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

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Abstract

Self-reported health (SRH) provides a simple, direct, and global way in which to capture perceptions of a person's health. Most household surveys defer to parents or other caregivers to provide reports regarding children's and adolescents' general health. But little is known about the validity and utility of these health reports, particularly in developing countries. The Young Lives Study of International Child Poverty is one of the few data collection efforts undertaken in a low resource setting to elicit both adolescent's SRH and conventional parent's reports about the adolescent's health. This paper undertakes an assessment of both, first by evaluating their convergent validity as illustrated by their association with major physical health indicators, and then by estimating their sensitivity and specificity. While results point to the validity of both reports, parent's health assessments appear to be slightly more robustly associated with indicators of the adolescent's physical health. Adolescents with a long term health problem

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have 4 times the odds of reporting they are in worse as compared to the same or better health as their peers; the odds are 6 times for the parent's report. Exploratory multiple imputation simulations suggest that researchers should request *both* adolescent SRH and parent's reports in household surveys; having both substantially improves the imputation of one if it is missing or implausible. As such, this paper contributes to literature on the measurement of latent constructs in household surveys, and the quantification of the burden of poor health.

Introduction

Good health is essential for brain development, educational attainment, labor force participation, and longevity, among other facets of wellbeing across the life course. Levels and trends in child health are generally assessed using indicators of under-five mortality and height for age, and adult health with clinical endpoints such as mortality from cardiovascular disease, and morbidities such as cancer. Adolescence, however, as a transitory period between the health risks of childhood and those of adulthood, is often presumed to be a time of excellent health (Erginoz et al., 2004; Vinglis et al., 1998). Research on this age group has generally focused on sexual activity and/or drug use in select populations, as well as poor mental health and its psychosomatic implications (Haugland and Wold, 2001; Ansari et al., 2013). While investigating these specific issues is helpful for more deeply understanding the different facets of an adolescent's health, assessing adolescents' health in general is equally important given the association between poor overall health in early life and adult morbidity and mortality (Piko, 2007). One way of obtaining information about adolescents' general health is to ask a self-rated health (SRH) question, which usually appears in the form "How would you rate your health?", with options of very poor, poor, good, very good, or excellent.

SRH enjoys widespread use in social science research (Baker et al., 2004; Johnston et al., 2007; Strauss and 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 par-

ticularly 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 studies 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 et al., 2012), and biomarkers and other health measures can be costly to collect (Etile and Milcent, 2006). The validity and stability of SRH has been investigated most thoroughly in adults and the elderly (Fosse and Haas, 2009; Goldman et al., 2004; Molarius and Janson, 2002; Murata et al., 2006; Smith and Goldman, 2011). Much less is known about adolescent SRH (Boardman, 2006), especially in low resource settings. This is partly because many household surveys defer to parents or other caregivers to provide reports regarding children's and adolescents' general health (Garbarski, 2014). However, the Young Lives Study of International Child Poverty is one of the few data collection efforts in a low resource setting to elicit both the conventional parent's report and adolescent SRH, and to measure a variety of standard physical health indicators. With these data I address the following research questions:

1. Do major physical health conditions predict adolescent SRH and/or parent's report of the adolescent's health?
    (a) Is one of the two health reports a more informative indicator of whether the adolescent is in particularly poor health?
    (b) Is there a case for asking for both health reports?

The first sub-question is particularly important from a policy perspective, as it may inform our understanding of the distribution of the burden of disease, and inform efforts to reduce it. While

comparisons of health reports from different sources on the same index individual have been undertaken previously (Todd and Goldman, 2013; Waters et al., 2003; Smith and Goldman, 2011), the analyses I present here are the first to do so using data from developing countries.

I use the framework of convergent validity to assess whether adolescent SRH and/or parents' report of the adolescent's health is an informative indicator 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 is whether measures of a construct that are expected to be related are, in fact, related. A statistically significant association between the health reports and major indicators of physical health would be supportive of the health 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 measured indicator of poor child and adolescent nutritional and epidemiological environment.

Given the precious few methods by which adolescent general health may be evaluated, the results of these analyses are promising: both adolescent SRH - and to an even greater extent, parent's report - are associated with physical health indicators, and thus may provide substantial information regarding the physical aspects of an adolescent's health. Both health reports exhibit high sensitivity, although their specificity is significantly lower. Finally, exploratory multiple imputation simulations suggest that collecting both parent's health reports *and* adolescent SRH may be helpful to researchers using these measures; each are found to substantially improve the imputation of the other if missing or implausible.

Self-reported health

SRH provides a simple, direct, and global way of capturing perceptions of health (Idler and Benyamini, 1997; Idler et al., 2000). While individuals may not accurately assess isolated health-

related issues such as overweight (Ali et al., 2013; Clarke and Ryan, 2006), arthritis (Butler et al., 1987), physical activity (Celis-Morales et al., 2012), and hypertension (Goldman et al., 2003), general SRH has been shown to be a robust predictor of later health outcomes such as mortality (Idler and 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 et al., 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 Page et al. (2009); Vie et al. (2014); Au and Johnston (2014) for excellent reviews of this literature).

