Received: 14 March 2019 | Revised: 7 October 2019 | Accepted: 10 February 2020

DOI: 10.1111/rode.12660

SPECIAL ISSUE ARTICLE

WILEY

Survey attrition after 15 years of tracking children in four developing countries: The Young Lives study

Alan Sánchez | **Javier Escobal**

Grupo de Análisis para el Desarrollo (GRADE), Lima, Peru

Correspondence
Alan Sánchez, Grupo de Análisis para el Desarrollo (GRADE), Lima, Peru.
Email: asanchez@grade.org.pe

Abstract

Young Lives (YL) is a multicountry, birth cohort study that, over a period of 15 years, followed nearly 8,000 individuals born in 2001–2002 and 4,000 individuals born in 1994–1995 in Ethiopia, India (states of Andhra Pradesh and Telangana), Peru, and Vietnam. This study aims to document attrition in the YL samples, to identify the correlates of attrition, and to test for attrition bias. The cumulative year-to-year attrition rate is 0.5% and 0.8% for the younger and older cohorts, respectively, among the lowest attrition rates in longitudinal studies in low- and middle-income countries. Attrition rates vary by household wealth, area of residence, and ethnicity/caste across countries. Attrited individuals in Peru are poor and those in other countries are wealthier. When analyzing a set of nutritional and cognitive outcomes, suggestive evidence of attrition bias exists, part of which is driven by child mortality. Even though attrition is very low, our findings highlight the importance of controlling for household socioeconomic characteristics when performing statistical analysis of the YL samples. The study also highlights key insights that can be helpful to reduce attrition or ameliorate its effects in other longitudinal studies.

KEYWORDS

attrition, birth cohort, developing countries, longitudinal study, young Lives

1 | INTRODUCTION

In developing countries, birth cohort studies—those that track a group of individuals born in a given year or period, either since birth or early childhood—remain scarce.[1] The Young Lives (YL) study is the largest existing multicountry, birth cohort, longitudinal study focused on low- and middle-income countries. Between 2002 and 2016, it collected data for approximately 12,000 individuals in four countries: Ethiopia, India (states of Andhra Pradesh and Telangana), Peru, and Vietnam. The data from YL study have been used in more than 200 peer-reviewed papers.[2] However, after 15 years of data collection, there is little evidence about the nature of attrition in the YL samples.[3]

Longitudinal studies try to keep attrition rates low to retain statistical power and to reduce the possibility of attrition bias. Attrition bias might occur under certain conditions if attrited and non-attrited individuals are different and no further measures are taken. Previous studies that use follow-up data from birth cohorts or household panels in developing countries show that while it is common that attrited and non-attrited individuals differ in their characteristics, this does not necessarily lead to attrition bias (Alderman, Behrman, Kohler, Maluccio, & Cotts Watkins, 2001; Dercon & Outes-Leon, 2009; Falaris, 2003). However, the absence of attrition bias cannot be established a priori.

Within this context, this study has three aims: first, to document the attrition rates observed in the YL samples and their evolution between 2002 and 2016; second, to identify which individual and household characteristics predict attrition and how results vary across country samples; third, to establish whether the attrition observed leads to biased estimates of key outcome indicators.[4] We expect our results to contribute to the scarce literature on the nature of attrition bias in birth cohort studies in developing countries (Alderman et al., 2001; Dercon & Outes-Leon, 2008; Falaris, 2003; Norris, Richter, & Fleetwood, 2007; Thomas, Frankenberg, & Smith, 2001) and to inform researchers who use YL data to investigate child development in low- and middle-income countries.

The rest of the paper is organized as follows. Section 2 summarizes the design of the YL study and explains fieldwork procedures. Section 3 reports YL attrition rates by country sample and cohort, and Section 4 shows graphical evidence of their evolution over time. Sections 5 and 6 explain the methodology and data used, respectively. Section 7 reports the results obtained, and Section 8 reports our conclusions and suggestions.

2 | YOUNG LIVES STUDY

2.1 | General design

YL is a multicountry, birth cohort, longitudinal study designed to track children born into poverty (and some born nonpoor) over a period of 15 years with the objective of tracing the causes and consequence of childhood poverty (Barnett et al, 2013; Harpham, 2002). Countries from different continents were chosen to reflect the diversity of the developing countries: Ethiopia, the state of Andhra Pradesh in India (currently split into the states of Andhra Pradesh and Telangana), Peru, and Vietnam. Two birth cohorts were selected in each country: a younger cohort (YC) born in 2001–2002 and an older cohort (OC) born in 1994–1995. The first visit took place in 2002, when children in each cohort aged (approximately) 1 and 8 years, respectively. More details about the sample design are explained later in the paper.

The YL study differs from a standard household panel for several reasons. First, the unit of interest is children, and only one child per family was selected. We use YLI to refer to YL individual. An implication of focusing attention on YLI is that, were the child to become part of a new family, the previous family was no longer followed; and, if YLI died, his or her family was no longer followed. Second, in the case of migration, the protocol was to follow YLI as long as he or she remained within the national territory (or within the state boundaries in the case of Andhra Pradesh in India). Third, YL does not have refreshment samples, as it is common practice in household panels.

2.2 | Context of the study countries

Some key characteristics of the selected countries are reported in Table 1. At the beginning of the third millennium, Ethiopia, India, and Vietnam were classified as low-income countries by the World Bank, whereas Peru was classified as a middle-income country. Consistent with this classification, in 2004, Peru had a relatively low level of poverty compared to Ethiopia. Another key difference was the level of urbanization: in 2002, in Peru, approximately 3 out of 4 lived in urban areas, whereas 1 out of 4 lived in urban areas in the other three countries. Despite these differences, in 2002, Vietnam reported the highest level of educational attainment followed by Peru closely.

Between 2002 and 2016, these four countries enjoyed high rates of economic growth (9.2% in Ethiopia, 7.4% in India, 5.6% in Peru, and 6.4% in Vietnam, according to the World Bank Development indicators). Aligned with this, by 2016, Vietnam and Peru had been reclassified as upper-middle-income countries and India as lower-middle-income country. Despite an exceptional reduction in poverty during the study period, Ethiopia remained a low-income country. Among the four countries, Peru appears as the most unequal in its income distribution according to the Gini coefficient (using information from 2010–2011).

2.3 | Sample design

Sample design in each country was guided by three principles (Wilson, Huttly, & Fenn, 2006). First, there would be two samples in each country, one with 2,000 YLIs aged between 6 and 18 months (YC), and the other with 1,000 YLIs aged between 7 and 8 years (OC), during the first visit. Second, YLIs were to be sampled from 20 sentinel sites (from here onward, clusters), selected to reflect the geographic, ethnic, and socioeconomic diversity of each selected country. In each sample, 100 were to be selected for the YC, and 50 for the OC. Third, each country sample had to be composed of YLIs mainly (but not uniquely) from poor households. In other words, poor households had to be oversampled. Samples were not required to be nationally representative, but they had to be informed of the diversity of living conditions in each country. Following these principles, in Ethiopia, India, and Vietnam, a purposive (i.e., nonprobabilistic) approach was used to select clusters, whereas in Peru, clusters were randomly selected. In particular, in Ethiopia, India, and Vietnam, clusters (*kebeles*, *mandalas*, and *communes*, respectively) were selected using a purposive approach oriented to reflect the geographic, ethnic, and socioeconomic diversity, to have a combination of urban/rural areas and poor/nonpoor areas, and to oversample the poor. In Peru, 20 clusters (or districts) were chosen randomly after excluding the wealthiest 5%. After the clusters were selected, a specific area of the cluster in each country was randomly selected for data collection. More information about the sample design

TABLE 1 Country characteristics

	Rural population (%)		Poverty rate (%) (USD 1.90 per day, PPP 2011)				Gini coefficient	Primary completion rate (%)	
Country	2002	2016	1999	2004	2010–2011	2015–2016	2010–2011	2002	2015
Ethiopia	85	80	56	36	34	27	33	31	54
India	72	67		38	21		35	76	98
Peru	26	21	18	14	6	4	46	97	99
Vietnam	74	66		27	4	3	39	101	104

Source: World Bank Development indicators.

followed in each country is reported in Table S1 in the Supporting Information. For technical details, see Outes-Leon and Sánchez (2008), Kumra (2008), Escobal and Flores (2008), and Nguyen (2008).

Given that the samples do not statistically represent a specific population in each country, it follows that the attrition patterns evaluated in this paper are associated with the potential differences in the relationships between observable variables and outcomes appearing in the original samples and those relationships appearing in the follow-up samples after years of data collection. As such, this analysis does not pretend to infer any relationships in the country population for which the YL study does not claim any statistical representativeness.

