henningsen, A. & Hamann, J. D. (2015). *Systemfit: a package for estimating systems of simultaneous equations in R*. The Comprehensive R Network.

Hurd, M. D. & McGarry, K. (1995). Evaluation of the subjective probabilities of survival in the health and retirement study. *The Journal of Human Resources (Special Issue on Health and Retirement)*, *30*, 268–292.

Idler, E. L. & Angel, R. J. (1990). Self-rated health and mortality in the NHANES-I epidemiologic follow-up study. *American Journal of Public Health*, *80*, 446–452.

Idler, E. L. & Benyamini, Y. (1997). Self-rated health and mortality: a review of twenty-seven community studies. *Journal of Health and Social Behavior*, *38*(1), 21–37.

Idler, E. L. & Kasl, S. (1991). Health perceptions and survival: do global evaluations of health status really predict mortality? *Journal of Gerontology*, *46*(2), 55–65.

Idler, E. L., Russell, L. B., & Davis, D. (2000). Survival, functional limitations, and self-rated health in the NHANES I epidemiologic follow-up study, 1992. First National Health and Nutrition Examination Survey. *American Journal of Epidemiology*, *152*(9), 874–83.

Johnson, S. B. & Wang, C. (2008). Why do adolescents say they are less healthy than their parents think they are? The importance of mental health varies by social class in a nationally representative sample. *Pediatrics*, *121*(e307).

Johnston, D. W., Propper, C., & Shields, M. A. (2007). Comparing subjective and objective measures of health: evidence from hypertension for the income/health gradient. *Journal of Health Economics*, *28*(3), 540–552.

Jurges, H. (2007). True health vs response styles: exploring cross-country differences in self-reported health. *Health Economics*, *16*(2), 163–78.

Jurges, H., Avendano, M., & Mackenbach, J. P. (2008). Are different measures of self-rated health comparable? an assessment in five European countries. *European Journal of Epidemiology*, *23*(12), 773–81.

Jylha, M. (2009). What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Social Science and Medicine*, *69*, 307–316.

Jylha, M., Guralnik, J. M., Ferrucci, L., Jokela, J., & Heikkinen, E. (1998). Is self-rated health comparable across cultures and genders? *The Journal of Gerontology Series B: Psychological Sciences and Social Sciences*, *53*(3), 144–152.

King, T., Cook, S., & Childs, J. H. (2012). Interviewing proxy versus suspected duplicate respondents to obtain information regarding potential duplicate living situations. Presented at the American Association of Public Opinion Research Annual Conference, Orlando, FL.

Krause, N. M. & Jay, G. M. (1994). What do global self-rated health items measure? *Medical Care*, *32*(9), 930–42.

Kuhn, R., Rahman, O., & Menken, J. (2006). Aging in Sub-Saharan Africa: recommendation for furthering research. In B. Cohen & J. Menken (Eds.), (pp. 314–341). National Research Council (US) Committee on Population.

Kumra, N. (2008). *An assessment of the young lives sampling approach in Andhra Pradesh, India*. Young Lives. Available at http://bit.ly/1BiFATj.

Layes, A., Asada, Y., & Kepart, G. (2012). Whiners and deniers - what does self-rated health measure? *Social Science and Medicine*, *75*(1), 1–9.

Lee, S. (2014). Self-rated health in health surveys. In T. P. Johnson (Ed.), *Handbook of health survey methods* (pp. 193–216). Wiley.

Lee, S. & Grant, D. (2009). The effect of question order on self-rated general health status in a multilingual survey context. *American Journal of Epidemiology*, *169*(12), 1525–30.

Lee, S., Mathiowetz, N., & Tourangeau, R. (2004). Perceptions of disability: the effect of self- and proxy-response. *Journal of Official Statistics*, *20*(4), 671–686.

Lee, S. & Schwarz, N. (2014). Question context and priming meaning of health: effect on differences in self-rated health between Hispanics and non-Hispanic Whites. *American Journal of Public Health*, *104*(1), 179–185.

