

The Impact of Respondent Selection on Dietary Diversity and Quality Measurement in Surveys: Findings from Ethiopia and Nigeria

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Abstract

This study investigates the effects of different respondent selection strategies on the measurement of dietary diversity and quality within household surveys, using large-scale, nationally representative datasets from Ethiopia and Nigeria that include the Global Diet Quality Questionnaire (DQQ). Acknowledging the increased costs and logistical challenges associated with collecting data from all household members—particularly with efforts to minimize proxy responses—the research assesses whether interviewing a single, randomly selected adult per household yields statistics as reliable as those obtained from interviewing every adult household member. The analysis considers alternative methods for respondent selection, such as random selection with and without replacement, the use of proxy respondents, and interviewing the household head. Findings reveal that proxy and non-responses systematically differ from self-responses, introducing bias into the estimates. Similarly, household heads differ from the broader adult population in several key demographic and socioeconomic aspects. The study highlights that, when appropriately calibrated and executed in the field, random respondent selection with replacement can produce robust indicators of dietary diversity and quality. These findings offer valuable guidance to national statistical offices and survey practitioners seeking cost-effective yet reliable approaches to individual-level dietary data collection in low- and middle-income countries.

JEL Classification: C81, C83

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1. Introduction

Previous research has highlighted the importance of individual-level survey data collection on topics that have traditionally been investigated at the household-level, even though the unit of observation should conceptually be the individual (Doss et al., 2020). Research on best practices on individual-level survey data collection has also emphasized the importance of self-reporting and minimizing the reliance on proxy-reporting (Bound et al., 2001; Carletto et al., 2022; Cobb, 2018; Dillon & Mensah, 2024; Deininger et al., 2021; Kilic et al 2023; Kilic, Koolwal & Moylan, 2021). While survey practitioners may be sympathetic to enhancing the scope of individual-level data collection and improving data quality by minimizing proxy-response or non-response, individual-level data collection undoubtedly increases survey costs. This increase is driven by separate interviews that need to be scheduled by each eligible interview target, implying multiple trips to the sampled household and often an extension to the time spent in the sample enumeration area, particularly in the context of large-scale surveys that rely on mobile teams (Hasanbasri et al., 2021).

In many low- and middle-income countries, financial and logistical constraints hinder the scope, frequency, and timeliness of household surveys. These limitations slow the adoption of individual-level survey data collection and validated tools for measuring dietary diversity and quality in large-scale surveys. Thus, National Statistical Offices (NSOs) and survey practitioners seek cost-effective methods for individual-level data collection that still yield representative statistics.

This study aims to fill this knowledge gap by investigating several inter-connected research questions pertaining to respondent selection in the context of collecting individual-level survey data on dietary diversity and quality. Specifically, the study examines the following questions. Can only one eligible individual be selected at random as a respondent in each household to derive estimates that are statistically indistinguishable vis-à-vis the scenario of interviewing all eligible individuals? Can the randomly selected individual be replaced in the event of unavailability? Can proxy respondents accurately fill data gaps when interview targets cannot be reached? What are the implications for interviewing a single household member that is deemed most knowledgeable about household affairs? We examine these issues within the context of measuring dietary diversity and quality outcomes in household surveys, given their significance as predictors of health status.

Accurate measurement of these factors offers essential insights for assessing the overall health and wellbeing of populations (Kant, 2004; Verger et al., 2021).

Several measurement approaches of dietary diversity and quality exist, each addressing different dimensions of wellbeing. Among from the recently validated approaches to measure dietary diversity and quality at population level include Dietary Diversity Score (DDS), Global Dietary Recommendations for Adults (GDR) and Minimum Dietary Diversity for Women (MDD-W) (FAO, 2021; Henforth, Ballard & Rzepa, 2024 Kennedy et al., 2011; Martin-Prevel 2017; Trijsburg et al., 2019). These indicators are aggregated using individual-level information on consumption of 29 food items in the past 24 hours.

We examine the respondent selection impacts on the measurement of the above-mentioned indicators using data from Ethiopia (ESPS-2021/22) and Nigeria (GHS-Panel 2023/24) which were implemented by the respective NSO with support from the World Bank and administered the Global Diet Quality Questionnaire (DQQ). The DQQ module represents a significant advancement in global nutrition monitoring, offering a practical solution for tracking the newly approved SDG indicator on Minimum Dietary Diversity under SDG 2 and informing policy. Moreover, it allows for consistent data collection across age groups, facilitating comparisons and insights into intrahousehold dietary disparities.

In Ethiopia, all adults (aged 15 and older) were attempted to be interviewed, and proxy responses were allowed in the event that the interview targets were not available. In Nigeria, all women aged 15-49 were attempted to be interviewed along with two randomly selected adults in each household, and proxy responses were not allowed. For Nigeria, we focus exclusively on the women aged 15-49 sample where the survey design intended to capture the entire sample. Comparing individuals that self-reported versus those that were eligible but were not interviewed, we see statistically significant differences between the two samples across an extensive set of individual- and household-level characteristics related to demographics, education, labor market outcomes, and wealth. These differences have direct implications for the measurement of dietary diversity and quality outcomes, as well as consumption patterns.

The analysis shows that reasonable accuracy is achieved on indicators of dietary diversity and quality when randomly selecting a single individual compared to the benchmark case of interviewing all eligible members of the household, provided that robust calibration is made to account for the loss of individuals that are not available to answer for themselves and that

reasonable fieldwork measures are taken to maximize the probability of interviewing the targeted individual. The study also reveals that interviewing a single household member that is deemed most knowledgeable about household affairs cannot provide data that is deemed representative of the adult population.

The paper is organized as follows. Section 2 describes the experimental design. Section 3 presents the data and the dietary diversity and quality indicators considered in this study, Section 4 presents the results, followed by the discussion in Section 5, and Section 6 concludes.

2. Experimental Design

2.1 Respondent selection scenarios

To test the effects of alternative respondent selection on measures of dietary quality, we construct alternative datasets using source data collected in Ethiopia and Nigeria. Four alternative scenarios for the adults' sample and three for the women sample are identified (Table 1a). These scenarios are identified based on common respondent selection practices in household surveys and the possibilities available in the two surveys under consideration.

We examine dietary quality outcomes for two target populations: adults aged 15 years and older, and women of reproductive age (15–49 years). The Adults (15+) sample is used to assess dietary quality indicators for all adults. These indicators include Dietary Diversity Score (DDS), All-5 food groups, protections and risks from non-communicable diseases (NCD Protect and NCD Risk) and Global Dietary Recommendations (GDR) Score. The Women (15–49) sample is specifically designed to construct selected food group metrics and Minimum Dietary Diversity for Women of this reproductive age cohort (MDD-W).

Table 1a. Experimental Design: Dietary outcome domains and sample strategies

Target Population	DQQ Indicators	Sample	Selection Rule
Adults 15+ years	All-5 DDS NCD Protect NCD Risk GDR	All Adults	Interviews all eligible household members and is regarded as the most accurate method to construct household level estimates since it is a direct measure rather than rely on extrapolation from a single individual. It is also the costliest scenario due to the time requirement to directly interview every eligible household member.
		Randomly selected adult: Convenient	This approach involves selecting one respondent from all eligible respondents who are available. This method increases the sample size at the household level, as households with non-missing responses are included in the analysis. The process is similar to replacement; if the initial selection is unavailable, another respondent is chosen from those available. However, this method can lead to bias if there are systematic differences between individuals who are available and those who are not.
		Randomly selected adult: Strict	Select a single respondent from all <i>eligible</i> respondents regardless of availability at the time of the interview. This will increase reliance on proxy response, or else a reduced sample where proxy response is not included.
		Household Head	Select the head of household. This construct is commonly used to identify a primary decision-maker in a household and can be an important predictor of household level outcomes. We include it for reference here due to the prevalence of this construct in the literature, though <i>a priori</i> it is not expected to perform well compared to the randomization-based approaches, and thus unlikely to prove reliable when extrapolated to population level estimates.
Women 15-49 years	Food Groups MDD-W	All Women	Interviews all eligible women in the household. This is expected to be the most accurate method, though also more costly due to increased interview duration.
		Randomly selected woman: Convenient	Select a single respondent from all eligible women that were available to respond at the time of the interview.
		Randomly selected woman: Strict	Select a single respondent from <i>all eligible</i> women. This will lead to reduced sample overall where proxy response is not included and the selected respondent is not available at the time of the interview.