2.4 | Fieldwork procedures for enrollment and follow-up

To enroll participants, a door-to-door screening task was performed in all countries to identify YLIs in the expected age range (Alemu et al., 2003; Escobal et al., 2003; Galab et al., 2003; Tuan et al., 2003). Contact was made through the principal caregivers of prospective participants, who were told that participation was voluntary and informed of the following. First, the study would last 15 years, with visits occurred between 3 and 4 years. Second, in the first visit, a survey would be administered to collect information about (1) the socioeconomic aspects of the family; (2) health, education, and time-use of YLI; (3) anthropometric measures of YLI; and (4) cognitive achievement of YLI (for the OC). Third, no monetary incentive or compensation would be given to participants in the study. Fourth, it would be possible for participants to drop from the study at any point in time. The caregivers who agreed to participate under these terms were asked to sign a consent agreement (oral agreement for illiterate caregivers). In the case of OC, YLIs were also asked for assent. Fieldwork teams in these countries did not report problems with refusals in the enrolment phase.[5]

Fieldwork teams, as part of the follow-up process, tracked YLIs by all means possible, as long as they were within the country borders (or within the borders of Andhra Pradesh and Telangana in the case of India). For illustrative purposes, the follow-up process is shown in Figure 1, for the most common case in which YLI is a minor. At the beginning of round *x*, the team of enumerators received the contact information (addresses and phone numbers) of all YLIs who were alive and whose care-givers agreed to continue as part of the study in the previous round. For simplicity, consider round 2

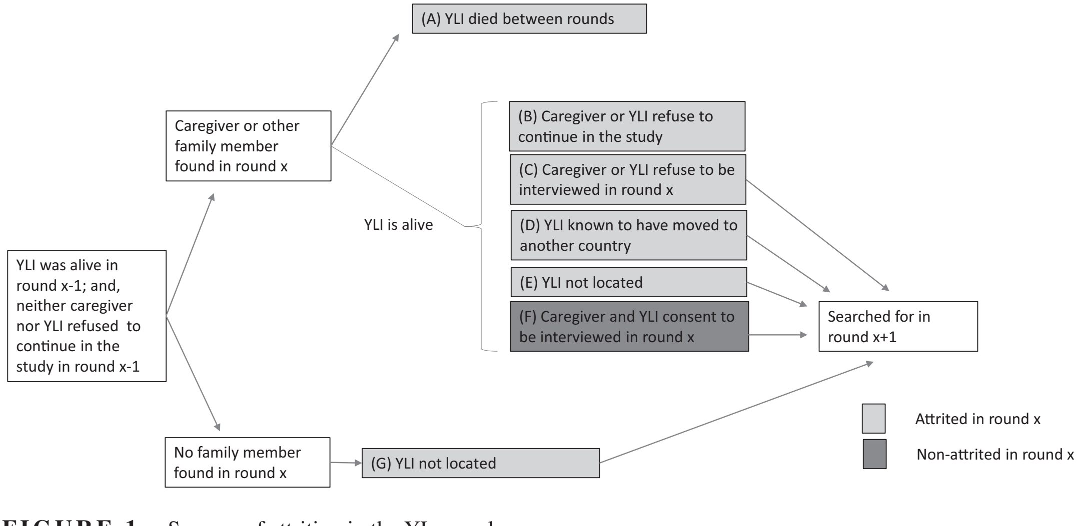

FIGURE 1 Sources of attrition in the YL samples

($x = 2$) when all original members were tracked. For a given YLI, enumerators searched for either the main caregiver or another adult family member. If none of them were found, YLI was classified as not located; if one of them was found, several possible outcomes arise, as shown in Figure 1. Only when consent for interview was obtained, YLI is considered as non-attrited; in all other cases (not located, died, moved to another country, refused to be interviewed this time or continue as part of the study), YLI is classified as attrited. Attrited participants in round x might become non-attrited in subsequent rounds because the fieldwork team is instructed to continue searching for all YLIs as long as they are known to be alive and have not refused to continue as part of the study. In other words, it is possible for a participant to re-enter the sample.

The process shown in Figure 1 reflects the sources of attrition when the participant was a minor during data collection. If YLI is an adult (which was the case in the last two rounds for the OC), the protocol varies according to whether YLI depends economically on his or her original family (or from a new family that has ties with the original family), is economically independent, and/or has formed a new family. In the last two cases, consent only from YLI was required to proceed with the interview.

3 | ATTRITION RATES IN THE YL STUDY

For this analysis, attrition in round x is defined as the ratio of total number of YLIs who died, were not located, moved to another country, or for whom consent was not obtained, relative to the total number of YLIs in round 1. Following this definition, Table 2 (column [6]) reports the cumulative

TABLE 2 Attrition rates in round 5 of the Young Lives country samples

	Original sample (1)	Gave consent in round 5 (2)	Died (3)	Refused/ not located (4)	Total attrited in round 5 (5)	Attrition rates in round 5 (6)		Attrition rates without dead YLIs (7)	
						Total (%)	By year (%)	Total (%)	By year (%)
Block A: younger cohort									
Ethiopia	1,999	1,812	85	102	102	9.4	0.6	5.4	0.4
India	2,011	1,900	43	68	68	5.5	0.4	3.5	0.2
Peru	2,052	1,831	25	167	167	9.4	0.6	8.2	0.6
Vietnam	2,000	1,938	12	48	48	3.1	0.2	2.4	0.2
Total:	8,062	7,481	165	385	385	6.8	0.5	4.9	0.3
Block B: older cohort									
Ethiopia	1,000	814	11	175	175	18.6	1.2	17.8	1.2
India	1,008	922	19	67	67	8.5	0.6	6.9	0.5
Peru	714	597	6	100	100	14.8	1.0	14.1	0.9
Vietnam	1,000	910	5	85	85	8.5	0.6	8.5	0.6
Total:	3,722	3,243	41	427	427	12.6	0.8	11.8	0.8

Source: Reports from country teams of Young Lives and own calculations. In column (3), death reports correspond to information collected between rounds 2 and 5. In column (4), YLIs who refused or who were not located were typically classified as such based on fieldwork efforts made in round 5, except for cases of families that requested to be excluded from the study at some point between rounds 2 and 4. In column (7), attrition rates reported exclude dead YLIs from both the numerator and the denominator.

attrition rates observed in the fifth visit in 2016 (round 5). The average attrition rate is 6.8% in the YC and 12.6% in the OC. To facilitate comparison with other longitudinal studies, this equates to 0.5% and 0.8% per year, respectively. For the YC, the smallest attrition rate is observed in Vietnam (3.1% in total, 0.2% per year) and the largest in Peru (9.4% in total, 0.6% per year). For the OC, the smallest rate is observed in India and Vietnam (8.5% and 0.6% per year, respectively) and the largest in Ethiopia (18.6% in total, 1.2% per year).

Our definition of attrition considers dead children as attrited.[6] As a reference, if dead children are excluded from the calculation (column [7]), average attrition rates reduce to 4.9% in the YC and 11.8% in the OC (0.3% and 0.8% per year, respectively). The reduction in attrition is most prominent for the YC, which is consistent with the fact that infant mortality is higher than mortality in other stages of childhood. For the YC, the largest contribution of mortality to attrition (in percentage points) is observed in Ethiopia and the smallest contribution is observed in Vietnam. This pattern is consistent with the poverty and educational rankings listed in Table 1.

Attrition rates appear to be low, more so considering the challenges involved in collecting longitudinal data in low-income countries. To put results in context, we proceed to compare the attrition rates observed in the YL country samples with those observed in other birth cohort, longitudinal studies that track children from birth or early childhood in other developing countries. To this end, we used the information collected by the Institute of Fiscal Studies (IFS) as a reference. IFS has gathered information on 175 longitudinal studies in developing countries although few of them are cohort studies. We were able to identify 12 similar studies.[7] Since two of the studies do not report attrition rates, we only report results of 10 studies. Figure 2 summarizes the average year-to-year attrition rates of the selected studies and of the YL country samples (for more information, see Table S2 in the Supporting

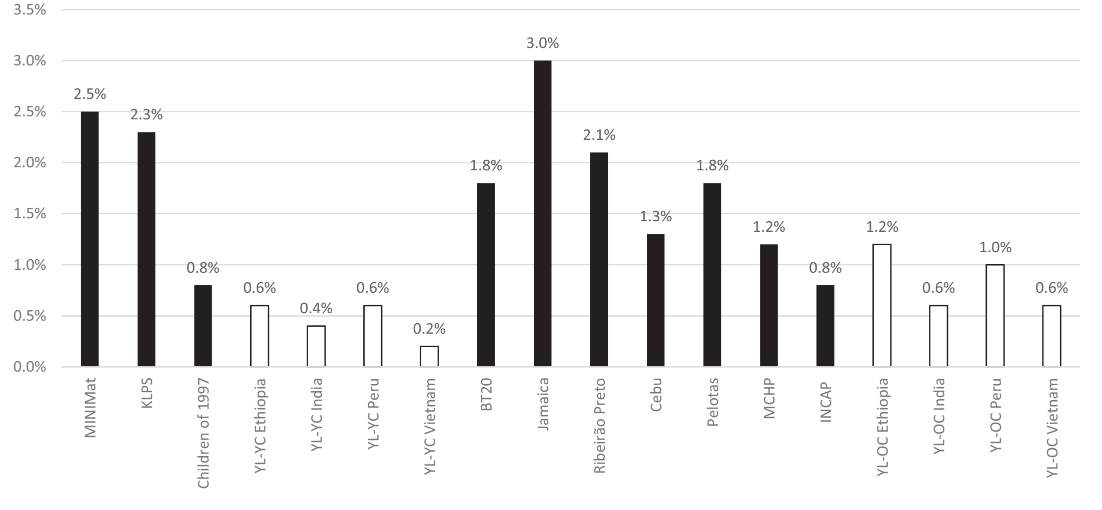

FIGURE 2 Year-to-year attrition rates in longitudinal studies tracking indiviudals since infancy in the developing world