Lin, C.-Y., Su, C.-T., Wang, J.-D., & Ma, H.-I. (2013). Self-rated and parent-rated quality of life (QoL) for community-based obese and overweight children. *Acta Paediatrica*, *102*(3), e114–e119.

Lindeboom, M. & Doorslaer, E. v. (2004). Cut-point shift and index shift in self-reported health. *Journal of Health Economics*, *23*(6), 1083–1099.

Lundberg, O. & Manderbacka, K. (1996). Assessing reliability of a measure of self-rated health. *Scandinavian Journal of Public Health*, *24*, 218–224.

Manor, O., Matthews, S., & Power, C. (2001). Self-rated health and limiting longstanding illness: inter-relationships with morbidity in early adulthood. *International Journal of Epidemiology*, *30*(3), 600–7.

Moore, J. C. (1988). Self/proxy response status and survey response quality: a review of the literature. *Journal of Official Statistics*, *4*(2), 155–172.

Nguyen, N. (2008). *An assessment of the Young Lives sampling approach in Vietnam*. Available at http://www.younglives . org . uk / publications / TN / assessment - young-lives-sampling-approach-vietnam.

Normandeau, S., Kalnins, I., Jutras, S., & Hanigan, D. (1998). A description of 5- to 12-year old children's conception of health within the context of their daily life. *Psychology and Health*, *13*, 883–896.

Outes-Leon, I. & Sanchez, A. (2008). *An assessment of the Young Lives sampling approach in Ethiopia*. Young Lives.

Page, R. M., Simonek, J., Ihász, F., Hantiu, I., Uvacsek, M., Kalabiska, I., & Klarova, R. (2009). Self-rated health, psychosocial functioning, and other dimensions of adolescent health in Central and Eastern European adolescents. *European Journal of Psychiatry*, *23*(2), 101–114.

Piko, B. & Fitzpatrick, K. M. (2001). Does class matter? SES and psychosocial health among Hungarian adolescents. *Social Science and Medicine*, *53*(6), 817–30.

Punpanich, W., Hays, R. D., Detels, R., Chokephaibulkit, K., Chantbuddhiwet, U., Leowsrisook, P., & Prasitsuebsai, W. (2011). Development of a culturally appropriate health-related quality of life measure for human immunodeficiency virus-infected children in Tailand. *Journal of Pediatrics and Child Health*, *47*, 27–33.

R Core Team. (2014). *R: a language and environment for statistical computing*. R Foundation for Statistical Computing. Vienna, Austria.

Rajmil, L., Lopez, A. R., Lopez-Aguila, S., & Alonso, J. (2013). Parent-child agreement on health-related quality of life (HRQOL): a longitudinal study. *Health and Quality of Life Outcomes*, *11*.

Riley, A. W. (2004). Evidence that school-age children can self-report on their health. *Ambulatory Pediatrics*, *4*(4 Suppl), 371–6.

Sakshaug, J. W. (2014). Proxy reporting in health surveys. In T. P. Johnson (Ed.), *Handbook of health survey methods* (pp. 367–381). Wiley.

Singh-Manoux, A., Martikainen, P., Ferrie, J., Zins, M., Marmot, M., & Goldberg, M. (2006). What does self-rated health measure? Results from the British Whitehall II and French Gazel cohort studies. *J Epidemiol Community Health*, *60*(4), 364–72.

Smith, K. V. & Goldman, N. (2011). Measuring health status: self-, interviewer, and physician reports of overall health. *Journal of Aging and Health*, *23*(2), 242–266.

Strauss, J. & Thomas, D. (1998). Health, nutrition and economic development. *Journal of Economic Literature*, *36*(2), 766–817.

Su, Y.-S., Gelman, A., Hill, J., & Yajima, M. (2011). Multiple imputation with diagnostics (mi) in R: opening windows into the black box. *Journal of Statistical Software*, *45*(2).

Todd, M. A. & Goldman, N. (2013). Do interviewer and physician health ratings predict mortality?: a comparison with self-rated health. *Epidemiology*, *24*(6), 913–20.

UK Data Archive. (2016). Young Lives Study of international child poverty data. Available at www . data - archive.ac.uk.