Early SRH research was very optimistic regarding the validity and usefulness of the measure (Hurd and McGarry, 1995; Idler and 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 and 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 et al., 2008; Layes et al., 2012; Lindeboom and Doorslaer, 2004), the placement of survey questions in a survey questionnaire (Bowling and Windsor, 2008; Crossley and Kennedy, 2002; Lee and Grant, 2009), type of survey administration (Clarke and Ryan, 2006), and answer options (Jurges et al., 2008). These challenges notwithstanding, SRH has proven to be a uniquely informative health indicator.

Adolescent's self-reported health

Although SRH has been studied extensively in adults and the elderly (Manor et al., 2001), adolescent SRH has not received the same attention from researchers (Page et al., 2009; Breidablik et al., 2008). Much of the literature on health-related self reports from young people involve their reporting either about their quality of life (Lin et al., 2013; Upton et al., 2008; Punpanich et al., 2011; Cremeens et al., 2006; Eiser and Varni, 2013; Rajmil et al., 2013) or about specific and separate psychosocial, social/familial, behavioral, symptomatic, or economic dimensions of well-being (Vinglis et al., 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 et al., 2014) and comprehend the importance of functionality, lifestyle and mental health (Normandeau et al., 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 et al., 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 et al., 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 indicates

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 (Waters et al., 2003; Page et al., 2009).

In the few previous studies on the topic, a wide variety of variables have been identified as being associated with adolescent SRH, including physical health, the structural environment, social factors, health behavior, psychological health, and demographic information (Breidablik et al., 2008). This research has been conducted almost exclusively in the US and the UK, however, and suggests that SRH in these contexts may be a valid measure of health. This paper is the first step towards evaluating the validity and thus the utility of both adolescent SRH and parent's reports of an adolescent's health in developing countries.

Data and Methods

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 jointly funded by the Department for International Development (DFID) and the Netherlands Ministry of Foreign Affairs. 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 (Outes-Leon and Sanchez, 2008; Kumra, 2008; Nguyen, 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 and 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 Vietnam), respectively.

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

Analysis overview

The way in which I explore the convergent validity of adolescent SRH and parent's reports of the adolescent's health is by evaluating their association with other measures of the same underlying construct, namely major physical heath indicators. I do this by estimating a regression model with the health reports - separately - on the left-hand side as outcomes, and physical health indicators on the right-hand side as predictors. A significant association between health reports and physical health indicators would suggest that the health reports do indeed exhibit validity, and that they may reflect well the physical health of adolescents. An additional secondary strategy I use is 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 outlines more specifically the outcome and predictor variables and the regression specification, and engages in a more in-depth discussion of sensitivity and specificity.

Outcome variables

Health reports 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 and Jay, 1994). For example, older individuals may consider themselves in excellent health in spite of physical ailments because they are comparing themselves to their peers, some of whom may have died. I would argue that since respondents will always 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 parent and 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 (Figure 2) 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, over 40% 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 concordance between female and male adolescent's report and their parent's report are presented in the Appendix.

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

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 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 final specification has the advantage of using all information concurrently.

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 he/she 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.[2] I also include an indicator for whether the parent reported there had been a food shortage 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 1). We would hypothesize that a yes to each of these four physical health indicators 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 1). 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.

Measured: There is one 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 used indicator of an individual's long term nutritional and epidemiological environment (Case et al., 2005; Case and Paxson, 2010).

[2]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.

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).[3] Almost a third of adolescents (about 31.2 percent) were stunted in wave 2 (Table 1). We would hypothesize that stunting would be associated with higher odds of reporting worse health as compared to the adolescent's peers.

Socio-demographic

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 et al., 2004), education, culture (Jylha et al., 1998), and personality, just to name a few (Groot, 2000; Jylha, 2009; Layes et al., 2012; Bzostek et al., 2007; Jurges, 2007; Etile and Milcent, 2006). Health reports also vary by a family's socioeconomic status (Piko and Fitzpatrick, 2001; Bago d'Uva et al., 2008; Dowd and Zajacova, 2007); 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, parental 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.[4] I also include an indicator for whether the adolescent is female; it may

[3]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).

[4]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

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 1).

All analyses include country fixed effects in order to control for differences in level of development, culture, etc.[5] 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 variable 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.

Methods

As outlined previously, finding a significant association between the 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

main source of drinking water; type of toilet facility; and the type of fuel used for cooking.

[5] 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.

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 SRH for identifying young people in poor health; a better understanding of the burden of disease can inform resource allocation and intervention. Equation 1 presents this specification; the odds of reporting worse as compared to the same or better health.

$$log(\frac{p(worsehealth)}{1-p(worsehealth)}) = \beta_0 + \beta_{1-6}phys\_hlth + \beta_{7-8}educ + \beta_9 wealth + \beta_{10-12}country + \beta_{13}female \quad (1)$$

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.

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.[6]

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

[6]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".