Source: Own elaboration based on data reported by each study. Dead children are considered as attrited observations. The full name of the studies are as follows (from left to right): "The Maternal and Infant Nutrition Intervention in the Matlab" (MINIMat), "Kenya Life Panel Survey" (KLPS), "Children of 1997", "Young Lives (Younger cohort)" (YL-YC), "Birth to Twenty" (BT20), "1986 Jamaica" (Jamaica), "1978/79 Ribeirao Preto " (Ribeirao Preto), "Cebu Longitudinal Health and Nutrition Survey" (Cebu), "1982 Pelotas" (Pelotas), "Mauritius Child Health Project" (MCHP), "Institute of Nutrition of Central American and Panama (INCAP) Nutrition Trial Cohort Study" (INCAP), and "Young Lives (Older cohort)" (YC-OC). For more details of the selected studies see Table S1.

Information). Annualized attrition rates in the literature range between 0.8% and 3.0% (per year), with an average of 1.3%. Comparatively, the attrition rates observed in the YL country samples for the YC are the lowest in the group. Although the OC is not directly comparable to these studies because children from these cohorts are not tracked since early childhood, attrition rates are at the lower end of longitudinal studies in developing countries.

4 | CUMULATIVE ATTRITION RATES OVER TIME

YLIs were revisited in 2006 (round 2), 2009 (round 3), 2013 (round 4), and 2016 (round 5). Figure 3 shows the evolution of the cumulative attrition rate across rounds, separately for each cohort. Results do not change in any substantive way if dead children are excluded from the definition of attrition (see Figure S1 in the Supporting Information).

Cumulative attrition rates have increased over time, with the only exception of Vietnam between rounds 4 and 5.[8] For the OC, it is evident that the speed at which attrition grew increased after round 3 in all country samples, except for India. This pattern for the OC, which is not observed for the YC, is likely associated with the age of the OC who reached adulthood in round 4. This is important for several reasons. First, when becoming adults, YLIs might have felt empowered to decide whether to remain in the study, which impact on refusal rates is ambiguous. Second, some YLIs became economically independent and/or formed new families (had children, got married/cohabitated, or both). One consequence of this is that the length of the questionnaire increased for them, compared to a previous

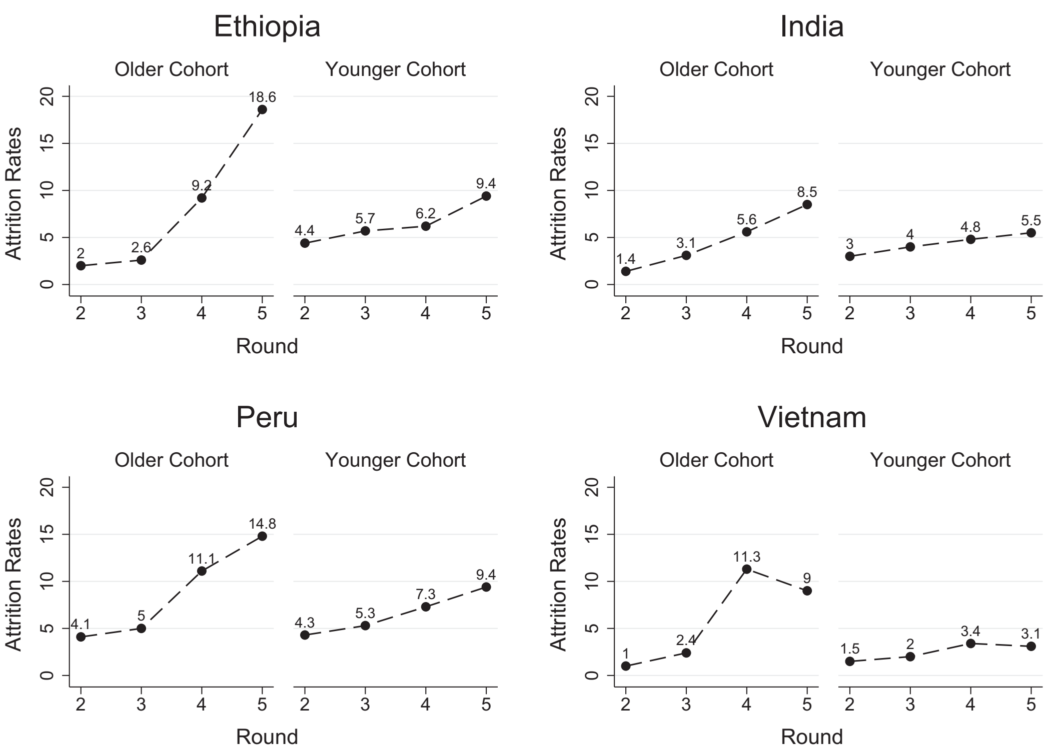

FIGURE 3 Cumulative attrition rates over time
Source: Own elaboration using Young Lives data.

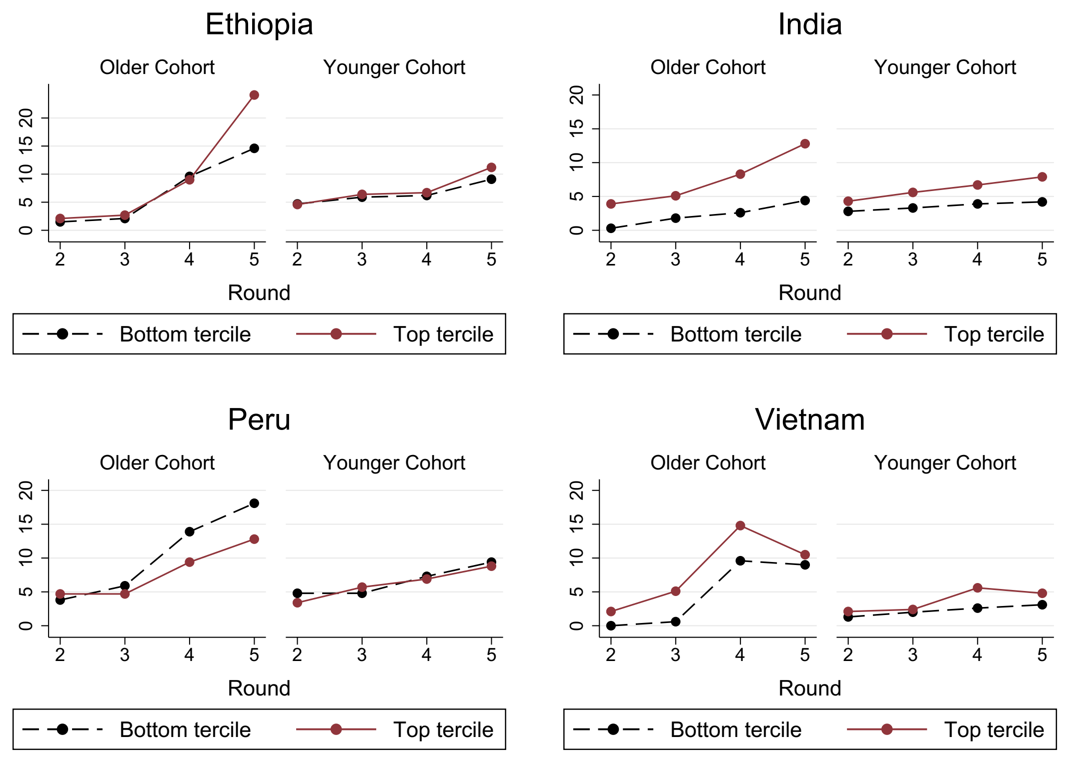

FIGURE 4 Cumulative attrition rates over time by tercile of wealth [Colour figure can be viewed at wileyonlinelibrary.com]
Source: Own elaboratio using Young Lives data.

scenario where they only had to answer the individual questionnaire; in this case, they would also have to answer the household questionnaire. This is likely to increase refusal rates. Third, the transition to adulthood likely increased the probability of migration, which increases the difficulty to locate study participants.

