

Chapter 12: SAMPLING OUTCOMES

A high-quality survey produces estimates that are both unbiased and low in variability. This chapter reports on PISA-D Strand C sampling outcomes related to bias and variability. Details of the sample design are provided in Chapter 5.

SAMPLE YIELDS AND COVERAGE

Sample size is one of the main factors that affect the variability of survey estimates. Table 12.1 shows the final sample sizes for the five countries that participated in PISA-D Strand C. The completed cases for analysis include all cases that received a final weight and are included in the analysis file. They consist of youth that completed the Youth Interview (YI) or could not respond to the Youth Interview for a literacy-related reason (language barrier or learning/mental disability). The completed cases include only those that complete the full assessment. For comparison, target sample sizes are provided in Table 5.6. Overall, the target sample size was 2 000 for Senegal, which had two assessment languages, and 1 600 for the other countries.

For the representative sample, the final sample sizes depended on the initial number of sampled dwelling units (DUs) and the hit rate. The hit rate is defined as the number of sampled dwellings units required to obtain one completed assessment. There are several reasons for a lower than expected hit rate, including undercoverage and lower than expected eligibility rates, household size and response rates (discussed later in this chapter). Undercoverage may indicate that the country had difficulty locating and identifying members of the target population. It can lead to bias in the survey estimates, to the extent that the proficiency levels of the sampled youth differ from the youth that did not have a chance of selection. The weighting adjustments described in Chapter 9 were intended to reduce this source of bias.

Table 12.2 shows the initial number of sampled dwelling units and the expected and achieved hit rates for the representative sample in each country. The table also shows the factors contributing to the hit rates – occupancy rates (the percentage of sampled dwelling units that are occupied), average household sizes, eligibility rates (the percentage of household members that are eligible for the survey), and unweighted screener, YI, and assessment completion rates. A parallel table (Table 5.7) in Chapter 5 shows the expected values prior to data collection.

The following provides a summary of sampling outcomes for each country:

Guatemala

Hit rates were somewhat lower than expected, primarily due to lower-than-expected eligibility rates, indicating possible undercoverage of the target population. In relation to sample size, the hit rates were compensated to some extent by a greater-than-expected number of dwelling units in primary sampling units (frame data were based on Census 2002), resulting in a sample yield close to target.

Honduras

Hit rates were somewhat lower than expected, primarily due to lower than expected eligibility rates, indicating possible undercoverage of the target population. This was compounded by the lower than expected number of dwelling units (because not all primary sampling units [PSUs] were worked) and a shortfall in the limited representative sample (because of lack of time and resources), resulting in a sample yield below target. The fact that not all PSUs worked was accounted for in the weighting process through the PSU nonresponse adjustment. See Chapter 9 for more details.

Panama

The hit rates were considerably higher than expected because of higher-than-expected occupancy rates, completion rates and eligibility rates – see cautionary notes in Chapter 9. In terms of sample size, the hit rate counteracted the much lower-than-expected number of sampled dwelling units (because the number of DUs listed from maps was smaller than expected and not all PSUs were worked) and shortfall in the limited representative sample (because location sampling was not implemented), resulting in a sample yield above target.

Paraguay

Actual hit rates were less than half the expected hit rates, which is explained partially by lower-than-expected completion rates. The other contributing factor was lower-than-expected eligibility rates, indicating possible undercoverage of the target population. Although the number of dwelling units within the PSUs was higher than expected, the final sample yield was under target.

Senegal

Hit rates were somewhat lower than expected, partially due to lower-than-expected eligibility rates in the high-density stratum, indicating possible undercoverage of the target population. In relation to sample size, the hit rates were compensated to some extent by greater-than-expected number of dwelling units in PSUs, resulting in a sample yield above target.

Chapter 9 provides a comparison of the population control totals to the sum of weights prior to calibration. The sum of weights was lower than the control totals for Guatemala, Honduras, Paraguay and Senegal and was higher than the control totals for Panama, which is consistent with the hit rate patterns described above. Sampling frame exclusions, described in Chapter 5, also contribute to the undercoverage. Weights were calibrated to population control totals to reduce both sources of noncoverage bias (see Chapter 9).