The inclusion and exclusion criteria start with the eligible household members. It then explores the case of treating proxy and non-response.¹ We explore potential changes that may occur due to relying on proxy responses. Although self-report is generally considered more reliable, we

¹ Proxy-response data is one question we provide insight on with this analysis. Proxy response occurs when an individual is not available to respond, and another household member answers for them. This may lead to inaccurate and potentially biased estimates, particularly for members that spend some time outside of the home and thus may not share all meals. Our data allows a comparison of proxy-response vs self-response.

compare two approaches for obtaining individual level data that survey implementers may consider as options. There are three hypothetical scenarios we consider on this question.

- A. **Proxy Included** – no distinction is made analytically between proxy and self-reported data. This is only possible in the Ethiopia data where proxy responses were collected. A fundamental assumption of this approach is that proxy response data is equally accurate to self-report.
- B. **Unadjusted self-report** – drop all proxy responses and ignore non-responses and adjust weights for the lost observations without further adjustment. This approach relies on the assumption that individuals that are not available to respond are not systematically different from those that are present at an interview.
- C. **Adjusted self-report** – estimate individual probability to be available to be interviewed based on their observable characteristics, and with this construct weights to emphasize respondents with high probability to be unavailable.

2.2 Reweighting

Two reweighting methods were implemented. The first method involves excluding the proxy and non-response cases and recalculating the weights accordingly. Here, we present the generalized adjustment applied to household weights when a portion of the sample is omitted.

$$P \begin{cases} I | Rule = 1 \\ J | Rule = 0 \end{cases} \quad (1)$$

where P is the survey population pre-adjustment, which is divided by a rule into sets I where rule=1 and J where rule=0. We then modify weights for an individual in population I and generate the adjusted weight as follows

$$w_{i,a} = (w_{i,p} | Rule = 1) * \left[1 + \left(\frac{\sum_{j=1}^J w_{j,p} | Rule=0}{\sum_{p=1}^P w_p} \right) \right] \quad (2)$$

where $w_{i,a}$ is an adjusted weight and $w_{i,p}$ is the unadjusted weight for observation i . This weight is then post-stratified according to the sum of weights in the baseline survey.

The second method of reweighting involves adjust for non-response rather than simply dropping non-responders. Here, we first estimate a logistic regression of the form specified in equation 3.

$$\Pr (self = 1) = F(\beta_0 + \sum_{k=1}^K \beta_k X_k) \quad (3)$$

where the dependent variable is a binary that is equal to one where a household member was the respondent and 0 otherwise; X is a vector containing K independent explanatory variables including individual characteristics, household characteristics, and a spatial fixed effect. Using the estimated probability for an individual to be a respondent (\widehat{self}), an adjustment factor is created. First, deciles of estimated probability are constructed, then the average probability within decile is calculated, then the inverse of that average is taken, as illustrated in equation 4.

$$af_{D=d} = \frac{1}{\frac{\sum_{i=1}^N \widehat{self}_i}{N}} \quad (4)$$

This adjustment factor is then applied to $w_{i,a}$ to construct an updated weight. This weight is winsorized at the second and ninety-eighth percentiles to minimize the impact of extreme values, and then the updated weight is post-stratified to ensure that the final weights continue to reflect the sum of weights in the overall sample. For comparability of estimates across the various sample scenarios, all estimates in adults sample is extrapolated to the population of individuals (household weight * household size), and the women of reproductive age.

3. Data and Indicators

3.1 Data

The study uses individual-level Dietary Quality Questionnaire (DQQ) data, along with corresponding demographic, time use, and household characteristics obtained from recently implemented large-scale household surveys in Ethiopia and Nigeria.

The Ethiopia data are part of Wave 5 of the Ethiopia Socioeconomic Panel Survey (ESPS), which was implemented in two visits in 2021/22. It covered 437 enumeration areas and interviewed 4,955 households in total. The interview relevant for the DQQ module is conducted as part of the household questionnaire, which is administered from April-June 2022. From this visit, there were 4,955 with at least one successful response to the DQQ module. Responses were recorded for all members aged 15 years and above, including proxy response where an eligible member was not available to respond for themselves.

The Nigeria data come from Wave 5 of the Nigeria General Household Survey-Panel in 2023/24, which covered 511 EAs and 4,715 households in total. The DQQ module is administered

as part of the household interview in the post-harvest visit, which captured 3,661 households with at least one successful interview. The survey protocol differed for Nigeria, where the rule was to interview all adult women, ages 15-49, as well as up to two randomly selected members aged 15-49 which could include males. Nigeria also required that the individual respond for themselves, meaning no proxy response data is available. To maximize comparability across countries, we restrict the analysis of the Nigeria data to the women ages 15-49 sample where the survey protocol matches.

Table 1b presents the summary of respondent counts by selection scenario. There are ten alternative scenarios for the adults (15+) target population. For the Women (15-49) target population, there are seven scenarios in the Ethiopia data and six in the Nigeria data. This variation is attributed to options for including or excluding proxies in the Ethiopia dataset. The benchmark in each country and sample category is indicated in bold. The benchmark is expected to be the most reliable information available. In the adults (15+) target population, the benchmark scenario is the adjusted self-report of all eligible adults and there are 8,665 eligible adult self-respondents in this scenario. In the Women (15-49) target population, the benchmark is the adjusted self-report of all women in this group and there are 4,352 respondents in the Ethiopia data and 4,330 respondents in the Nigeria data.

Another observation in the scenarios is that the convenience random selection enabled replacement of eligible participants who were unavailable for interviews during the initial household visit or subsequent follow-ups. This approach resulted in an expanded sample size. For instance, within the adult sample, the replacement strategy yielded 1,483 additional eligible respondents compared to a strict random selection, reflecting an approximate 30% increase (4,914 vs. 3,431). Similarly, in the women's sample, it contributed 388 extra respondents in Ethiopia and 322 in Nigeria, corresponding to an 11% increase in both cases.

Table 1b. Respondents by Selection Scenarios

Country	Target Population		Sample	Proxy Included (A)	Unadjusted Self-Report (B)	Adjusted Self-Report (C)
Ethiopia	Adults (15+)	1	All Adults	14,058	8,802	8,665
		2c	Convenience Random Selection		4,914	4,792
		2s	Strict Random Selection		3,431	3,313
		3	Household Head	4,950	3,653	3,534
	Women (15-49)	1W	All Women	6,218	4,352	4,352
		2Wc	Convenience Random Selection		3,602	3,602
3Ws		Strict Random Selection		3,214	3,214	
Nigeria	Women (15-49)	1W	All Women		4,330	4,330
		2Wc	Convenience Random Selection		3,032	3,032
		3Ws	Strict Random Selection		2,710	2,710

Note: Values in each category are total number of respondents.

Source: Author's compilation from ESPS (2012) and GHS (2023/24) data.