In Figure 4, cumulative attrition rates over time are reported separately for YLIs who were in the bottom-tercile of wealth during the first round, relative to those in the top-tercile. For the YC, YLIs from the top-tercile report higher attrition rates (on average) in the Ethiopian, Indian, and Vietnamese samples. A similar pattern is observed for the OC, with differences being larger in this case. In contrast, for the Peruvian sample, higher attrition rates (on average) are observed for YLIs from the bottom-tercile in the OC. In the YC, differences are not discernable. The differences in attrition rates between YLIs from poorer and wealthier households may be the effect of several factors. On the one hand, one might expect lower mortality rates in the top-tercile. On the other hand, if it is more likely for those that are better off to migrate, mobility could generate higher attrition rates in the top-tercile. Differences in opportunity costs across YLIs and their families suggest that the continuing participation rate may be different across the wealth spectrum.

Figure 5 shows the evolution of cumulative attrition rates by area of residence. For the YC, in all country samples, attrition rates are higher (on average) for YLIs who were selected from urban areas. This is consistent with the findings from the literature that urban households are more likely to disappear from longitudinal studies (Rayan & Petesch, 2007). The fact that the study does not follow-up YLIs who move to other countries (or other states in India), which are more likely to be urban, may also contribute to higher attrition rates for urban areas. The same pattern is observed for the OC, with

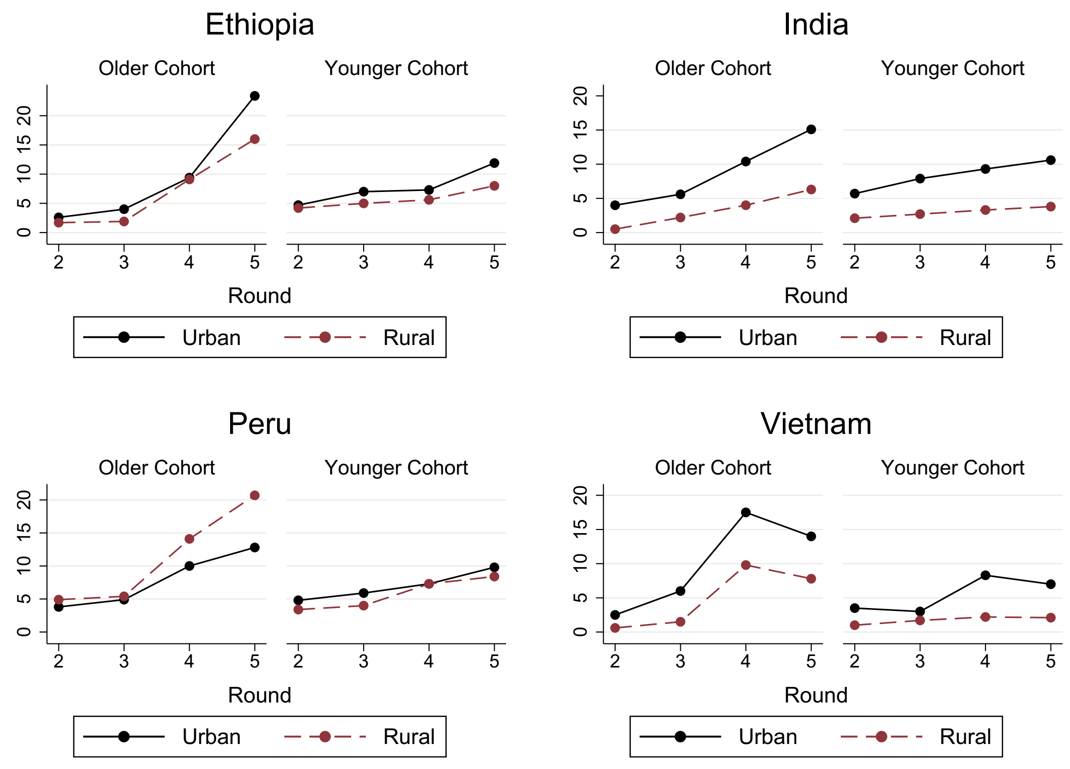

FIGURE 5 Cumulative attrition rates over time by area of residence [Colour figure can be viewed at wileyonlinelibrary.com]
Source: Own elaboration using Young Lives data.

the only exception of the Peruvian sample, where, in fact, the opposite is observed—attrition rates are higher for YLIs from rural areas.

Finally, Figure 6 shows the temporal evolution of the cumulative attrition rates by gender. For the YC, no relevant differences arise. In the case of OC, attrition rates are higher for males in Vietnam and Peru and higher for females in Ethiopia. Transition into adulthood may be related to the exploration of educational and labor opportunities away from the original place of residence, and these opportunities tend to be different for men and women (Heckert, 2015; Valentine, Barham, Gitter, & Nobles, 2017).

5 | METHODOLOGY

Attrition rates in the YL samples are low compared to similar longitudinal studies in developing countries, especially in the YC, but they are not negligible (cumulative attrition in round 5 can go up to 18% in the OC for Ethiopia). Therefore, it is important to identify if there is selective attrition and, if so, whether it leads to biased estimates of key outcome indicators. While it can be expected that selective attrition leads to biased estimates, the two phenomena need not concur. A set of studies that analyze attrition patterns in longitudinal data from the US find that even though attrition is high and correlates with observable characteristics, it does not lead to biased estimates. A similar conclusion is reached by Alderman et al. (2001), after analyzing longitudinal data from Bolivia, Kenya, and South Africa, and by Falaris (2003), using longitudinal data from Peru, Cote d'Ivoire, and Vietnam.

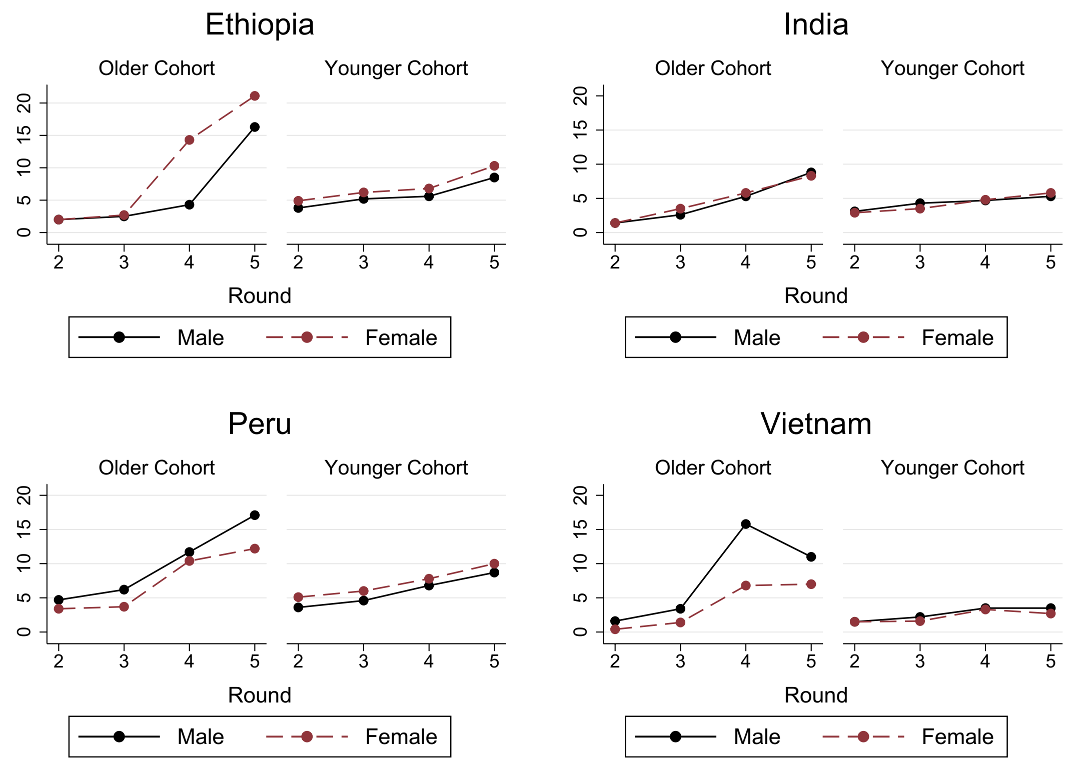

FIGURE 6 Cumulative attrition rates over time by sex [Colour figure can be viewed at wileyonlinelibrary.com]
Source: Own elaboration using Young Lives data.