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 these types of data, I perform a number of exploratory analyses using multiple imputation simulation procedures. These analyses address the question of which health report the researcher should collect, and whether they 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 et al., 2011). This package approximates a Bayesian framework, running multiple chains and assessing their convergence after a pre-specified 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[7] 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).

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

Results

Predicting health reports

Odds ratios from regular logistic regression models of the association between health reports and a variety of physical health indicators are presented in Figures 3-5. 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 A1 and A2.

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 3). 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. 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 4). 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. 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 do find, however, in Figure 4, that adolescents who have undergone puberty are reported by their parents as being in significantly better (versus the same) health as their peers (OR: 1.40, CI: 1.15, 1.70), while having poor or disabling physical functioning is associated with significantly lower odds of being reported as such (OR: 0.52, CI: 0.27, 0.93). This latter finding is again supportive of the idea that parents consider disabling physical challenges to be health problems. Further, adolescent reports of better as compared to the same health are counterintuitively associated with having had a recent serious illness or injury from which their parent thought they might die (OR: 1.30, CI: 1.04, 1.61). This may reflect improvement in health after an acute event. Finally, both parents of, and female adolescents themselves, report higher odds of better as compared to the same health.

Because one of the important functions of health reports is to identify individuals in poor health, Figure 5 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 parent's report of the adolescent's health. These results are nearly identical to those of worse as compared to the same health, again due to there being few physical health problems among adolescents who report they have same or better health than 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. 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, the results for boys and girls do not differ when they are modeled separately.[8] Taken together, the regression results presented in Figures 3-5 suggest that both adolescent - and to a slightly greater extent parent - health reports are significantly associated with physical health indicators, suggesting their usefulness as valid gauges of an adolescent's physical health.

Table 2 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.

Sensitivity and specificity

A final way in which to evaluate the validity of these health 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, while a false positive would be represented by an adolescent who is *not* stunted reporting they are in worse health than their peers. 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.[9] This indicates that the health reports are excellent at identifying adolescents in poor

[8] See Figures A3 and A4 in the Appendix for models of worse as compared to same or better health separately for boys and girls.

[9] 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.

health, 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.

Multiple imputation simulations

Finally, while it appears that parent's reports may be a slightly more informative indicator of an adolescent's physical health than adolescent SRH, in the event that these data are missing or implausible, adolescent SRH may be particularly helpful for imputing parental responses. More specifically, imputations of parent reports 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 6). 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 7).

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. However, these respondent-reported health measures - and particularly those of adolescents - have not been studied in low resource contexts. It is in these contexts that the efficient and effective collection of health information may be particularly helpful for targeting and evaluating programs intended to improve human wellbeing, and for assessing the burden of poor health. This study is the first to evaluate and to directly compare adolescent SRH and the conventional parent's report of the adolescent's health in low-resource settings. It is very unusual - and to my knowledge unprecedented - for both adolescent and parent health reports to be asked in the same survey in these contexts.

The association between indicators of poor physical health and both adolescent SRH and parents' reports of the adolescent's health suggest their convergent validity (as compared to major physical health indicators), and that both health reports may provide meaningful information about adolescents' general health. Parent's reports display a slightly stronger association with physical health indicators than adolescent's SRH, however. Exploratory multiple imputation simulations suggest that eliciting both parent's report and adolescent SRH significantly improves the imputation of either measure in the event that it is missing or implausible. Even if researchers prefer the parent's report of the adolescent's health, it may still be informative to collect adolescent reports where possible.

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.

There are a number of additional important 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. Further, most of the health measures that are included in the analyses are themselves self-reported.[10] Unfortunately, there are no other measured physical (or mental or social) health indicators available for the Young Lives older cohort to further establish the link between health reports and physical

[10]One may argue that it is unfair to compare the association between parent-reported physical health indicators and parent-reported health 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.

health. 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.

Second, 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. Third, the SRH measure 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 (Eiser and Morse, 2001). Indeed, although SRH may principally reflect physical health problems (Krause and 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 et al., 2000), trust and participation in groups and institutions, and collective efficacy (Browning and 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 et al., 2000).

In spite of these limitations, this paper makes a contribution both to the survey research literature and to the literature on the assessment of health among young adults. The findings indicate that both adolescent SRH and parent's report of the adolescent's health provide meaningful information about the state of the adolescent's physical health; each can be used to improve the imputation of the other if the preferred measure is missing or implausible. While SRH is already in wide use in developed countries, it may also prove useful in low-resource settings for identifying adolescents in poor general health.