3.2 DQQ Indicators

The DQQ module administered in both surveys includes a standard set of questions used to construct the indicators. These constitute a series of 29 binary response questions on whether the individual consumed food of a certain type yesterday.² In certain cases, the standard set of food types is sub-divided to maximize data capture based on local eating patterns. For indicator

² The 29 food list included in the DQQ are: 1. Foods made from grains, 2. Whole grains, 3. White roots, tubers, and plantains, 4. Pulses, 5. Vitamin A-rich orange vegetables, 6. Dark green leafy vegetables, 7. Other vegetables, 8. Vitamin A-rich fruits, 9. Citrus, 10. Other fruits, 11. Baked / grain-based sweets, 12. Other sweets, 13. Eggs, 14. Cheese, 15. Yogurt, 16. Processed meats, 17. Unprocessed red meat (ruminant), 18. Unprocessed red meat (non-ruminant), 19. Poultry, 20. Fish and seafood, 21. Nuts and seeds, 22. Packaged ultra-processed salty snacks, 23. Instant noodles, 24. Deep fried foods, 25. Fluid milk, 26. Sweet tea / coffee / cocoa, 27. Fruit juice and fruit-flavored drinks, 28. Soft drinks (sodas, energy drinks, sports drinks), and 29. Fast food. (Global Diet Quality Project. 2022)

construction, these sub-divided types are combined into their standardized type, with a “yes” for any sub-type translating to a “yes” in the standard type. Responses from the 29 types are then consolidated into 10 food groups, with a “yes” from any type translating to a “yes” in the food group. These category binary indicators are then summed to capture the total number of food groups consumed (0-10), which in the general population is called the Dietary Diversity Score (DDS). Using this sum, MDD-W is then constructed as a binary indicator that equals one if the individual consumed 5+ food groups yesterday, which indicates higher likelihood of adequate micronutrient intake. Additionally, we calculate All-5, NCD-Protect, NCD-Risk and Global Dietary Recommendations (GDR) Scores. The full list and descriptions are presented in Appendix-1, Table A1.

4. Results

4.1 Comparison between self-reported and proxy-reported populations

The Ethiopia survey allowed proxy responses, so the dietary outcome measures are non-missing for almost all eligible individuals. In Nigeria, since proxy response was not allowed, dietary outcomes are simply missing to indicate non-response for individuals that were not present to respond for themselves. Both proxy responses and non-responses can affect dietary outcome estimates, particularly if they differ in important ways from those provided by participants who were available and responded directly. This is particularly relevant for dietary recall: those at home are likely not aware of the information about absent family members' meals taken in the past 24 hours, who may also eat out and consume different foods than those prepared at home.

We therefore begin with the investigation of differences between self-report and proxy respondents using individual and household level demographic and socioeconomic characteristics that can influence the individual’s dietary choices. The results are presented in Table 2a and 2b. The comparison shows that self-report individuals differ from those providing proxy responses and from non-respondents. Compared to the proxy and non-responses, the self-reporting members of the household tend to be older, female, either the household head or spouse, married, and less educated. In Ethiopia, the self-report individuals were also more likely to own a mobile phone. In Nigeria, we show that the self-report individuals are more likely to work outside the home in enterprises. Self and non-self-respondents are also different by the household-level characteristics. These groups tend to come from different households. For instance, self-

respondents are more likely to be from households with more dependents. The result is intuitive because an adult typically needs to be present to provide supervision for children and other members requiring care. The result also shows that households with a higher number of eligible adults and eligible women tend to have more proxy responses or instances of non-response. This may occur because, when proxy responses are allowed, enumerators are more likely to collect information from available household members on behalf of those who are absent, avoiding additional visits to the household.

Table 2a. Comparison of self-report vs proxy report individuals in the Adult(15+) sample

Category	Variable	Self-report=1	Self-report=0	Difference	
Individual characteristics	Age†	36.54	30.18	-17.4	***
	Age 15-24	0.23	0.49	25.9	***
	Age 25-49	0.57	0.39	-18.2	***
	Female	0.57	0.40	-16.4	***
	Head	0.40	0.23	-17.1	***
	Spouse of head	0.32	0.11	-20.8	***
	Child of head	0.21	0.52	30.5	***
	Married	0.65	0.37	-27.3	***
	No education	0.44	0.31	-12.2	***
	Primary education	0.36	0.45	8.9	***
	Secondary education	0.12	0.17	5.1	***
	Tertiary education	0.08	0.06	-1.9	**
	Can read and write	0.55	0.68	12.9	***
	Owns working cellphone	0.27	0.24	-3.3	*
	Worked in agriculture	0.45	0.45	0.0	
	Worked in non-farm enterprise	0.08	0.07	-1.2	
	Worked for wages	0.15	0.15	0.3	
	Any income-generating work	0.60	0.60	-0.5	
	Household characteristics	Dependency ratio†	0.74	0.59	-20.6
Eligible adults†		3.46	4.25	22.8	***
Eligible females†		1.42	1.75	23.3	***
Lowest wealth quintile		0.30	0.29	-0.5	
Second wealth quintile		0.31	0.33	1.5	
Third wealth quintile		0.23	0.19	-3.6	*
Fourth wealth quintile		0.10	0.11	1.1	
Highest wealth quintile		0.06	0.08	1.6	
No land ownership		0.22	0.23	0.7	
Smallest quintile of land area		0.08	0.06	-1.7	
Second quintile of land area		0.11	0.10	-1.5	
Third quintile of land area		0.17	0.17	0.1	
Fourth quintile of land area		0.19	0.15	-3.8	**
Largest quintile of land area		0.23	0.29	6.3	**

Notes: Table presents mean values of self-report and non-self-report (proxy) Adult (15+) sample. The difference between self-report and non-self-report mean values is expressed as percentage points from the mean for binary variables and proportion difference for continuous indicated by †. Statistics account for complex survey design. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Source: Authors' calculations from ESPS (2022) data.

Table 2b. Comparison of self-report vs proxy report individuals in the Women (15-49) sample

Category	Variable	Ethiopia			Nigeria		
		Self-report=1	Self-report=0	Difference	Self-report=1	Self-report=0	Difference
Individual characteristics	Age†	30.80	24.36	-20.9***	31.74	24.56	-22.6***
	Age 15-24	0.28	0.63	35.7***	0.3	0.63	33.8***
	Age 25-49	0.72	0.37	-35.7***	0.7	0.37	-33.8***
	Female	1.00	1.00	0.0	1.0	1.00	0.0
	Head	0.13	0.02	-10.5***	0.1	0.01	-6.3***
	Spouse of head	0.61	0.23	-38.2***	0.6	0.33	-27.6***
	Child of head	0.18	0.58	39.7***	0.2	0.52	27.4***
	Married	0.72	0.31	-41.0***	0.6	0.35	-28.6***
	No education	0.45	0.31	-13.8***	0.3	0.26	-6.8**
	Primary education	0.37	0.46	8.9***	0.3	0.30	2.3
	Secondary education	0.11	0.18	6.7***	0.3	0.31	4.3*
	Tertiary education	0.07	0.05	-1.8*	0.1	0.13	0.2
	Can read and write	0.53	0.67	14.1***	0.7	0.76	9.3***
	Owns working cellphone	0.19	0.14	-5.1***	0.6	0.55	-2.9
	Worked in agriculture	0.33	0.35	2.0	0.0	0.02	-1.5**
	Worked in non-farm enterprise	0.08	0.07	-1.3	0.3	0.18	-15.1***
	Worked for wages	0.11	0.10	-1.4	0.1	0.06	-2.4**
	Any income-generating work	0.49	0.48	-0.9	0.4	0.25	-18.9***
Household characteristics	Dependency ratio†	0.81	0.52	-35.7***	1.0	0.75	-22.8***
	Eligible adults†	3.34	4.48	34.2***	3.4	4.27	23.8***
	Eligible females†	1.67	2.34	40.7***	2.0	2.64	30.7***
	Lowest wealth quintile	0.28	0.32	3.7	0.2	0.13	-4.5**
	Second wealth quintile	0.31	0.32	0.6	0.2	0.16	-6.2***
	Third wealth quintile	0.23	0.17	-5.8**	0.2	0.19	-0.3
	Fourth wealth quintile	0.12	0.11	-0.4	0.2	0.24	4.8**
	Highest wealth quintile	0.07	0.08	1.8	0.2	0.28	6.2***
	No land ownership	0.23	0.24	1.0	0.2	0.16	0.6
	Smallest quintile of land area	0.08	0.06	-1.5	0.2	0.16	0.2
	Second quintile of land area	0.11	0.09	-1.8	0.1	0.13	-0.6
	Third quintile of land area	0.17	0.18	0.9	0.2	0.19	1.3
	Fourth quintile of land area	0.19	0.16	-3.0	0.2	0.16	-1.6
	Largest quintile of land area	0.22	0.27	4.5	0.2	0.19	0.1

Note: Table presents mean values of self-report and non-self report (proxy) for the Women (15-49) sample. The difference between self-report and non-self report mean values is expressed as percentage points from the mean for binary variables and proportion difference for continuous indicated by †. Statistics account for complex survey design. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Source: Authors' calculations using ESPS (2022) and GHS (2022) data.