Table 12.1a Main survey sample sizes for completed cases

Country	Completed cases for analysis							
	Overall	Representative probability	Representative non-probability		Limited representative			
			Link-tracing through households	Link-tracing through households recruiting	School frame approach for OOS	School frame approach for grade 6 or below	Location sampling	Special operation for street children
Guatemala	1 749	1 250	NA	NA	129	181	189	0
Honduras	1 281	1 161	NA	NA	NA	15	105	NA
Panama	2 055	1 902	79	2	0	72	0	NA
Paraguay	1 002	814	NA	NA	NA	188	NA	0
Senegal	2 103	2 103	NA	NA	NA	NA	NA	NA

Table 12.1b Main survey sample sizes for completed assessments

Country	Completed assessments							
	Overall	Representative probability	Representative non-probability		Limited representative			
			Link-tracing through households	Link-tracing through households recruiting	School frame approach for OOS	School frame approach for grade 6 or below	Location sampling	Special operation for street children
Guatemala	1 523	1 041	NA	NA	114	181	187	0
Honduras	1 187	1 070	NA	NA	NA	15	102	NA
Panama	2 049	1 902	79	2	0	66	0	NA
Paraguay	825	669	NA	NA	NA	156	NA	0
Senegal	2 023	2 023	NA	NA	NA	NA	NA	NA

Table 12.2a Sample sizes, unweighted eligibility rates and unweighted completion rates for the representative probability sample, by country and density strata

Counts and rates	Guatemala			Honduras (rural only)			Panama		
	Total	H	L	Total	H	L	Total	Indigenous	Rural
Number of PSUs	101	59	42	217	169	4	531	414	117
Number of sampled dwelling units	25 875	14 089	11 786	18 582	14 558	4 024	6 081	5 000	1 081
Occupancy rate	79%	78%	80%	87%	86%	89%	99%	99%	100%
Screener completion rate	89%	94%	84%	93%	93%	93%	90%	89%	97%
Average household size	4.5	4.7	4.1	4.1	4.1	4.1	3.9	4.0	3.2
Eligibility rate	2.1%	2.7%	1.3%	2.3%	2.4%	1.8%	9.6%	8.3%	16.8%
Number of eligible sampled persons	1 724	1 291	433	1 397	1 152	244	2 022	1 459	563
YI completion rate	70%	70%	71%	82%	82%	83%	94%	95%	92%
Number of completes for analysis*	1 250	936	314	1 161	958	203	1 902	1 386	516
Assessment completion rate	86%	84%	93%	93%	94%	90%	100%	100%	100%
Number of completed assessments	1 041	754	287	1 070	888	182	1 902	1 386	516
Hit rate	4.02	5.35	2.44	5.76	6.10	4.52	31.28	27.72	47.73
Expected hit rate	5.82	9.40	2.31	6.31	7.27	2.89	5.83	6.69	2.70

Table 12.2b Sample sizes, unweighted eligibility rates and unweighted completion rates for the representative probability sample, by country and density strata (continued)

Counts and rates	Paraguay			Senegal		
	Total	H	L	Total	H	L
Number of PSUs	498	420	78	80	56	24
Number of sampled dwelling units	28 709	23 555	5 154	8 774	5 906	2 868
Occupancy rate	81%	81%	85%	96%	98%	94%
Screener completion rate	84%	85%	80%	81%	83%	78%
Average household size	3.8	3.8	3.8	9.4	9.8	8.4
Eligibility rate	1.4%	1.5%	0.7%	3.4%	3.5%	3.0%
Number of eligible sampled persons	1 041	950	92	2 195	1 667	530
YI completion rate	76%	75%	85%	92%	92%	94%
Number of completes for analysis*	814	735	79	2 103	1 601	502
Assessment completion rate	85%	84%	91%	100%	100%	100%
Number of completed assessments	669	598	71	2 023	1 527	496
Hit rate	2.33	2.54	1.38	23.06	25.86	17.29
Expected hit rate	5.87	6.68	2.80	25.58	30.60	15.44

* Includes completed YI's and YI's that were not completed for a literacy-related reason.

Of the target 1 600 completed cases for the main language, countries were to obtain at least 1 300 that passed the core cognitive assessment module and continued to take the main assessment items. Table 12.3 gives core results for completed cases by sample type. Paraguay had a low percentage of youth passing the core.