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Tables and Figures

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

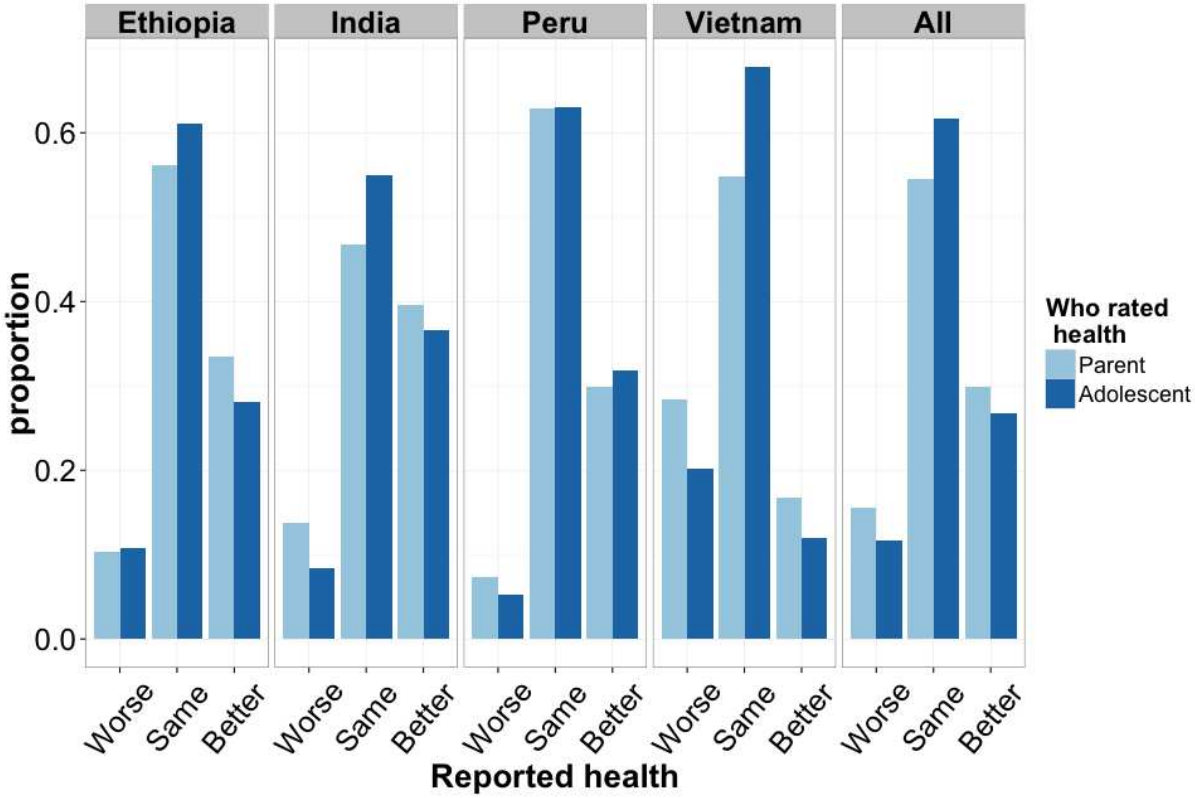


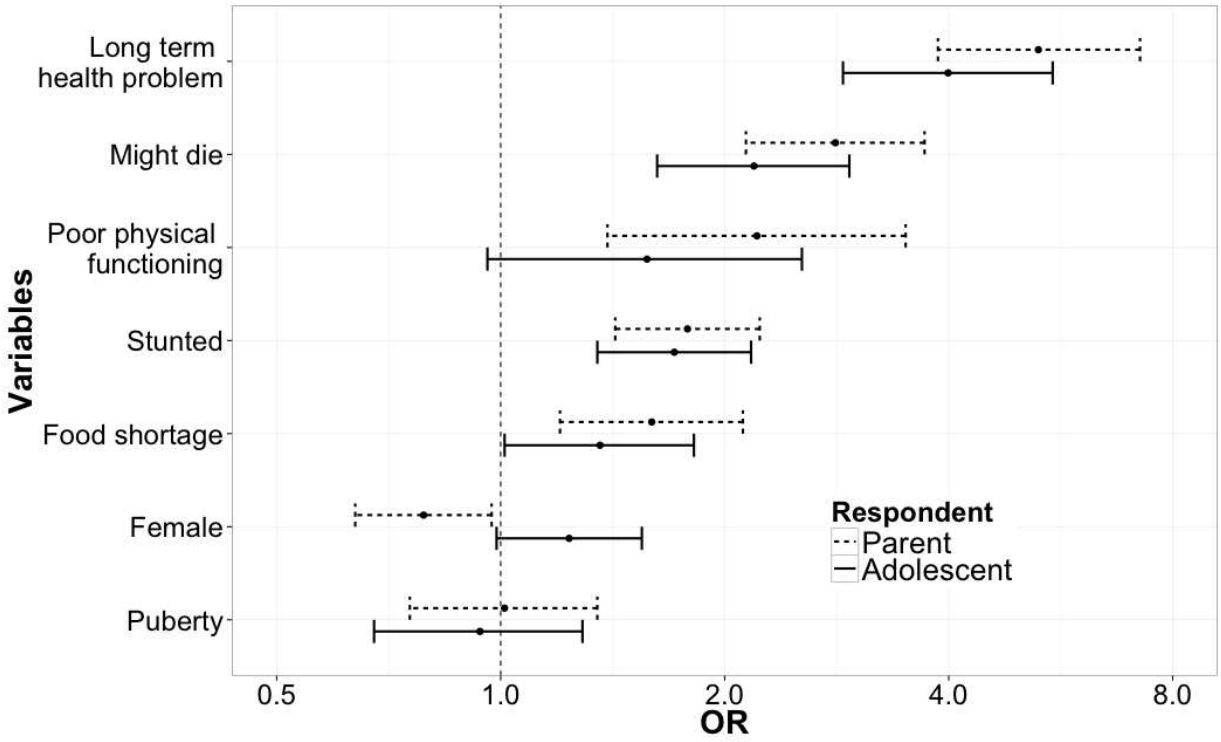
Figure 2: Concordance between adolescent SRH and parent's reports, percent(N)