Overall, Tables 2a and 2b indicate that the self-report and non-self-report groups differ in their individual and household characteristics. We therefore investigate the assumed relationship between observable characteristics that are shown to differ significantly and key nutrition outcomes for self-report individuals. These analyses are presented in Table 3. Across these and other analyses not included here, we note the consistent positive effect of income generating work in Nigeria, the positive effect of being the spouse of a household head vis-à-vis the omitted category of being the head among women of reproductive age in Ethiopia, and the positive impact of higher education in the adult sample in Ethiopia. These specifications are simplistic, but the results reinforce the intuition that the observable characteristics previously demonstrated to be imbalanced are also predictors of DQQ outcomes and thus greater care is justified.

Table 3. Effects of imbalanced covariates on DQQ outcomes

	Ethiopia			Nigeria	
	Adults	Women (15-49)		Women (15-49)	
	Dietary Diversity Score (DDS)	Food groups (0-10) consumed yesterday by women aged 15-49	Minimum dietary diversity for women (5+ food groups)	Food groups (0-10) consumed yesterday by women aged 15-49	Minimum dietary diversity for women (5+ food groups)
Age	-0.021 * (.012)	-0.108 ** (.049)	-0.001 (.002)	-0.032 (.031)	-0.001 (.001)
Age squared	0.000 * (.000)	0.002 ** (.001)		0.000 (.000)	
Sex = Female	-0.121 (.090)				
Relation to Head = Spouse	0.162 (.105)	0.297 * (.170)	0.072 ** (.035)	0.235 (.224)	0.01 (.057)
Relation to Head = Child	-0.291 * (.150)	-0.136 (.256)	-0.005 (.036)	0.246 (.208)	0.044 (.056)
Relation to Head = Other	0.003 (.157)	0.443 (.286)	0.104 * (.053)	0.312 (.224)	0.053 (.055)
Education = Primary	0.334 ** (.161)	0.148 (.194)	-0.005 (.031)	-0.249 * (.141)	-0.076 ** (.036)
Education = Secondary	0.661 *** (.193)	0.408 * (.229)	0.038 (.043)	-0.047 (.176)	-0.014 (.045)
Education = Tertiary	0.702 *** (.184)	0.313 (.236)	0.019 (.043)	0.146 (.217)	0.024 (.053)
Marital status = Married	-0.088 (.091)	-0.003 (.152)	-0.029 (.037)	0.106 (.197)	0.066 (.049)
Income generating work	0.153 (.127)	0.26 * (.139)	0.027 (.021)	0.445 *** (.093)	0.077 *** (.024)
Eligible adults	0.075 (.048)				
Eligible females		-0.027 (.071)	-0.002 (.011)	0.044 (.047)	0.032 *** (.011)
Dependency ratio	0.01 (.067)	-0.049 (.077)	-0.006 (.017)	-0.02 (.057)	-0.003 (.015)
Household member can read and write in any language	-0.079 (.169)	0.132 (.193)	0.082 ** (.037)	0.194 (.151)	0.061 * (.036)
Constant	2.744 *** (.371)	3.933 *** (.864)		4.107 *** (.542)	
Spatial Fixed Effects	Yes	Yes	Yes	Yes	Yes
Number of Observations	8666	4352	4352	4330	4330
Model	OLS	OLS	Logit	OLS	Logit
Overall F-test	5.65	5.01	3.55	7.95	5.73
Prob > F	0.000	0.000	0.000	0.000	0.000
R-squared	0.093	0.096		0.101	

Note: Standard errors in parentheses. Marginal effects are reported for binary outcomes of interest. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Source: Authors' calculations using ESPS (2022) and GHS (2022) data.

4.2 Assessing likelihood of self-response

Firstly, more individuals responded for themselves in the Nigeria data than the Ethiopia data, with 78 percent reporting in Nigeria compared to 68 percent in Ethiopia among women of reproductive age. In the full adults sample, the share falls to 61 percent in Ethiopia. We expect some of this difference is due to the survey protocol to exclude proxy response in the Nigeria case, which likely led to greater efforts (callbacks and schedule accommodations for example) to maximize sample for the DQQ questions. This is by no means the only difference between the Ethiopia and Nigeria case, but as a base survey implementers might take this ten percentage point increase as a rough piece of guidance about the scale of the increase in self-reporting that this discreet shift in approach had.

Given the observed differences between individuals that self-report vs proxy report, we estimate probability of being self-respondent as a function of observable characteristics, as outlined in the methodology section. Covariates were chosen to maximize predictive power for each sample while remaining as parsimonious as possible. Table 4 shows the marginal effects from logistic regressions estimated in the three samples considered here. The results indicate that, in the adults sample, older individuals and female household members are more likely to be present during survey administration or subsequent follow-ups and tend to provide responses themselves. Conversely, adult children and other household members are less likely to be available at home, leading to an increased incidence of proxy responses or no responses. This pattern holds in the women only sample; older women are typically available for interviews, but children and other relatives of the household head generally fall in the proxy or no response categories. In both Ethiopia and Nigeria, being the spouse of the household head and having more eligible women in the household decreases the likelihood of being self-reporting. The result also shows some country differences. For instance, education and asset ownership influence response patterns differently between the two countries.

Table 4. Individual estimated probability to respond to DQQ module for themselves

	Ethiopia		Nigeria
	All adults (15+)	Women (15-49)	Women (15-49)
Age = 15-24	-0.08	***	

	Ethiopia		Nigeria	
	All adults (15+)	Women (15-49)	Women (15-49)	
Age = 50+	(.025) 0.004 (.021)			
Age		0.006 *** (.002)		
Age (ln)			0.217 *** (.032)	
Sex = Female	0.11 *** (.019)			
Relation to Head = Spouse	0.033 (.030)	-0.138 *** (.033)		-0.158 *** (.047)
Relation to Head = Child	-0.256 *** (.032)	-0.4 *** (.049)		-0.131 *** (.031)
Relation to Head = Other	-0.258 *** (.035)	-0.368 *** (.044)		-0.174 *** (.034)
Marital status = Married		0.101 *** (.037)		0.061 (.046)
Education = Primary		0.079 *** (.028)		0.063 ** (.025)
Education = Secondary		0.048 (.034)		0.033 (.027)
Education = Tertiary		0.11 *** (.040)		0.039 (.032)
Worked in agriculture		-0.056 * (.030)		0.122 ** (.054)
Worked in non-farm enterprise		-0.068 * (.038)		0.05 ** (.020)
Worked for a wage		-0.01 (.040)		0.022 (.035)
Eligible adults	-0.023 *** (.007)			
Eligible females		-0.032 *** (.011)		-0.046 *** (.007)
Dependency ratio	-0.021 (.014)			
Wealth quintile = Second	-0.003 (.032)			-0.008 (.029)
Wealth quintile = Third	-0.004 (.036)			-0.066 ** (.031)
Wealth quintile = Fourth	-0.091 * (.047)			-0.091 *** (.032)
Wealth quintile = Highest	-0.084 (.062)			-0.095 *** (.037)
Land ownership = Lowest quintile	0.128 ** (.065)	0.158 ** (.068)		
Land ownership = Second quintile	0.056 (.058)	0.151 *** (.058)		
Land ownership = Third quintile	0.04 (.056)	0.131 ** (.058)		
Land ownership = Fourth quintile	0.1 * (.056)	0.159 *** (.056)		
Land ownership = Highest quintile	0.04 (.060)	0.116 * (.061)		
Spatial Fixed Effects	Region x Urban	Region x Urban	Zone x Urban	
Number of Observations	13908	6218	5490	
Overall F-test	10.29	9.38	11.08	
Prob > F	0.000	0.000	0.000	