Following Fitzgerald, Gottshalk, and Moffitt (1998), the concept of attrition bias can be linked to that of sample selection bias (Heckman, 1979). For clarity of exposition, we follow a terminology proposed by Alderman et al. (2001)—which derives from Fitzgerald et al. (1998) but is closer to the statistical literature—and consider the following types of attrition: missing completely at random, attrition that exhibits selection on unobservables, and attrition that exhibits selection on observables. Consider A_t as an indicator of attrition that takes value 1 if an observation is missing due to attrition, and 0 otherwise. The model of interest is as follows:

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t, \tag{1}$$

where y_t is an outcome of interest for a researcher (e.g., child's height-for-age) observed if $A_t = 0$ (i.e., for the non-attritors), x_t is a variable (or vector) observed for both attritors and non-attritors (e.g., a set of variables observed in the first visit), and ε_t is the error term with mean zero. Now, consider the following linearization of the attrition process:

$$A_t^* = \delta_0 + \delta_1 x_t + \delta_2 z_t + \mu_t, \tag{2}$$

where A_t^* is a latent variable such that $A_t = 1$ if $A_t^* > 0$ and $A_t = 0$ if $A_t^* \le 0$; μ_t is the error term with mean zero; and z_t is an auxiliary variable (or vector) observed for both attritors and non-attritors that is not part of x_t. There are several alternatives for z_t, including characteristics of the interviewer and/or of the participant that might be correlated with attrition but that are not of interest in Equation 1.

Attrition that exhibits selection on unobservables occurs when $\mu_t|x_t$ is not independent of $\varepsilon_t|x_t$. This means that there are unobserved factors that explain attrition and that simultaneously explain the outcome of interest. Solving attrition bias of this nature is challenging because a exclusionary restriction is required (i.e., a suitable variable z_t such that $z_t|x_t$ is independent of $\varepsilon_t|x_t$). For simplicity, from here onward, we assume that $\mu_t|x_t$ is independent of $\varepsilon_t|x_t$.

Attrition due to selection on observables might not generate bias (*ignorable* selection on observables) if one of the following conditions holds: (a) $z_t|x_t$ is independent of $\varepsilon_t|x_t$ and (2) $\delta_2 = 0$. Moreover, if $\delta_2 = \delta_1 = 0$, there will be completely random attrition. On the contrary, if neither (1) nor (2) holds, there will be *nonignorable* selection on unobservables. When this happens, information from $f(y_t|x_t, A_t = 0)$ is not enough to recover information from $f(y_t|x_t)$.

For instance, suppose that the outcome of interest is height-for-age. A child's height-for-age is expected to be negatively correlated with the altitude of the place in which the child was born (Pomeroy et al., 2014); however, altitude might not be part of the model of interest for the researcher. At the same time, it is plausible that altitude is correlated with attrition under the assumption that communities located at higher altitudes are more difficult to reach. The combination of these two circumstances would lead to (*nonignorable*) selection on observables. In this case, suitable alternatives need to be considered. Fitzgerald et al. (1998) and Alderman et al. (2001) show that using weighted least squares regressions, with the expression $\Pr(A_t = 0|x_t)/\Pr(A_t = 0|z_t, x_t)$ as weights, allows one to recover the parameters from $f(y_t|x_t)$. Other alternatives suggested in the wider literature include the use of fixed effects estimates to absorb the effects of attrition (Verbeek & Nijman, 1996; Ziliak & Kniesner, 1998) and multiple imputation methods (Schafer & Graham, 2002).

In our analysis, we are interested in two aspects: first, to identify which individual and household characteristics predict attrition; and second, to test if there might be attrition bias due to *nonignorable* selection on observables in the YL samples. For the first objective, we use *t* tests to establish whether attrition varies according to individual and household characteristics that would typically be considered in vector x_t for models of determinants of health, nutrition, and educational outcomes. For the second objective, we rely on two strategies. First, we estimate models that regress A_t on x_t and z_t and then test the importance of z_t (attrition probit tests). Following Fitzgerald et al.'s (1998) suggestion that a lagged value of y_t can play the role of z_t, we use y_1 as a proxy for z_t. Second, we consider the so-called BLGW test proposed by Becketti, Gould, Lillard, and Welch (1988). The objective of this test is to verify whether the coefficients of models to predict an outcome of interest vary between attrited and non-attrited participants. This is verified by including an interaction between all the selected predictors for the child outcome (included in vector x_t) and whether the child is attrited. The joint significance of these interactions is then assessed by means of an F -test.

6 | DATA

We use data from the first visit of the YL study combined with an attrition indicator that takes value 1 if YLI is attrited in the last visit (round 5), and 0 otherwise. The following individual and household characteristics measured in the first visit are considered potential correlates of attrition: sex of YLI, whether YLI is the first born (OC only), caregivers' basic demographic characteristics (sex, age, and marital status), household characteristics (household wealth, area of residence, and caregivers' education), caregivers' ethnicity or caste, and household size. Household wealth is measured considering the location of the household across terciles of the distribution of the wealth index.[9] As for ethnicity/caste, in Ethiopia, we consider the caregiver's region of origin (Amhara, Gurage, Hadiva, Oromo, Sidama, and Tigrian); in India, whether the caregiver belongs to one of the following castes:

Scheduled Castes, Scheduled Tribes, Backward Classes, and Other Classes; in Peru, whether Spanish is the caregiver's native tongue—as opposed to Quechua, Aymara, and other dialects; in Vietnam, whether the caregiver belongs to Kinh, the main ethnic group—as opposed to other ethnic origins (Chinese, Tay, H'Mong, Nung, Ede, Thai, Dao, and Giay).

As for YLI outcomes, we use those available in round 1. For nutritional status, we choose three indicators based on anthropometric data that are available for the YC and OC (at ages 1 and 8, respectively): height-for-age Z scores, weight-for-age Z scores, and stunting. Z scores are based on the reference growth curves of the World Health Organization (WHO). Stunting is defined as being two standard deviations below the height of the median child of a given age and sex according to the latest WHO standard definition, and is associated with chronic undernutrition. For educational achievement, we focus only on the OC and look at school enrolment and literacy indicators at age 8. We use a reading task that tests the child's ability to read letters, a simple word, and a simple sentence, and a writing task that determines a child's ability to write a simple sentence. In particular, for this analysis, we focus on the proportion of children able to read words or sentences, and able to write without difficulty/errors (treating each as separate outcomes). Table 3 reports averages of stunting and the educational variables across countries and cohorts, whereas the distributions of height-for-age and weight-for-age for the YC and OC are reported in Figures S2 and S3, respectively, in the Supporting Information.

7 | RESULTS

7.1 | Comparison between attrited and non-attrited YLIs using *t* tests

We begin by describing differences between attrited and non-attrited YLIs as identified by *t* tests (results are reported in Tables S3 and S4 for the YC and OC, respectively, in the Supporting Information). For the YC, in Ethiopia, India, and Vietnam, attrited YLIs are more likely to be from urban areas and from the top-tercile of wealth, as shown by the patterns in Figures 3 and 4. For the Peruvian sample, differences by household wealth and area of residence are not statistically significant. In addition, attrited YLIs are more likely to have caregivers with a higher level of education in India and more likely to have caregivers who are single in Ethiopia, Peru, and Vietnam.

Differences by ethnicity/caste also appear relevant. In the Peruvian sample, the proportion of caregivers whose native tongue is Spanish (who are more likely to come from wealthier households) is lower among the attrited group. In the Vietnamese sample, children from the largest ethnic group (Kinh) are less likely to be attrited. In the Indian sample, attrited children are less likely to be from BC (Backward Classes) and more likely to be from the OC (Other Classes).

TABLE 3 Selected outcomes of the country samples

	Stunting (%)		Writes without difficulty/errors (%)	Reads words or sentences (%)	School enrolment (%)
	Younger cohort	Older cohort	Older cohort		
Ethiopia	43	33	23	27	66
India	31	33	53	65	98
Peru	29	27	55	85	99
Vietnam	21	29	75	92	99

Source: Young Lives data, authors' elaboration.

For the OC, females are more likely to be attrited in the Ethiopian sample, whereas males are more likely to be attrited in the Peruvian sample. In addition, YLIs who are the first born are less likely to be attrited in the Indian sample. Looking at caregiver and household characteristics, attrited YLIs are more likely to come from better-off families in Ethiopia, India, and Vietnam. For instance, attrited children are more likely to be from urban areas in India and Vietnam, less likely to be from the bottom-tercile in Ethiopia, more likely to be from the top-tercile in India, and their caregivers are more likely to have a higher level of education in India. Conversely, for Peru, the opposite seems to occur: attrited children are more likely to be from rural areas, to come from larger households, and are less likely to have Spanish as maternal language. In addition, for this cohort, some differences according to YLI characteristics are found. Confirming patterns observed in the graphical analysis, we also explore differences in YLI outcomes by attrition status. For the YC, in the Ethiopian sample, attrited participants have lower height-for-age, lower weight-for-age, and higher levels of stunting. In contrast, for the OC, whose mortality is much lower, in the Ethiopian sample, attrited participants have a higher height-for-age, are more likely to read words and sentences, and more likely to read without difficulties compared to non-attrited participants. In addition, stunting levels are higher in the Peruvian sample among attrited participants (YC), whereas in the Indian and Vietnamese samples, attrited participants are less likely to be school enrolled (OC).