		Adolescent's report			
		Worse	Same	Better	
Parent's report	Worse	44%	45%	11%	100%
		(224)	(250)	(58)	(532)
	Same	7%	76%	17%	100%
		(127)	(1473)	(329)	(1929)
	Better	4%	43%	52%	100%
		(41)	(459)	(560)	(1060)

Table 1: Descriptive statistics of the study population

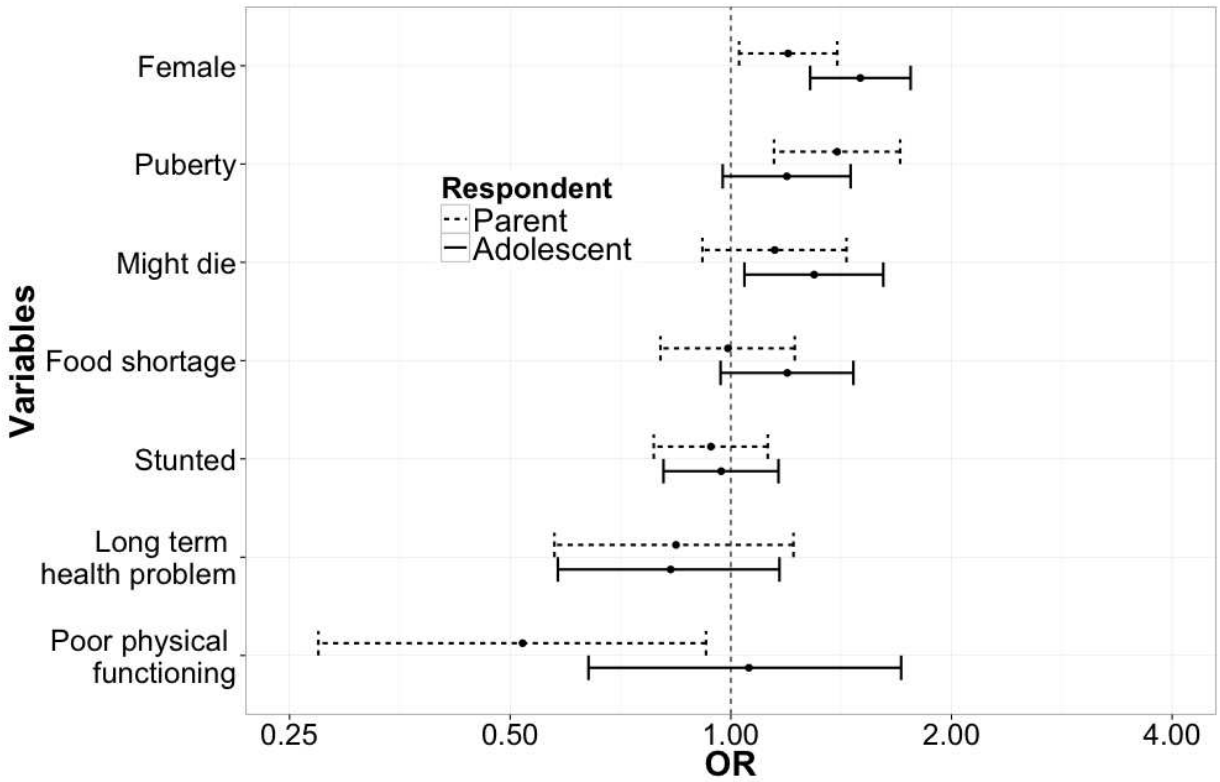
Item	Percent	Min	Max
HEALTH INDICATORS			
1) Whether the adolescent had one or more serious illnesses/injuries in past year	15.5	0	1
2) Whether the adolescent has a long term health problem	8.4	0	1
3) Whether the adolescent has a poor physical functioning	3.8	0	1
4) Whether the adolescent's height is 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)	0.441	0.00	0.926

Figure 3: Odds ratios and 95 percent confidence intervals from logistic regression of worse as compared to same health report