Notes: Table reports marginal effects from logit regressions, with standard errors reported in parentheses. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Source: Authors' calculations using ESPS (2022) and GHS (2023/24) data.

4.3 Comparison between alternative scenarios and the benchmark

Using the results shown in Table 4, we estimate the adjustment factor for individuals based on the inverse of their probability to respond for themselves. The distribution of the resulting predicted probability to respond can be seen in the graphs in Appendix 2. Following this estimation, we can construct the final sample to compare the benchmark scenarios against other scenarios. Table 5 shows the assessment of the balance of the different scenarios that also incorporate proxy responses against the benchmark. It presents a summary statistic capturing the sum of the absolute differences that are significant to enable a summary comparison of the difference from the benchmark scenario. Full balance tests are available in Appendix 3. The bottom row in tables A3.1-A3.3 contains the same information presented here in Table 5.

Table 5: Balance summary on covariates by survey response protocol and sample scenario

Self-Response Protocol: Scenario for Adult (15+)	Proxy Included			Unadjusted Self Report				Adj Self Report		
	1	2	3	1	2c	2s	3	2c	2s	3
Ethiopia	93.0	101.2	371.0	91.7	82.4	94.0	342.9	18.7	54.4	339.2
Scenario for Women(15-49)	1W	2W		1W	2Wc	2Ws		2Wc	2Ws	
Ethiopia	33.6	41.8		87.6	85.0	108.3		6.9	43.4	
Nigeria				61.1	47.9	73.6		5.1	32.0	

Notes: Table presents the sum of absolute difference on covariates between each named self-response protocol and scenario and the benchmark protocol and scenario for each country and sample. Difference statistic is percent difference for continuous variables and percentage point for binary variables. Statistically insignificant differences are excluded.

Source: Authors' calculations using ESPS (2022) and GHS (2023/24) data.

The benchmark scenario is expected to be the most reliable for the DQQ outcomes since it corrects for the potential bias from relying on proxy reporting and utilizes the most data to construct estimates. For the balance assessment, however, the main purpose is to check which alternative scenarios maximize the comparability of the samples on their observable characteristics prior to investigating DQQ outcomes. The adjusted self-report is the most successful at minimizing difference across all country and scenario combinations. We also see that within scenario 2 (random selection), the 2c (convenience random) approach performs better than 2s (strict random). The performance gap is greater in Ethiopia where the proportion of proxy respondents is higher, which we take as evidence that the primary reason for the weaker performance under strict random

selection is the decrease in sample size due to non-random incidence of individuals being unavailable to answer the questions. Although our adjustment helps to mitigate the decrease in performance, it is not completely successful. Table 5 also shows clear evidence that the household head sample differs substantially from the remainder of the sample, regardless of the self-report protocol.

In the Ethiopia women sample, retaining the proxy response observations performs slightly better than the adjusted 2s scenario, which we take to be consistent with the interpretation that the sample losses are too great for our adjustment to overcome. We also see in the Ethiopia women sample that retaining the full sample inclusive of proxy observations outperforms the adjusted 2s scenario by a relatively large margin. This leads to a caution that capturing proxy response data in the whole sample might be preferable to adjusting a strict random selection protocol in contexts where proxy response is relatively high.

4.4 DQQ outcomes and alternative respondent selection scenarios

The following section compares the DQQ outcomes under alternative respondent selection scenarios. Table 6 shows the descriptive statistics for the benchmark scenario and indicates the differences between the benchmark and each alternative respondent selection approach. The results are relatively stable across scenarios. One notable result is the consistently lower results in the Ethiopia adult sample when including proxy responses. The strict random selection scenario is consistently lower than the benchmark in the Ethiopia adult sample, although the adjustment we implement does at least eliminate the significance of the difference. In Nigeria, the adjusted strict random selection scenario also shows a significantly higher estimate on food groups consumed yesterday.

Overall, the results on DQQ indicators are reasonably stable across the different sample methodologies considered here. The results for household heads do not differ significantly on DQQ outcomes when excluding proxy responses, which does suggest that the strategy of interviewing a household head does not necessarily introduce serious bias on the DQQ indicators, though no evidence is presented for this hypothesis in the sample of women aged 15-49.

The most dramatic differences are observed in the adults 15+ sample when including proxy response. The results of all the six DQQ indicators are consistently lower than the benchmark

scenario when proxy responses are included or when the selection of self-respondents fails to adjust for absent eligible members, suggesting that including proxy responses will underestimate nutrition outcomes when considering this broader demographic. Meanwhile the differences are insignificant and directionally indeterminate when focusing in women 15-49, suggesting that the effect of proxy response bias is less important in the women 15-49 sample.

Table 6. Dietary Diversity and Quality outcomes

			Benchmark	Alternatives												
Self-Response Protocol:			Adj Self Report	Proxy Included						Unadjusted Self-Report				Adjusted Self-Report		
Country	Sample	Scenario	1 (All Adults)	1	2	3	1	2c	2s	3	2c	2s	3			
Ethiopia	Adults (15+)	All-5: Consumed all five recommended food groups	0.052	-0.3	-1.0 *	-0.8	-0.3	-0.6	-1.0 *	-0.8	-0.7 *	-0.8	-0.4			
		Dietary Diversity Score (DDS)†	3.011	-2.0 ***	-3.2 ***	-2.3 *	-1.0	-1.1	-2.7 **	-0.7	-0.9	-2.0	0.4			
		NCD-Protect total score†	2.539	-2.5 ***	-3.8 ***	-4.0 ***	-1.4 *	-1.7 *	-3.0 **	-2.7	-1.2	-2.1	-1.6			
		NCD-Risk total score†	0.369	-5.9 **	-1.7	-7.1 *	-6.0 ***	-1.5	-3.6	-2.1	2.5	2.5	3.6			
		GDR Score†	11.17	-0.4 *	-0.8 ***	-0.7 *	-0.1	-0.3	-0.6	-0.6	-0.4	-0.6	-0.5			
Ethiopia	Women (15-49)	Scenario	1W (All Women)	1W	2W		1W	2Wc	2Ws		2Wc	2Ws				
		Food groups (0-10) consumed yesterday by women aged 15-49†	2.987	-1.0	0.3		-0.8	-0.7	-1.2		0.3	0.6				
		Minimum dietary diversity for women (5+ food groups)	0.166	-0.5	0.2		-0.9 *	-0.9	-0.1		0.0	1.0				
Nigeria	Women (15-49)	Food groups (0-10) consumed yesterday by women aged 15-49†	4.324				-0.4	0.0	0.8		0.6	1.3 *				
		Minimum dietary diversity for women (5+ food groups)	0.432				-0.5	-0.4	-0.4		0.0	-0.2				

Notes: Table presents mean for the benchmark scenario and difference between the benchmark and all alternative scenarios. Difference is expressed as percentage points from the mean for binary variables and proportion difference for continuous indicated by †. Statistics account for complex survey design. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Source: Authors' calculations using ESPS (2022) and GHS (2023/24) data.