Upton, P., Lawford, J., & Eiser, C. (2008). Parent-child agreement across child health-related quality of life instruments: a review of the literature. *Qual Life Res*, *17*(6), 895–913.

van Doorslaer, E., Wagstaff, A., van der Burga, H., Christiansen, T., De Graeved, D., Duchesned, I., … Winkelhakej, O. (2000). Equity in the delivery of health care

in Europe and the US. *Journal of Health Economics*, *19*(5), 553–583.

Vie, T. L., Hufthammer, K. O., Holmen, T. L., Meland, E., & Breidablik, H. J. (2014). Is self-rated health a stable and predictive factor for allostatic load in early adulthood? Findings from the Nord Trøndelag Health Study (HUNT). *Social Science and Medicine*, *117*, 1–9.

Vinglis, E., Wade, T. J., & Seeley, J. S. (2000). *What factors predict adolescent self-rated health and health care utilization?* The Community Health Reporter. Available at http://www.uwo.ca/fammed/pchu/NHRDP_update.pdf.

Vinglis, E., Wade, T. J., & Adlaf, E. (1998). What factors predict student self-rated physical health? *Journal of Adolescence*, *21*, 83–97.

Waters, E., Stewart-Brown, S., & Fitzpatrick, R. (2003). Agreement between adolescent self- report and parent reports of health and well-being: results of an epidemiological study. *Child: Care, Health and Development*, *29*(6), 501–509.

WHO Multicentre Growth Reference Study Group. (2006). Enrolment and baseline characteristics in the WHO Multicentre Growth Reference Study. *Acta Pædiatrica*, *Suppl 450*, 7–15.

Wu, X., Ohinmaa, A., Johnson, J., & Veugelers, P. (2014). Assessment of children's own health status using visual analogue scale and descriptive system of the EQ-5D-Y: linkage between two systems. *Quality of Life Research*, *23*, 393–402.

Young Lives. (2002). *Summary of the Young Lives conceptual framework*. Available at http : / / r4d . dfid . gov . uk / PDF / Outputs / YoungLives / YoungLives - ConceptualFramework-Overview.pdf.

Appendix A
Figures

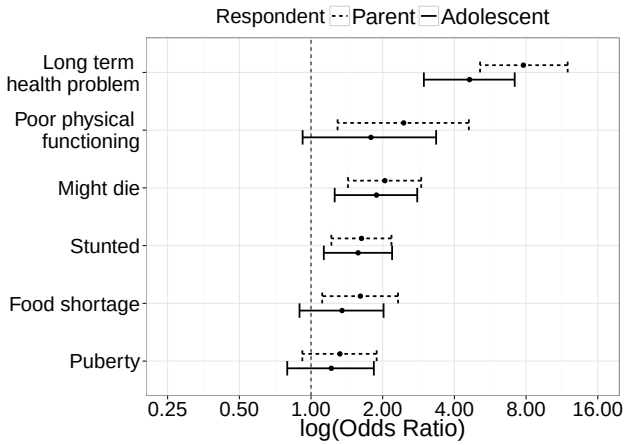

Figure A1. Log Odds ratios and 95 percent confidence intervals from logistic regression of worse as compared to same or better health report (just boys)
Note: includes country fixed effect, wealth index, parent/adolescent education

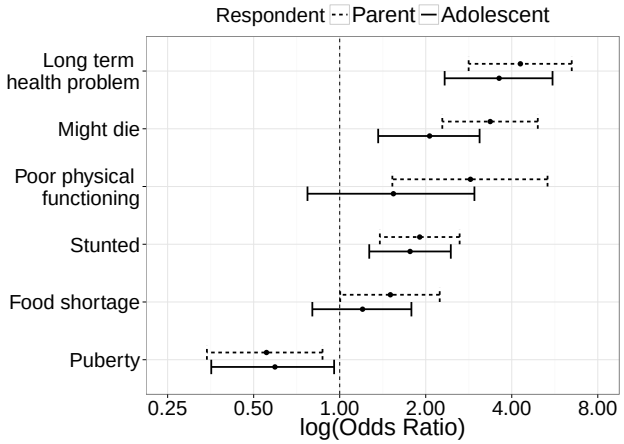

Figure A2. Log Odds ratios and 95 percent confidence intervals from logistic regression of worse as compared to same or better health report (just girls)
Note: includes country fixed effect, wealth index, parent/adolescent education