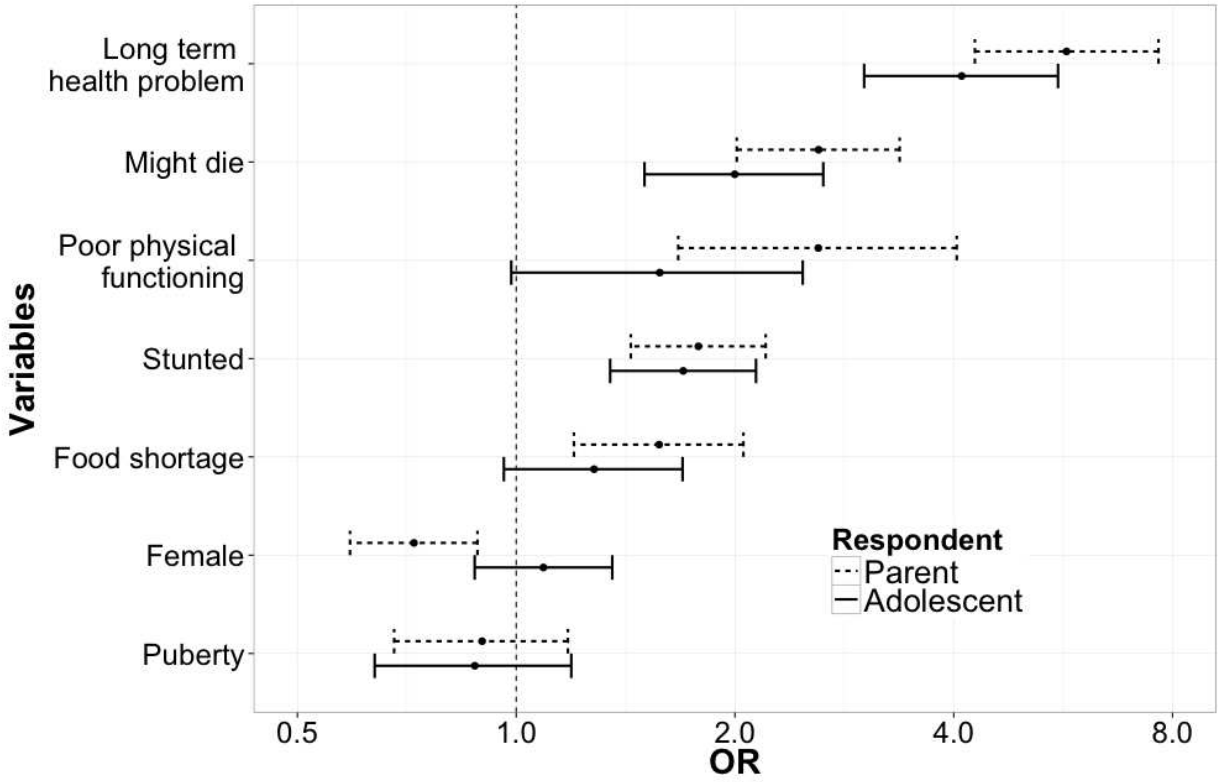
Note: includes country fixed effect, wealth index, parent/adolescent education

Figure 4: 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

Figure 5: 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

Table 2: 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 no school (ref.)	-	-	-	-
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)

*p<0.05; **p<0.01; ***p<0.001

Note: All models include country fixed effects

Figure 6: Spearman rank correlation between actual and imputed parent's health report (n = 3,541)