Table 12.3 Core results for completed cases by sample type

Country	Sample type	Passed core		Failed core		Did not complete core	
		Counts	Percent	Counts	Percent	Counts	Percent
Guatemala	Representative	793	63%	262	21%	195	16%
	Limited representative	402	81%	81	16%	16	3%
	All	1 195	68%	343	20%	211	12%
Honduras	Representative	971	84%	114	10%	76	7%
	Limited representative	112	93%	6	5%	2	2%
	All	1 083	85%	120	9%	78	6%
Panama	Representative	1 389	70%	594	30%	0	0%
	Limited representative	59	82%	7	10%	6	8%
	All	1 448	70%	601	29%	6	0%
Paraguay	Representative	375	46%	306	38%	133	16%
	Limited representative	113	60%	44	23%	31	16%
	All	488	49%	350	35%	164	16%
Senegal	Representative	1 672	80%	351	17%	80	4%
	All	1 672	80%	351	17%	80	4%

RESPONSE RATES AND NONRESPONSE BIAS

Response rate is a valuable data quality measure and the most widely used indicator of survey quality. A high response rate increases the likelihood that the survey accurately represents the target population and a low response rate reflects the possibility of bias in the outcome statistics.

Using the standard formulae shown in Table 12.4, weighted response rates for the representative sample were computed hierarchically for the following stages of data collection:

- screener
- Youth Interview
- assessment
- overall.

The literacy-related cases were included in the numerator of the response rates because their reason for nonresponse provides an indication of their proficiency level. In addition, technical problems are included in the count of completes at each stage, for the purpose of response rate calculations. Youth with disabilities or those lacking the technical skills to use a tablet, while considered in scope, were subtracted from the denominator because the assessment did not accommodate such situations.

Table 12.4 Response rate Calculation

<p>Screeener</p> <p>COMPLETE / ELIGIBLE</p> <p>COMPLETE = Cs</p> <p>ELIGIBLE = HHs - Is - Us * (Is / Ks)</p>	<p>Cs = Completed screeners,</p> <p>HHs = All sampled dwelling units (DUs),</p> <p>Is = DUs known to be ineligible,</p> <p>Us = DUs with unknown eligibility status,</p> <p>Ks = DUs with known eligibility status.</p>
<p>Youth Interview</p> <p>COMPLETE / ELIGIBLE</p> <p>COMPLETE = Cy + LRy</p> <p>ELIGIBLE = SPy - Dy - ly</p>	<p>Cy = Completed YI cases,</p> <p>LRy = Literacy-related nonrespondents,</p> <p>SPy = All sampled persons (SPs),</p> <p>Dy = SPs with a disability,</p> <p>ly = SPs known to be ineligible.</p>
<p>Assessment</p> <p>COMPLETE / ELIGIBLE</p> <p>COMPLETE = Ca + LRa</p> <p>ELIGIBLE = Cy - Da - Ta - la</p>	<p>Ca = Completed assessments,</p> <p>LRa = Literacy-related nonrespondents,</p> <p>Cy = Completed YI cases,</p> <p>Da = SPs with a disability,</p> <p>Ta = SPs unable to use the tablet,</p> <p>la = SPs known to be ineligible.</p>

Tables 12.5 shows a summary of the response rates for the participating countries.

Table 12.5 Weighted response rates for the representative sample

Country	Screeener	Youth Interview	Assessment	Overall
Guatemala	89%	71%	95%	60%
Honduras	92%	81%	95%	71%
Panama	96%	94%	100%	90%
Paraguay	81%	83%	96%	64%
Senegal	80%	91%	100%	73%

Nonresponse bias can be substantial when two conditions hold: i) the response rate is relatively low and ii) the difference between the characteristics of respondents and those of nonrespondents is relatively large. This is reflected in the following deterministic nonresponse bias formula:

$$Bias(\bar{y}_R) = (1 - W_R)(\bar{Y}_R - \bar{Y}_{NR}),$$

where W_R is the proportion of respondents, \bar{Y}_R is the mean outcome for respondents and \bar{Y}_{NR} is the mean outcome for nonrespondents. An alternative model of nonresponse assumes each sampled person has a certain propensity to respond, and nonresponse bias in a characteristic is a function of the covariance between the response propensity and the characteristic:

$$Bias(\bar{y}_R) = \frac{\sigma_{yp}}{\bar{p}},$$

where σ_{yp} is the covariance between the outcome variable and response propensity, and \bar{p} is the mean response propensity. Based on this model, nonresponse bias is present if missingness is related to proficiency, as measured by PISA-D Strand C.