5. Discussion

In this analysis we examined some key considerations regarding the selection of respondents for individual-level data collection. These are 1) the characteristics of individuals that self-report vs individuals with proxy and non-responses; 2) evaluation of alternative survey design scenarios including the inclusion of proxies and adjustments for non-response; and 3) the effects of these different approaches on key dietary quality indicators.

Regarding proxy and non-responses, the study consistently demonstrates that individuals represented by proxy responses or categorized as non-respondents differ from self-respondents on key demographic and socioeconomic variables. The result shows that proxy and non-responses are non-random. Furthermore, these key demographic and socioeconomic variables that differentiate self-responses to that of proxy and non-responses, as also indicated in several other studies, are in turn important determinants of dietary quality outcomes (Issa *et al*, 2024; Kant, 2004; Ochieng *et al*, 2017; Shamim, Mashreky & Ferdous, 2016; Thiele, Mensink & Beitz, 2004). Therefore, adjustments for proxy and non-responses are necessary when measuring dietary diversity and quality indicators.

On alternative design scenarios, the study shows that interviewing a randomly selected, self-responding participant—excluding proxies and non-responses—more effectively minimized covariate imbalance relative to the benchmark of interviewing all eligible household members. Other approaches considered in this study resulted in significant covariate imbalance relative to the benchmark. The convenience random selection method outperformed the strict random selection approach by allowing replacements and yielding a larger sample. We recommend using a convenience protocol for selecting from all eligible individuals, with strategies to maximize interview participation. While the strict approach performed reasonably well, its smaller sample size may limit the effectiveness of reweighting adjustments. The adjustment technique designed to address proxy response bias is shown to be limited when confronted with reduced sample sizes. Notably, the proposed adjustment did not eliminate the imbalance in covariates. Therefore, additional resources—such as increased scheduling flexibility and callback efforts—may be required to maximize the sample obtained through the strict random approach.

Examining the impact of both the recommended alternative scenario and others on DQQ indicators provided mixed results. However, the evidence compiled here does not support a consistent prediction of the size or even direction that proxy response bias will shift DQQ indicators. The systematic differences described between proxy response and self-response individuals show that there is reason for concern that the DQQ outcomes might also significantly differ. Although the DQQ outcomes observed by proxy response in this study are different only in the full adult sample population but not among women of reproductive age, the concern that the proxy responders do not have full information about eating choices of absent household members is difficult to dismiss. The differences described underline the need for implementers develop a model to predict probability for the selected individual to be available for interview, and weight the responses as outlined in this paper to maximize the generalizability of results.

The size of the differences considered here are relatively small between the simulated survey design protocols. This suggests that implementers that are less concerned with accuracy of their higher level DQQ measures than with other priorities need not agonize over the differences. We recommend relying on self-reported data from a randomly selected individual in the household that matches the eligibility requirements for the outcome being measured as the optimal choice for this type of implementer. A corollary to this recommendation is that households where the selected member that is able to answer the questions at the time of the interview will be dropped from the sample, and the efficacy of the adjustment procedure will be reduced by the loss of observations, and thus implementers need to take steps to minimize loss of observations. Where accuracy in DQQ outcomes is a high priority, our evidence builds on the foundation that interviewing every individual will provide a better measurement than relying on any single individual per household.

This study has the following limitations. First, the research employs a post-fieldwork design, which confines scenario selection to options present within the source data. Second, the findings in this study are primarily context-dependent, with particular relevance to the measurement of dietary diversity and quality. Although these results may be pertinent to similar cases under comparable circumstances, they should not be considered universally applicable because there are situations where another household member can reliably respond on behalf of a selected member who was unavailable for interview.

6. Conclusions

Capturing individual level data from all members of a household presents several challenges including increased interview length and thus cost, as well as the problem of availability of individuals to respond for themselves introducing additional logistical hurdles for survey implementation as well as potential bias due to non-random reasons for unavailability. The study investigated alternative respondent selection strategies to collect dietary recall information from individuals through household surveys using recently implemented large scale household surveys in Ethiopia and Nigeria. It explored, randomly selected individual and the household head as well as adjustments for proxy and non-responses. It compared all these approaches against the benchmark of interviewing all household members. Interviewing a randomly selected eligible household member can be a reasonable accuracy alternative to interviewing all eligible individuals, provided appropriate statistical calibration and diligent fieldwork to maximize respondent participation. The findings underscore the trade-offs between cost, statistical reliability, and data quality in survey design, offering practical guidance for national statistical offices and researchers in low- and middle-income countries aiming to enhance dietary data collection within financial and logistical constraints.

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Appendix 1. DQQ indicators.

Table A1: List of main DQQ dietary quality indicators

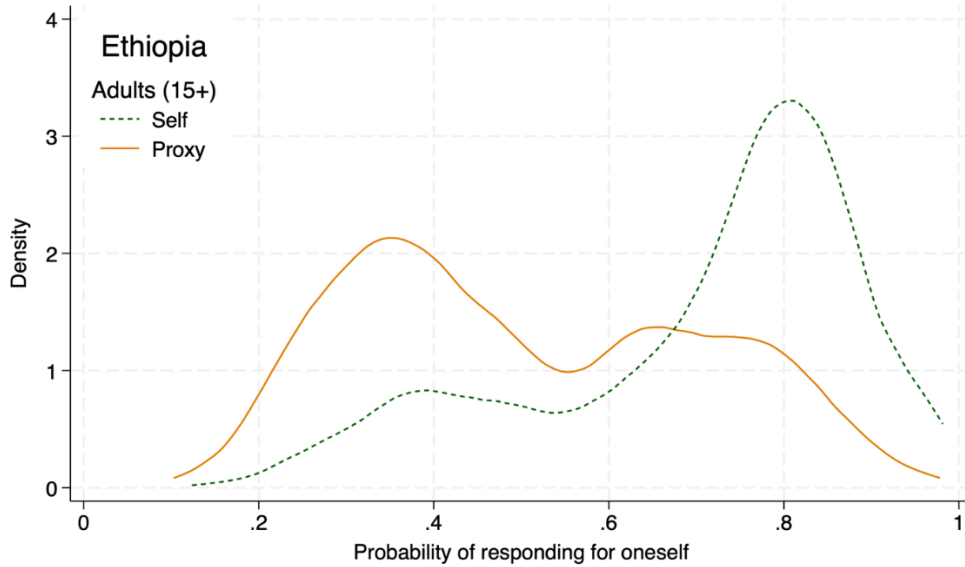
Indicator	Measurement and Definition
Minimum Dietary Diversity for Women of Reproductive Age (15-49 years) (MDD-W)	Binary score (1/0); takes 1 when is achieved when ≥ 5 out of 10 specific food groups are consumed by an individual over the course of a day, 0 otherwise.
Dietary Diversity Score (DDS)	Score range: 0-10; One point for each “Yes” in the 10 food groups and applied to the general population.
All - 5 [†]	Binary score (1/0); A score of less than 5 indicates that not all five recommended food groups were consumed.
NCD-Protect	Score range: 0-9; is based on food consumption from 9 healthy food groups during the past day and night.
NCD-Risk	Score range: 0-9; reflects adherence to global dietary recommendations on components of the diet to limit or avoid.
Global Dietary Recommendations (GDR) Score	Score range 0-18; indicates adherence to global dietary recommendations, which include dietary factors protective against non-communicable diseases.

Notes: [†]All five recommended food groups are: at least one vegetable, at least one fruit, at least one pulse, nut or seed, at least one animal-source food, and at least one starchy staple.