7.2 | Testing for attrition bias

Previous results show that attrition is correlated with observed variables. Therefore, it is important to establish whether there could be attrition bias driven by observable characteristics. We test whether YLI outcomes observed in the first visit predict attrition in the last visit, conditional on individual and household characteristics (attrition probit tests). Results are reported in Table 4 (Panel A). All estimations consider the clustered nature of the samples.

Out of 12 outcomes observed for the YC, YLI-lagged outcomes predict attrition in four cases (three at the 1% level and one at the 5% level). In the Ethiopian sample, the three available outcomes (height-for-age, weight-for-age, and stunting) predict attrition. Similarly, in the Peruvian sample, stunting predicts attrition. In both cases, YLIs with worse nutritional status are more likely to be attrited. For the OC, YLI-lagged outcomes predict attrition in 4 out of 24 outcomes (2 at the 5% level, 2 at the 10% level). There is evidence of attrition bias for height-for-age in the Ethiopian sample, for the reading task in the Indian sample, and for school enrolment in the Indian and Vietnamese samples. While this is not conclusive evidence of systematic *nonignorable* selection on observables in the YL samples, results show that this might occur in some cases. Our definition of attrition includes dead participants. When considering an alternative definition in which dead children are excluded (Table 4, Panel B), results become statistically insignificant for all outcomes in the YC and for the Indian sample in the OC. This suggests that to a large extent child mortality explains these biases, when they occur.

Finally, we report results of BGLW tests for the YC and OC. In total, we estimate 12 models for the YC (3 outcomes for each country sample) and 24 for the OC (6 outcomes for each country sample). For each estimation, the indicator of interest is the *F* test (derived from the Wald test) for the joint effect of attrition on all coefficients, including and excluding the attrition coefficient. See Tables 5 and 6, respectively. (Full estimates are reported in the Supporting Information, Tables S5.1–S5.3 and Tables S6.1–S6.6, respectively). One key consideration is that *F* tests must also consider the clustered nature of the YL samples (Cameron & Miller, 2015). At the same time, the number of clusters in each country sample is small. The combination of both elements limits the number of constraints one can test simultaneously. In particular, since there are 20 clusters, we can only test the joint significance

TABLE 4 Attrition probit tests (marginal effects)

	Attrition in younger cohort				Attrition in older cohort			
	Ethiopia	India	Peru	Vietnam	Ethiopia	India	Peru	Vietnam
PANEL A: using preferred definition of attrition								
Height-for-age Z score	−0.013***	−0.004	−0.004	−0.004	0.020**	−0.008	0.018	0.001
	(0.004)	(0.003)	(0.007)	(0.003)	(0.010)	(0.006)	(0.013)	(0.010)
Weight-for-age Z score	−0.016***	−0.006	−0.003	−0.003	0.017	−0.007	0.016	0.007
	(0.004)	(0.004)	(0.008)	(0.003)	(0.011)	(0.007)	(0.016)	(0.008)
Stunting	0.040***	0.017	0.028**	0.013	−0.033	−0.004	−0.009	0.002
	(0.013)	(0.011)	(0.014)	(0.008)	(0.029)	(0.014)	(0.027)	(0.022)
Reads words or sentences					0.016	−0.026*	−0.002	−0.009
					(0.056)	(0.014)	(0.030)	(0.037)
Writes without difficulty					0.043	−0.024	0.001	0.001
					(0.038)	(0.024)	(0.027)	(0.017)
Child is school enrolled					0.013	−0.147*	−0.050	−0.201**
					(0.034)	(0.084)	(0.102)	(0.078)
PANEL B: attrition excluding dead children								
Height-for-age z-score	−0.003	−0.000	0.002	−0.001	0.020**	−0.001	0.017	0.005
	(0.003)	(0.002)	(0.006)	(0.003)	(0.009)	(0.007)	(0.013)	(0.010)
Weight-for-age z-score	0.001	−0.000	0.003	0.001	0.012	−0.001	0.016	0.008
	(0.003)	(0.002)	(0.008)	(0.003)	(0.009)	(0.006)	(0.017)	(0.007)
Stunting	0.010	0.000	0.011	0.003	−0.034	−0.014	−0.008	−0.009
	(0.010)	(0.006)	(0.012)	(0.005)	(0.026)	(0.015)	(0.027)	(0.021)
Reads words or sentences					0.020	−0.016	0.015	−0.001
					(0.052)	(0.016)	(0.025)	(0.032)
Writes without difficulty					0.044	−0.018	0.003	−0.001
					(0.035)	(0.022)	(0.025)	(0.017)
Child is school enrolled					0.040	−0.071	−0.065	−0.152***
					(0.030)	(0.079)	(0.104)	(0.059)

Note: Each cell reports marginal effects from different probit model specifications. In all cases, the dependent variable takes value 1 if the YLI is attrited in the last visit, and 0 otherwise. YLI outcomes are observed at ages 1 and 8 for the younger cohort and older cohort, respectively. Estimates control for the following characteristics: sex of YLI; YLI is the first born (OC only); caregiver's sex, age, and marital status; household wealth; area of residence; caregiver´s education; ethnicity or region (caste in India); household size. Robust standard errors (clustered at the cluster level) are reported in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

of up to 19 coefficients. Although we have fewer than 19 constraints in each country sample (11 in Peru and Vietnam, 13 in India, 17 in Ethiopia), this limits the degrees of freedom available. To deal with this aspect, we report results with an alternative clustering at the community level, where the community is the smallest geographical unit observed in each sample. This makes a substantial difference in India and Peru, where there are 100 and 81 communities, respectively, but not in Ethiopia and Vietnam with 26 and 31 communities each. For this reason, for the BLGW tests, we focus our attention on the Indian and Peruvian samples.

For the YC, results show suggestive evidence of attrition bias for stunting in India and Peru. In both cases, the null hypothesis that all slope coefficients (excluding the constant) are equal for attritors

TABLE 5 BGLW tests, younger cohort

	Ethiopia		India		Peru		Vietnam	
Height for age								
N	1,942	1,942	1,992	1,992	2,036	2,036	1,992	1,992
F (excluding constant)	1.18	3.86	1.12	2.13	1.36	0.99	1.03	1.95
p value	0.2993	0.0030	0.3396	0.0284	0.2106	0.4485	0.4120	0.0891
F (including constant)	2.55	7.53	1.15	1.96	1.30	0.98	1.16	1.90
p value	0.0034	0.0000	0.3213	0.0409	0.2334	0.4594	0.3163	0.0906
Weight for age								
N	1,852	1,852	1,994	1,994	2,037	2,037	1,992	1,992
F (excluding constant)	1.61	4.08	1.05	1.18	2.65	2.19	1.37	4.42
p value	0.0980	0.0021	0.3987	0.3161	0.0069	0.0362	0.2053	0.0013
F (including constant)	3.05	6.07	1.22	1.24	2.39	1.97	1.30	3.93
p value	0.0005	0.0001	0.2686	0.2710	0.0108	0.0534	0.2294	0.0022
Stunting								
N	1,942	1,942	1,992	1,992	2,036	2,036	1,992	1,992
F (excluding constant)	1.05	4.06	1.62	3.42	1.48	2.69	2.15	4.80
p value	0.3962	0.0021	0.0957	0.0007	0.1607	0.0111	0.0288	0.0007
F (including constant)	1.89	7.18	1.69	3.85	1.72	2.54	2.11	6.30
p value	0.0363	0.0000	0.0697	0.0001	0.0787	0.0127	0.0261	0.0001
Clustered standard errors	No	Yes	No	Yes	No	Yes	No	Yes
Number of clusters	–	26	–	100	–	83	–	31

Note: Each country-outcome cell report results from a model specification in which the country outcome is regressed on individual and household characteristics observed in the first visit, the attrition indicator, and the interaction between the attrition indicator and all individual and household characteristics. The *F* statistic (excluding constant) corresponds to the null hypothesis that all slope coefficients are equal for attritors and non-attritors, whereas the *F* statistic (including constant) corresponds to the null hypothesis that all coefficients are equal for attritors and non-attritors.

and non-attritors is rejected at the 1% level. Similar evidence is observed for height-for-age in India (at the 1% level) and weight-for-age in Peru (at the 5% level). Results from the full model show that coefficients that are different between attrited and non-attrited participants are those associated with household wealth, area of residence, ethnicity in Peru, caste in India. The attrition dummy is not statistically significant in any of these models, which suggests that bias is already captured by the control variables included in the model.