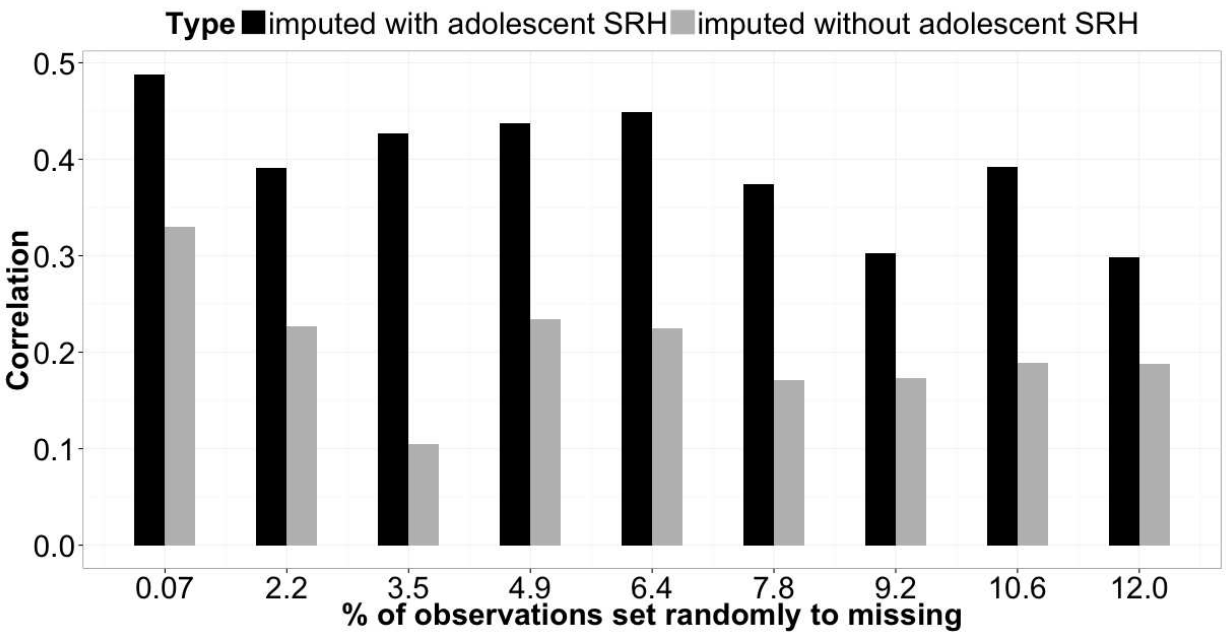
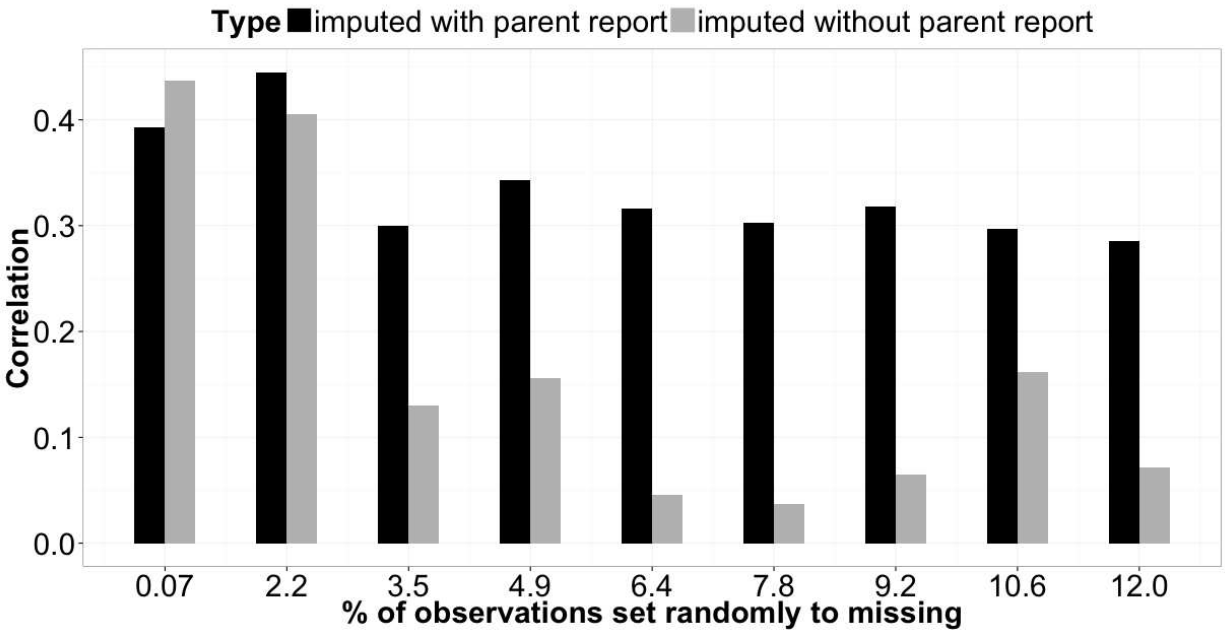


Figure 7: Spearman rank correlation between actual and imputed adolescent's SRH (n = 3,541)



Appendix

Figure A1: Concordance between male adolescent SRH and parent's reports, percent(N)

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

Figure A2: Concordance between female adolescent SRH and parent's reports, percent(N)

		Adolescent's report			
		Worse	Same	Better	
Parent's report	Worse	47%	41%	12%	100%
		(114)	(99)	(29)	(242)
	Same	8%	74%	18%	100%
		(74)	(669)	(174)	(917)
	Better	4%	38%	58%	100%
		(23)	(217)	(327)	(567)

Table A1: Odds ratios and standard errors from logistic regression of worse as compared to same, and better as compared to same health report

	Parent and Adolescent Health Reports			
	Worse-parent	Worse-adolescent	Better-parent	Better-adolescent
	(1)	(2)	(3)	(4)
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)
Parent no school (ref.)	-	-	-	-
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