For the representative sample, we evaluated the potential for nonresponse bias prior to weighting adjustments by reviewing weighted response rates by subgroup at the screener and Youth Interview stage, where subgroups were formed by crossing proficiency-related auxiliary variables. The following provides a summary of the findings for each country:

Guatemala

We identified low screener response rates (less than 60%) for households with no literacy-related nonresponse, located in rural areas with low to medium socioeconomic development, in the Peten region, in which the interviewer observed street lights. We identified low YI response rates (less than 60%) for sampled out-of-school persons aged 14 to 16 years old:

- in rural areas of the Southwest region in which the interviewer did not observe street lights
- belonging to households with more than five members located in rural areas of the Peten and Northwest regions in which the interviewer did not observe street lights, and of the Peten, North, Northwest and Southeast regions in which the interviewer observed street lights.

Honduras

We identified low screener response rates (less than 82%) for households with no literacy-related nonresponse, located in low density areas, in the west, in which the interviewer did not observe street lights. We identified low YI response rates (less than 60%) for sampled persons, 14- or 16-year-old youth, attending school at grade 6 or below in the rural areas of the West, Central West and South regions, in which the interviewer did not observe street lights, or for 16-year-old youth in the rural area of the West region, in which the interviewer observed street lights.

Panama

We did not identify any low screener response rates, as the lowest screener response rate was 91.3% for households in indigenous regions. We did not identify any low YI response rates, as the lowest YI response rate was 80.2% for sampled persons, 14-16-year-old youth, attending school at grade 6 or below, in the rural area of the Central region.

Paraguay

We identified low screener response rates (less than 60%) for households with no literacy-related nonresponse, located in rural areas of region 5 in the low density stratum, in which the interviewer observed street lights. Region 5 for Paraguay includes the following administrative departments: Concepcion, San Pedro, Canindeyu and Amambay. We identified low YI response

rates (less than 65%) for out of school 16 year olds belonging to households with more than four people in rural areas of region 3, in which the interviewer did not observe street lights. Region 3 includes departments Alto Parana and Caaguazu.

Senegal

We identified low screener response rates (less than 65%) for households in the low concentration stratum with no literacy-related nonresponse, located in urban areas of the Dakar region in which the interviewer did not observe street lights. We identified low YI response rates (less than 80%) for sampled persons 14 to 16 years old out-of-school, belonging to households with 10 members or less located in rural areas of the Diourbel region in which the interviewer did not observe street lights.

Variables from this evaluation were used in the weighting adjustments, with the goal of reducing nonresponse bias. The screener and YI adjustment cells are described in Tables 9.6 and 9.9, respectively.

LESSONS LEARNT

- Countries faced great difficulty and major challenges in accessing resources needed to conduct Strand C and adhering to the schedule. Countries experienced delays obtaining budget approval, delays in the preparation of material (translation and adaptation of instruments) impacting subsequent steps in data collection, pay freezes for interviewers, torrential rains and floods, and changes of political administration in the country affecting officials appointed to the Department of Education.
- Countries did not provide all the information requested by the international contractors for performing quality control checks on various aspects of sample design and selection. Therefore, we were unable to verify the accuracy of some samples.
- Countries with low rates of out-of-school youth had serious difficulty reaching their sample size goals, even after performing a significant amount of screening.

RECOMMENDATIONS

We suggest encouraging the country to engage the National Statistical Institute early in the project to participate or to provide:

- access to sampling frames, area maps, listings of dwelling units, etc.
- access to project staff with experience in household sampling
- assist or carry out the household sampling stage
- assist in deriving estimates of screening to locate eligible youth
- access to experienced and adequate number of interviewers
- a longer data collection period to navigating unforeseen issues and allow the country to deliver the data on time.