For the OC, among the nutritional outcomes, the null hypothesis that all slope coefficients are equal for attritors and non-attritors is rejected for weight-for-age in India and Peru (at the 1% and 5% level, respectively) and for height-for-age in Peru (at the 10% level). Among the educational outcomes,

TABLE 6 BGLW tests, older cohort

	Ethiopia		India		Peru		Vietnam	
Height for age								
N	963	963	1,008	1,008	709	709	1,000	1,000
F (excluding constant)	1.26	11.90	0.73	1.13	0.82	1.86	1.00	3.72
p value	0.2177	0.0000	0.7321	0.3458	0.6218	0.0639	0.4425	0.0021
F (including constant)	1.42	11.59	0.76	1.29	0.86	2.42	0.92	4.39
p value	0.1259	0.0000	0.7155	0.2298	0.5913	0.0129	0.5215	0.0005
Weight for age								
N	928	928	1,008	1,008	710	710	1,000	1,000
F (excluding constant)	1.87	28.82	0.69	2.49	1.24	2.29	0.64	3.08
p value	0.0224	0.0000	0.7739	0.0056	0.2539	0.0210	0.7934	0.0070
F (including constant)	1.87	46.46	0.70	2.38	1.24	2.35	0.65	2.94
p value	0.0197	0.0000	0.7734	0.0067	0.2541	0.0154	0.8033	0.0082
Stunting								
N	963	963	1,008	1,008	709	709	1,000	1,000
F (excluding constant)	1.35	41.24	0.57	1.01	0.69	1.08	1.50	6.38
p value	0.1678	0.0000	0.8783	0.4476	0.7520	0.3915	0.1239	0.0000
F (including constant)	1.36	48.02	0.54	1.16	0.64	1.39	1.38	7.10
p value	0.1563	0.0000	0.9123	0.3194	0.8094	0.1986	0.1687	0.0000
Reads words/ sentences								
N	988	988	997	997	685	685	994	994
F (excluding constant)	2.66	7.86	0.89	3.19	1.63	3.03	0.62	1.41
p value	0.0006	0.0000	0.5634	0.0005	0.0851	0.0029	0.8115	0.2179
F (including constant)	2.51	14.25	0.95	3.39	1.50	2.92	0.57	2.65
p value	0.0009	0.0000	0.5025	0.0002	0.1190	0.0032	0.8667	0.0152
Writes without difficulty								
N	988	988	997	997	685	685	994	994
F (excluding constant)	2.59	17.98	1.19	4.84	0.65	0.96	0.82	1.66
p value	0.0008	0.0000	0.2798	0.0000	0.7840	0.4880	0.6235	0.1331
F (including constant)	2.57	16.87	1.24	5.31	0.60	0.90	0.75	1.52

(Continues)

TABLE 6 (Continued)

	Ethiopia		India		Peru		Vietnam	
p value	0.0007	0.0000	0.2365	0.0000	0.8448	0.5484	0.6987	0.1717
Enrolled at school								
N	999	999	1,008	1,008	713	713	1,000	1,000
F (excluding constant)	2.06	48.94	2.73	0.83	0.72	0.39	3.85	10.26
p value	0.0100	0.0000	0.0008	0.6328	0.7197	0.9529	0.0000	0.0000
F (including constant)	1.95	47.20	2.90	0.91	0.68	0.38	4.01	9.41
p value	0.0140	0.0000	0.0003	0.5467	0.7676	0.9640	0.0000	0.0000
Clustered standard errors	No	Yes	No	Yes	No	Yes	No	Yes
Number of clusters	–	26	–	100	–	83	–	31

Note: Each country-outcome cell report results from a model specification in which the country outcome is regressed on individual and household characteristics observed in the first visit, the attrition indicator, and the interaction between the attrition indicator and all individual and household characteristics. The *F* statistic (excluding constant) corresponds to the null hypothesis that all slope coefficients are equal for attritors and non-attritors, whereas the *F* statistic (including constant) corresponds to the null hypothesis that all coefficients are equal for attritors and non-attritors.

similar evidence is found for the reading task in both country samples and for the writing task in the Indian sample (at the 1% level). While for the YC, household wealth, area of residence, and ethnicity appear as crucial dimensions, for the OC, coefficients that are different between attrited and non-attrited participants (especially for educational outcomes) are those related to caregivers' education, caregivers' age, and participants' order of birth. As in the previous case, the attrition dummy is not statistically significant in these models, suggesting bias is already captured by the control variables included in the model.

8 | CONCLUSIONS

This study looks at attrition patterns in the YL study. We document that the attrition rates observed for the YL samples are among the lowest observed attrition rates in longitudinal studies in low- and middle-income countries. The OC has a larger attrition rate than the YC, which is possibly related to increased migration rates and increased refusal rates among individuals who are transitioning to adulthood. While attrition rates are low compared to similar longitudinal studies in developing countries, our results show that attrition in the YL samples is correlated with aspects such as wealth, area of residence, ethnicity, and caste (among other socioeconomic characteristics of the household and caregiver). Given that 15 years of data collection has passed, this result is not surprising. Evidence suggests that better-off families (e.g., households from urban areas and/ or from the top-tercile of wealth) are more likely to be attrited in Ethiopia, India, and Vietnam. On the contrary, for the Peruvian sample, evidence shows that rural households are more likely to be attrited.

Using attrition probit tests, we find evidence of attrition bias in certain outcomes in some country samples (4 out of 12 in the YC and 4 out of 24 in the OC). To a large extent, this result is driven by child mortality. This is especially true for the YC in the Ethiopian sample. If children who died are excluded, there is no evidence of bias for the YC and very little evidence for the OC (2 out of 24 outcomes). We also performed BGLW tests; however, this type of test can be implemented only in the Indian and Peruvian samples because only these countries have a large number of communities. Using this strategy, we detect evidence of attrition bias, whose exact nature depends on the country sample, the cohort, and the outcome.

A research question that has not been considered in this paper and should be addressed in future work is the reasons for YL having lower attrition rates than those appearing in other comparable, longitudinal studies. Are these lower attrition rates related to characteristics of the chosen countries, characteristics of the children or families, or can be explained by the protocols used to track the individuals? Penny, Madrid, and Oré (2012) suggest that, at least for the case of Peru, fieldworker recruitment and training processes may partially explain low attrition rates. In addition, the fact that all countries implemented tracking exercises between rounds could also be part of the explanation. Having collected fieldworkers' characteristics across rounds should allow us to test whether differences in fieldworker characteristics (age, gender, ethnicity, education, experience) have influenced attrition rates across or within countries.

Recommendations that arise from our analysis can be divided in two strands: one related to YL study and the other related, in general, to other cohort studies. One specific recommendation is that when performing statistical analysis of the YL country samples, it is important to control for household and caregiver socioeconomic characteristics observed in the first visit. Other strategies often applied to longitudinal data, such as individual and household fixed effects estimates, can also be thought of as alternative ways to deal with potential attrition bias. The evidence found suggests that when there is bias, it is driven mostly by wealth and area of residence. Given that studies using the YL sample control for these characteristics in their statistical analysis, this strategy should suffice to limit the effects of attrition bias.

Our results show that some patterns are common to all samples and some patterns are country specific. For other birth cohort studies, it may be useful to distinguish between those correlates that consistently affect attrition in all countries (and have also been shown as relevant in the literature) and those whose relevance vary across cohorts or countries. In the first case, the recommendation involves the use of sampling strategies to reduce attrition in subpopulations that are likely to be exposed to attrition. Similarly, the evidence suggests that the effort for tracking a cohort of children needs to be increased as the children enter into adulthood, as they have a larger say in whether to remain in the study and their chances for increased mobility rise.

The evidence also suggests that different contexts may generate different attrition patterns, and if we cannot reduce attrition ex ante by increasing sample size, we still need to confront the potential biases its presence may generate. For example, attrition rates between YLIs from poorer and wealthier households may be different across countries. In this case, there is no single recommendation to tackle high attrition rates. Rather, there is a need to review its presence and control for wealth status accordingly. Similarly, females may be more likely to be attrited in one country (YL Ethiopia), whereas males may be more likely to be attrited in other countries (YL Peru). Controlling for sex should suffice to limit the effects of this attrition bias.

Even if attrition is low, we could expect attrition bias when a sample is followed for a long time. As children grow and as their families are exposed to changing conditions, reasons for splitting and migration arise, and these reasons are usually more likely to affect specific subgroups of the tracked sample. It is important to control for these observables when performing statistical analysis as a way to deal with potential attrition bias.

ACKNOWLEDGMENTS

We are very grateful to Juan Ferrer and Alessandra Hidalgo for excellent research assistance. We also thank Marta Favara, Jere Behrman, and two anonymous referees for providing detailed comments on an earlier version of this paper. GRADE is one of the partners of the Young Lives Study. We would like to state that GRADE and the authors in particular have been involved in the data collection process of the Young Lives study in Peru.

DATA AVAILABILITY STATEMENT

The data used for this analysis come from the five waves of data collection of the Young Lives study. The data are publicly available in the UK Data Service at http://doi.org/10.5255/UKDA-SN-5307-3, reference number 5307 (round 1), http://doi.org/10.5255/UKDA-SN-6852-3, reference number 6852 (round 2), http://doi.org/10.5255/UKDA-SN-6853-3, reference number 6853 (round 3), http://doi.org/10.5255/UKDA-SN-7931-2, reference number 7931 (round 4), and http://doi.org/10.5255/UKDA-SN-8357-1, reference number 8357 (round 5).