*p<0.05; **p<0.01; ***p<0.001

Note: All models include country fixed effects

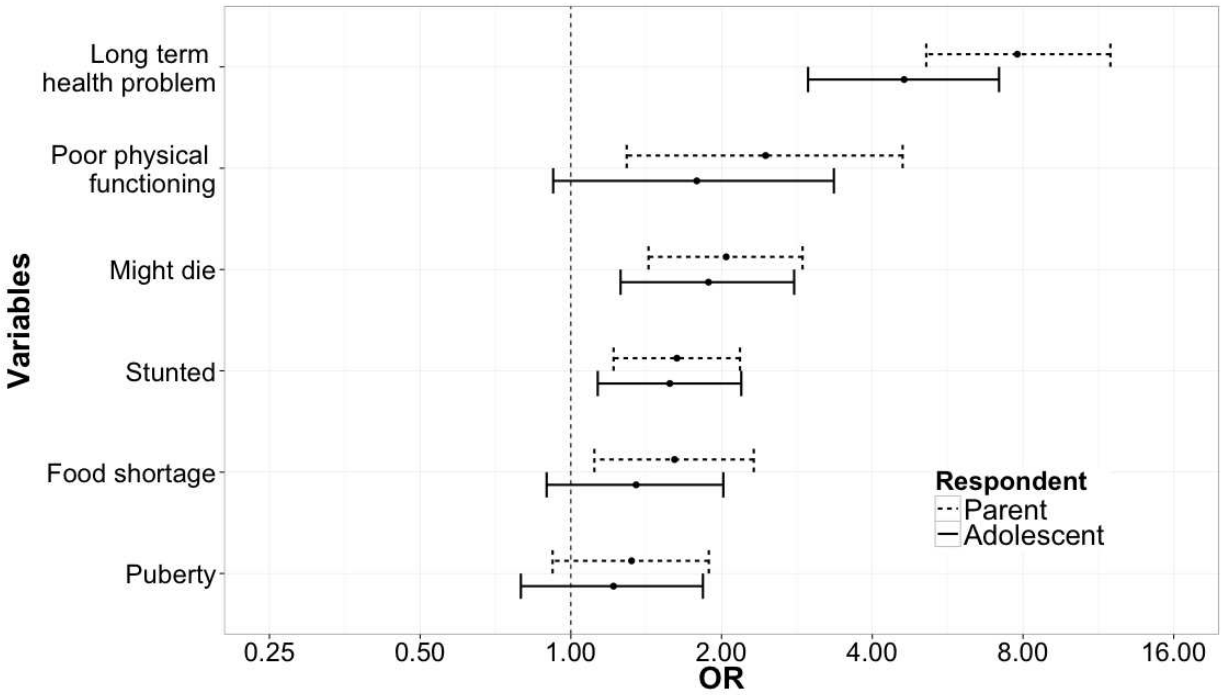
Table A2: Odds ratios and standard errors from logistic regression of worse as compared to same or better health reports

	Parent and Adolescent Health Reports	
	Parents	Adolescents
	(1)	(2)
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)
Parent no school (ref.)	-	-
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

*p<0.05; **p<0.01; ***p<0.001

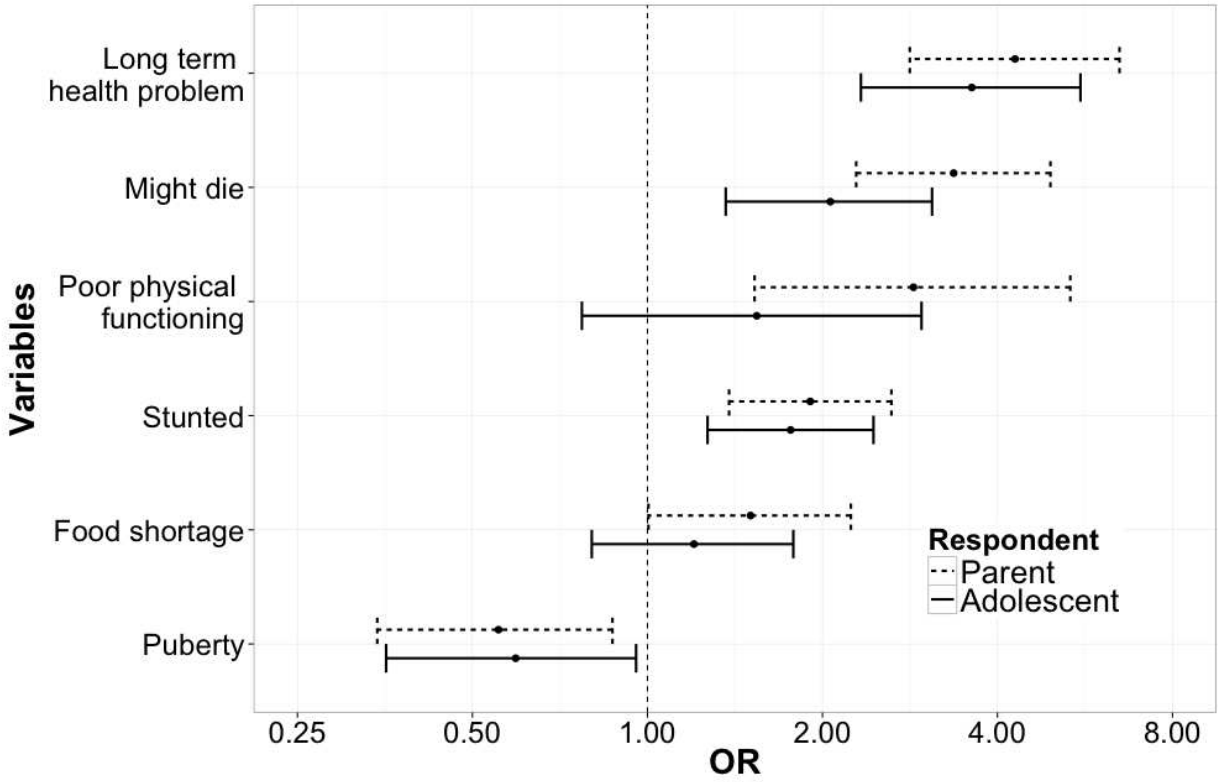
Note: All models include country fixed effects

Figure A3: 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 A4: 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