Source: [DQQ Indicator Guide 2023.pdf - Google Drive](#)

Appendix 2. Distribution of estimated probability to respond

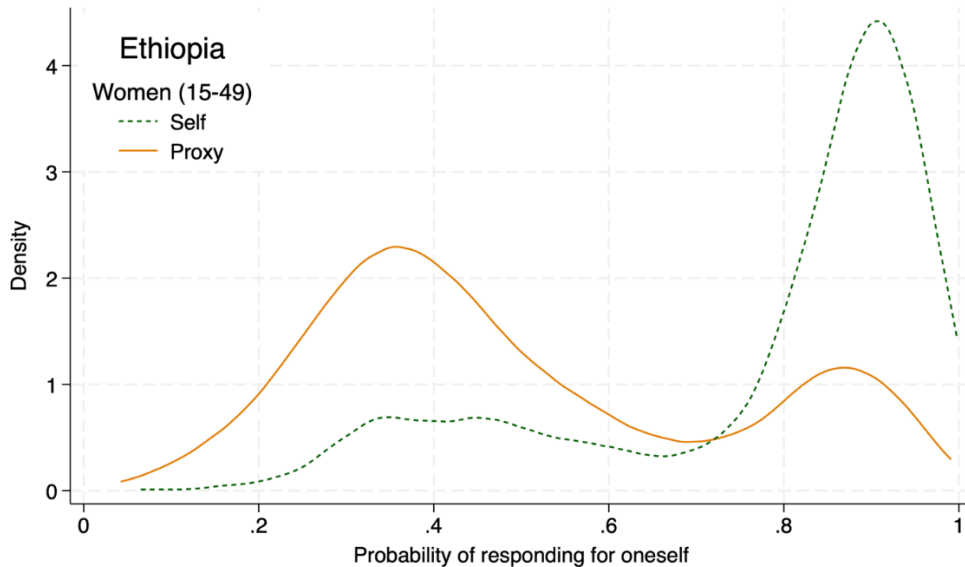
Figure A2.1 Distribution of estimated probability to respond, Ethiopia Adults



Notes: This figure shows the estimated kernel density distributions of the propensity scores for self and proxy respondents of the DQQ module. The respondents in this sample are adults (15 years and above). Propensity scores were estimated using a logistic regression model.

Source: Authors' calculation using ESPS (2022) data.

Figure A2.2 Distribution of estimated probability to respond, Ethiopia Women (15-49)



Notes: This figure shows the estimated kernel density distributions of the propensity scores for self and proxy respondents of the DQQ module. The respondents in this sample are women (15-49 years). Propensity scores were estimated using a logistic regression model.

Source: Authors' calculation using ESPS (2022) data.

Appendix 3. Balance on covariates

Table A3.1. Balance on covariates by survey protocol and scenario, Ethiopia Adult (15+)

Self-Response Protocol:	Benchmark: Adj Self Report	Proxy Included						Unadjusted Self Report						Adj Self Report					
	1 All Adults	1 All Adults	2 Randomly Selected Adult	3 HH Head	1 All Adults	2c Convenience Random Selection	2s Strict Random Selection	3 HH Head	2c Convenience Random Selection	2s Strict Random Selection	3 HH Head	2c Convenience Random Selection	2s Strict Random Selection	3 HH Head					
Age†	35.442	-4.5 ***	-5.5 ***	30.1 ***	5.0 ***	4.8 ***	0.1	30.7 ***	1.5 *	-3.5 ***	30.1 ***								
Age 15-24	0.253	4.4 ***	5.3 ***	-23.7 ***	-7.4 ***	-7.5 ***	-5.3 ***	-23.4 ***	-2.2 **	0.5	-23.3 ***								
Age 25-49	0.579	-1.9 *	-2.4 *	3.7 **	5.6 ***	5.1 ***	6.2 ***	1.3	1.0	1.8	2.3								
Age 50+	0.168	-2.5 ***	-2.9 ***	20.0 ***	1.8 ***	2.4 ***	-0.9	22.2 ***	1.2 *	-2.2 **	21.0 ***								
Female	0.55	-4.4 ***	-4.2 **	-35.4 ***	5.9 ***	5.2 ***	1.4	-30.6 ***	1.2	-2.1	-32.4 ***								
Head	0.359	-0.3	-0.1	64.1 ***	3.6 ***	4.7 ***	5.4 ***	64.1 ***	2.4 **	2.2	64.1 ***								
Spouse of head	0.31	-4.1 ***	-5.2 ***	-31.0 ***	7.5 ***	5.8 ***	2.8 *	-31.0 ***	0.3	-2.6 *	-31.0 ***								
Child of head	0.248	3.9 ***	4.6 ***	-24.8 ***	-8.9 ***	-8.7 ***	-6.4 ***	-24.8 ***	-2.9 ***	0.0	-24.8 ***								
Married	0.643	-3.8 ***	-4.5 ***	19.4 ***	8.1 ***	8.6 ***	5.4 ***	16.6 ***	2.8 ***	-0.8	17.4 ***								
No education	0.421	-1.2	-3.0 **	8.0 ***	4.7 ***	2.9 ***	0.8	8.9 ***	-0.3	-2.4 *	8.1 ***								
Primary education	0.38	2.2 **	3.6 **	-3.2 *	-2.6 ***	-1.0	2.4	-4.0 **	-0.3	3.7 **	-4.0 **								
Secondary education	0.127	0.0	0.0	-4.2 ***	-1.7 ***	-2.0 ***	-2.5 ***	-4.8 ***	-0.1	-1.0	-4.5 ***								
Tertiary education	0.072	-1.0 ***	-0.7	-0.6	-0.4	0.1	-0.7	-0.1	0.7	-0.2	0.4								
Can read and write	0.568	1.6 *	3.4 **	-5.3 ***	-4.9 ***	-2.9 ***	-0.5	-7.9 ***	0.7	3.3 **	-6.4 ***								
Owns working cellphone	0.256	-1.4 *	-1.6	11.3 ***	-1.4 ***	-0.8	-1.2	9.5 ***	0.5	-0.4	11.1 ***								
Worked in agriculture	0.466	0.7	0.4	13.1 ***	0.8	-0.2	1.3	15.0 ***	-1.2	-0.1	14.2 ***								
Worked in non-farm enterprise	0.075	0.1	0.2	1.8 ***	0.7 **	0.8 *	0.3	1.2 **	0.7 *	0.2	1.4 **								
Worked for wages	0.139	0.7	0.9	6.6 ***	0.1	-0.4	0.6	5.3 ***	0.0	1.1	6.0 ***								
Any income-generating work	0.604	1.1	0.9	15.6 ***	1.1 **	-0.3	1.1	16.5 ***	-0.9	0.2	16.5 ***								
Dependency ratio†	0.855	7.4 ***	7.4 ***	7.4 ***	7.3 ***	7.3 ***	18.8 ***	7.2 ***	2.1 ***	12.7 ***	7.8 ***								