Appendix B
Tables

(Appendix tables follow on next page)

Table B1
Concordance between male adolescent SRH and parent's reports

	Adolescent's Report							
	Worse		Same		Better		All	
Parent's Report	%	*n*	%	*n*	%	*n*	%	*n*
Worse	42	130	49	151	9	29	100	310
Same	6	53	78	774	16	155	100	982
Better	4	18	50	242	47	233	100	493

Table B2
Concordance between female adolescent SRH and parent's reports

	Adolescent's Report							
	Worse		Same		Better		All	
Parent's Report	%	*n*	%	*n*	%	*n*	%	*n*
Worse	47	114	41	99	12	29	100	242
Same	8	74	74	699	18	174	100	947
Better	4	23	38	217	58	327	100	567

Table B3
Odds ratios and standard errors from logistic regression of worse as compared to same, and better as compared to same health report

	Worse		Better	
	Parent	Adolescent	Parent	Adolescent
Might die	2.817***	2.190***	1.148	1.299*
	(0.141)	(0.152)	(0.115)	(0.111)
Long term health problem	5.279***	3.992***	0.842	0.828
	(0.159)	(0.165)	(0.191)	(0.177)
Poor physical functioning	2.210***	1.573	0.520*	1.058
	(0.235)	(0.248)	(0.308)	(0.250)
Stunted	1.782***	1.711***	0.939	0.970
	(0.114)	(0.121)	(0.091)	(0.092)
Food shortage	1.596**	1.360*	0.991	1.194
	(0.144)	(0.149)	(0.108)	(0.106)
Puberty	1.012	0.938	1.396***	1.192
	(0.148)	(0.164)	(0.101)	(0.102)
Female	0.788*	1.236	1.197*	1.502***
	(0.108)	(0.115)	(0.079)	(0.080)
Wealth index	0.813	0.449*	1.570	0.844
	(0.339)	(0.368)	(0.238)	(0.241)
Educational attainment (ref.: no school)				
Parent some primary	1.145	1.013	1.363**	1.339**
	(0.149)	(0.158)	(0.106)	(0.107)
Parent more than primary	0.965	0.874	1.436**	1.153
	(0.170)	(0.180)	(0.118)	(0.121)
Adolescent in school	1.279	0.727	1.061	0.865
	(0.236)	(0.228)	(0.172)	(0.172)
Constant	0.071***	0.150***	0.377***	0.366***
	(0.291)	(0.283)	(0.200)	(0.202)
Observations	2,481	2,594	2,989	3,129
Log Likelihood	−1,102.411	−1,008.312	−1,872.743	−1,826.482
Akaike Inf. Crit.	2,234.821	2,046.624	3,775.486	3,682.965

Note: All models include country fixed effects
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Table B4
Odds ratios and standard errors from logistic regression of worse as compared to same or better health reports

	Parents	Adolescents
Might die	2.607***	1.999***
	(0.132)	(0.144)
Long term health problem	5.718***	4.102***
	(0.148)	(0.157)
Poor physical functioning	2.604***	1.576
	(0.225)	(0.235)
Stunted	1.781***	1.698***
	(0.109)	(0.118)
Food shortage	1.573***	1.280
	(0.137)	(0.144)
Puberty	0.898	0.877
	(0.140)	(0.159)
Female	0.723**	1.090
	(0.103)	(0.111)
Wealth index	0.640	0.481*
	(0.323)	(0.353)
Educational attainment (ref.: no school)		
Parent some primary	1.006	0.926
	(0.142)	(0.153)
Parent more than primary	0.872	0.832
	(0.161)	(0.174)
Adolescent in school	1.246	0.749
	(0.224)	(0.216)
Observations	3,541	3,541
Log Likelihood	−1,268.112	−1,123.449
Akaike Inf. Crit.	2,566.224	2,276.898

Note: All models include country fixed effects
* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$