ORCID

Alan Sánchez https://orcid.org/0000-0001-7109-8613
Javier Escobal https://orcid.org/0000-0001-7458-8642

ENDNOTES

[1] According to the Institute of Fiscal Studies, by 2018, 175 longitudinal studies were operating in developing countries, but only 12 were birth cohort studies, following members since birth or childhood.

[2] On the YL website, 204 journal articles that use YL data are listed.

[3] Dercon and Outes-Leon (2008) used data from the first two rounds of the YL study to document attrition patterns and found no evidence of attrition bias. While this is reassuring, after three additional rounds of data collection, attrition levels must have increased and attrition patterns might have changed over time.

[4] The data used in this study are publicly archived at the UK Data Service. See Jones and Huttly (2018), Boyden (2018a,b), Woldehanna et al. (2018), and Sánchez et al. (2018).

[5] Vietnam reported 36 (out of 3,000) refusals (Tuan et al., 2003); India reported 14 refusals, presumably out of 3,000 (Galab et al., 2003); Ethiopia declared no refusals (Alemu et al., 2003).

[6] Although considering the YLIs who died as part of the attrited sample is open to debate, we do so because it clearly affects our ability to infer on the relationships between observables and outcomes for the original sample. Obviously, the reasons behind the death of a YLI are different from those why a YLI may migrate out of the country or be part of a family that refuses to continue in the study.

[7] These studies fulfill three conditions: (1) have tracked children since infancy, (2) have lasted at least 5 years, and (3) have reported results from follow-up studies within the last 15 years.

[8] For this country sample, a decrease in attrition is observed between rounds 4 and 5, which implies that some YLIs not interviewed in round 4 reentered the sample in round 5.

[9] The wealth index is a composite measure that comprises information related to household access to services (electricity, drinking water, and toilet facilities), housing quality (main material used for floor, wall, and roof), and durable goods (TV, radio, refrigerator, and computer).

REFERENCES

Alderman, H., Behrman, J. R., Kohler, H.-P., Maluccio, J. A., & Cotts Watkins, S. (2001). Attrition in longitudinal household survey data. *Demographic Research*, *5*(4), 79–124.

Alemu, T., Asgedom, G., Liebenberg, J., Mekonnen, A., Seager, J., Tefera, B., & Woldehanna, T. (2003). *Young Lives preliminary country report: Ethiopia*. Oxford: Young Lives.

Barnett, I., Ariana, P., Petrou, S., Penny, M., Duc le, T., Galab, S., … Boyden, J. (2013). Cohort profile: The Young Lives study. *International Journal of Epidemiology*, *42*(3), 701–708.

Becketti, S., Gould, W., Lillard, L., & Welch, F. (1988). The panel study of income dynamics after fourteen years: An evaluation. *Journal of Labour Economics*, *6*, 472–492.

Boyden, J. (2018a). Young Lives: An International Study of Childhood Poverty: Round 2, 2006. [data collection]. 3rd Edition. UK Data Service. SN: 6852. https://doi.org/10.5255/UKDA-SN-6852-3

Boyden, J. (2018b). Young Lives: An International Study of Childhood Poverty: Round 3, 2009. [data collection]. 3rd Edition. UK Data Service. SN: 6853. https://doi.org/10.5255/UKDA-SN-6853-3

Cameron, C., & Miller, D. (2015). A practitioner's guide to cluster-robust inference. *The Journal of Human Resources*, *50*, 317-372.

Dercon, S., & Outes-Leon, I. (2008). *Survey attrition and attrition bias in Young Lives*. Technical Note Number 5. Oxford: Young Lives.

Escobal, J., & Flores, E. (2008). *An assessment of the Young Lives sampling approach in Peru*. Technical Note 3. Oxford: Young Lives.

Escobal, J., Lanata, C., Madrid, S., Penny, M., Saavedra, J., Suárez, P., … Huttly, S. (2003). *Young Lives preliminary country report: Peru*. Oxford: Young Lives.

Falaris, E. (2003). The effect of survey attrition in longitudinal surveys: Evidence from Peru, Côte d'Ivoire and Vietnam. *Journal of Development Economics*, *70*, 133–157.

Fitzgerald, J., Gottshalk, P., & Moffitt, R. (1998). An analysis of sample attrition in panel data: The Michigan panel study on income dynamics. *Journal of Human Resources*, *33*, 251–299.

Galab, S., Reddy, G., Antony, P., McCoy, A., Ravi, C., Raju, S., Reddy, , … Reddy, P. (2003). *Young Lives preliminary country report: Andhra Pradesh, India*. Oxford: Young Lives.

Harpham, T. (2002). Measuring child poverty and health: a new international study. *Journal of Tropical Pediatrics*, *48*, 128–131.

Heckert, J. (2015). New perspective on youth migration: Motives and family investment patterns. *Demographic Research*, *33*, 765–800.

Heckman, J. (1979). Sample selection bias as a specification error. *Econometrica*, *47*, 153–162.

Jones, N., & Huttly, S. (2018). Young Lives: An International Study of Childhood Poverty: Round 1, 2002. [data collection]. 6th Edition. UK Data Service. SN: 5307. https://doi.org/10.5255/UKDA-SN-5307-3

Kumra, N. (2008). An assessment of the Young Lives sampling approach in Andhra Pradesh, India. Technical Note 2.Oxford: Young Lives.

Nguyen, N. (2008). An assessment of the Young Lives sampling approach in Vietnam. Technical Note 4.Oxford: Young Lives.

Norris, S., Richter, L., & Fleetwood, S. A. (2007). Panel studies in developing countries: case analysis of sample attrition over the past 16 years within the Birth to Twenty cohort in Johannesburg, South Africa. *Journal of International Development*, *19*, 1143–1150.

Outes-Leon, I., & Sánchez, A. (2008). An assessment of the Young Lives sampling approach in Ethiopia. Technical Note 1.Oxford: Young Lives.

Penny, M., Madrid, S., & Oré, B. (2012). Selection and induction of supervisors for fieldwork: Experiences from Young Lives in Peru. Technical Note 24.Oxford: Young Lives.

Pomeroy, E., Stock, J., Stanojevic, S., Miranda, J., Cole, T., & Wells, J. (2014). Stunting, adiposity, and the individual-level "dual burden" among urban lowland and rural highland Peruvian children. *American Journal of Human Biology*, *26*(4), 481–490.

Rayan, D., & Petesch, P. (2007). *Moving out of poverty (Volume 1) cross-disciplinary perspectives on Mobility*. Washington, DC: Palgrave Macmillan and The World Bank.

Sánchez, A., Penny, M., Woldehanna, T., Galab, S., Boyden, J., Duc, L., & Thuc Boydon, J. (2018). Young Lives: An International Study of Childhood Poverty: Round 5, 2016. [data collection]. UK Data Service. SN: 8357.

Schafer, J., & Graham, J. (2002). Missing data: Our view of the state of the art. *Psychological Methods*, *7*(2), 147–177.

Thomas, D., Frankenberg, E., & Smith, J. P. (2001). Lost but Not Forgotten: Attrition and Follow-up in the Indonesia Family Life Survey. *The Journal of Human Resources*, *36*, 556–592.

Tuan, T., Thi Lan, P., Harpham, T., Thu Huong, N., Duc Thach, T., Tod, B., … Thi Van Ha, N. (2003). *Young Lives preliminary country report: Vietnam*. Oxford: Young Lives.

Valentine, J. L., Barham, B., Gitter, S., & Nobles, J. (2017). Migration and the pursuit of education in southern Mexico. *Comparative Education Review*, *61*(1), 141–175.

Verbeek, M., & Nijman, T. (1996). Incomplete panels and selection bias. In L. Maty & P. Sevestre (Eds.), *The econometrics of panel data*. Dordrecht: Kluwer.

Wilson, I., Huttly, S., & Fenn, B. (2006). A case study of sample design for longitudinal research: Young Lives. *International Journal of Social Research Methodology*, *9*(5), 351–365.

Woldehanna, T., Galab, S., Sanchez, A., Penny, M., Duc, L., & Thuc Boyden, J. (2018). Young Lives: An International Study of Childhood Poverty: Round 4, 2013–2014. [data collection]. 2nd Edition. UK Data Service. SN: 7931. https://doi.org/10.5255/UKDA-SN-7931-2

Ziliak, J., & Kniesner, T. (1998). The importance of sample attrition in life cycle labour supply estimation. *Journal of Human Resources*, *33*, 507–530.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Sánchez A, Escobal J. Survey attrition after 15 years of tracking children in four developing countries: The Young Lives study. *Rev Dev Econ*. 2020;24:1196–1216. https://doi.org/10.1111/rode.12660