Self-Response Protocol:	Benchmark: Adj Self Report	Proxy Included						Unadjusted Self Report						Adj Self Report							
Scenario	1 All Adults	1 All Adults		2 Randomly Selected Adult		3 HH Head		1 All Adults		2c Convenience Random Selection		2s Strict Random Selection		3 HH Head		2c Convenience Random Selection		2s Strict Random Selection		3 HH Head	
Eligible adults†	3.662	-4.8	***	-4.8	***	-4.8	***	-4.7	***	-4.7	***	-14.1	***	-5.6	***	-2.4	***	-11.4	***	-6.5	***
Eligible females†	1.532	-3.9	***	-3.9	***	-3.9	***	-3.9	***	-3.9	***	-12.4	***	-6.6	***	-0.5		-9.1	***	-5.9	***
Lowest wealth quintile	0.308	0.4		0.4		0.4		0.3		0.3		1.1		2.8	**	-0.5		0.3		1.8	*
Second wealth quintile	0.323	0.5		0.5		0.5		0.5		0.5		0.7		-0.8		-0.3		-0.1		-1.2	
Third wealth quintile	0.202	0.6		0.6		0.6		0.6		0.6		1.5	*	0.7		0.1		1.3		0.6	
Fourth wealth quintile	0.103	-0.7	**	-0.7	**	-0.7	**	-0.6	**	-0.6	**	-1.5	***	-1.2	**	0.4	*	-0.5		-0.3	
Highest wealth quintile	0.065	-0.9	***	-0.9	***	-0.9	***	-0.9	***	-0.9	***	-1.8	***	-1.5	***	0.2		-1.0	*	-0.9	**
No land ownership	0.215	-1.5	***	-1.5	***	-1.5	***	-1.6	***	-1.6	***	-2.8	***	-1.3	*	0.5		-1.3		0.2	
Smallest quintile of land area	0.07	0.0		0.0		0.0		0.1		0.1		0.0		0.5		-0.2		-0.4		0.1	
Second quintile of land area	0.109	0.4		0.4		0.4		0.4		0.4		1.4	*	0.5		0.2		1.0		0.3	
Third quintile of land area	0.172	-0.3		-0.3		-0.3		-0.5		-0.5		-0.9		-1.0		-0.5		-0.2		-0.9	
Fourth quintile of land area	0.18	0.8	**	0.8	**	0.8	**	0.9	**	0.9	**	3.6	***	1.1		0.1		2.5	***	0.2	
Largest quintile of land area	0.253	0.6		0.6		0.6		0.7		0.7		-1.3		0.2		0.0		-1.6		0.2	
Self response	1.0	-36.5	***	-35.9	***	-28.8	***	0.0		0.0		0.0		0.0		0.0		0.0		0.0	
Urban resident	0.232	-0.9	*	-0.9	*	-0.9	*	-1.0	**	-1.0	**	-2.0	*	-0.9		0.6		-0.9		-0.3	
Total absolute difference		93.0		101.2		371.0		91.7		82.4		94.0		342.9		18.7		54.4		339.2	

Notes: Table presents mean for the benchmark scenario and difference between the benchmark and all alternative scenarios. Difference is expressed as percentage points from the mean for binary variables and proportion difference for continuous indicated by †. Statistics account for complex survey design. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Source: Authors' calculations using ESPS (2022) and GHS (2023/24) data.

Table A3.2. Balance on covariates by survey protocol and scenario, Ethiopia Women (15-49)

Self-Response Protocol:	Benchmark:	Proxy Included		Unadjusted Self Report			Adj Self Report	
	Adj Self Report	1W -All Women	2W Randomly Selected Woman	1W All Women	2Wc Convenience Random - Women	2Ws Strict Random - Women	2Wc Convenience Random - Women	2Ws Strict Random - Women
Age†	29.891	-4.0 ***	-4.9 ***	6.1 ***	5.7 ***	2.3 **	1.2 *	-1.8 *
Age 15-24	0.351	4.1 **	5.2 **	-9.4 ***	-9.1 ***	-6.2 ***	-2.2 **	0.1
Age 25-49	0.649	-4.1 **	-5.2 **	9.4 ***	9.1 ***	6.2 ***	2.2 **	-0.1
Age 50+	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Female	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Head	0.095	-0.3	-0.7	2.7 ***	1.9 ***	2.7 ***	-0.5	0.3
Spouse of head	0.511	-2.7 *	-3.8 **	9.2 ***	9.2 ***	8.7 ***	1.5	2.0
Child of head	0.286	2.5	4.4 **	-9.8 ***	-8.9 ***	-8.7 ***	-0.7	-1.9
Married	0.611	-2.8 *	-3.3 *	9.7 ***	9.9 ***	9.4 ***	1.7	2.0
No education	0.414	-1.2	-1.0	4.4 ***	4.3 ***	2.7 **	1.1	-0.1
Primary education	0.371	2.6 **	2.7 *	-2.7 ***	-2.5 **	0.9	-1.2	2.3 *
Secondary education	0.141	-0.5	-0.8	-1.9 ***	-2.2 ***	-3.1 ***	-0.7	-1.6
Tertiary education	0.074	-0.9 *	-1.0 *	0.1	0.4	-0.6	0.7 *	-0.5
Can read and write	0.568	0.8	0.4	-4.8 ***	-4.5 ***	-3.1 **	-1.0	0.0
Owns working cellphone	0.191	-1.3 *	-1.4	0.7	0.4	-0.7	0.1	-0.4
Worked in agriculture	0.334	0.7	0.5	0.2	-0.9	-1.5	-0.5	-0.7
Worked in non-farm enterprise	0.081	-0.1	-0.2	0.5	0.7	0.6	0.5	0.6
Worked for wages	0.114	-0.4	0.3	0.5	0.2	0.5	0.3	0.4
Any income-generating work	0.485	0.5	0.9	1.2	0.2	-0.3	0.2	0.0
Dependency ratio†	0.699	2.3	2.3	5.7 ***	5.7 ***	15.3 ***	-0.2	10.1 ***
Eligible adults†	3.805	-2.5 **	-2.5 **	-4.0 ***	-4.0 ***	-12.9 ***	0.1	-9.7 ***
Eligible females†	2.001	-5.7 ***	-5.7 ***	-4.7 ***	-4.7 ***	-15.7 ***	-0.2	-12.8 ***
Lowest wealth quintile	0.276	1.6	1.6	0.8	0.8	-0.8	-0.4	-2.2 **
Second wealth quintile	0.302	1.0	1.0	0.9	0.9	2.8 ***	-0.3	1.4 *
Third wealth quintile	0.217	-0.7	-0.7	-0.5	-0.5	1.0	0.1	1.9 **
Fourth wealth quintile	0.123	-0.8	-0.8	0.0	0.0	-1.3 **	0.5 **	-0.6
Highest wealth quintile	0.082	-1.0 **	-1.0 **	-1.1 ***	-1.1 ***	-1.8 ***	0.0	-0.5
No land ownership	0.248	-2.0 **	-2.0 **	-2.3 ***	-2.3 ***	-2.2 ***	0.3	0.4
Smallest quintile of land area	0.073	0.1	0.1	0.4	0.4	0.5	-0.3	-0.3
Second quintile of land area	0.1	0.7	0.7	0.6	0.6	1.5 **	0.1	1.2 **
Third quintile of land area	0.177	-0.5	-0.5	-0.4	-0.4	-1.2	0.0	-0.9
Fourth quintile of land area	0.179	0.1	0.1	0.5	0.5	1.7 **	-0.3	0.7
Largest quintile of land area	0.222	1.6	1.6	1.1	1.1	-0.3	0.2	-1.2
Self response	1.0	-32.5 ***	-31.6 ***	0.0	0.0	0.0	0.0	0.0
Urban resident	0.279	-2.5 **	-2.5 **	-1.8 ***	-1.8 ***	-2.1 **	0.5	0.6

Self-Response Protocol:	Benchmark: Adj Self Report	Proxy Included		Unadjusted Self Report			Adj Self Report	
Scenario	1W- All Women	1W -All Women	2W Randomly Selected Woman	1W All Women	2Wc Convenience Random - Women	2Ws Strict Random - Women	2Wc Convenience Random - Women	2Ws Strict Random - Women
Total absolute difference		33.6	41.8	87.6	85.0	108.3	6.9	43.4

Notes: Table presents mean for the benchmark scenario and difference between the benchmark and all alternative scenarios. Difference is expressed as percentage points from the mean for binary variables and proportion difference for continuous indicated by †. Statistics account for complex survey design. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Source: Authors' calculations using ESPS (2022) data.

Table A3.3. Balance on covariates by survey protocol and scenario, Nigeria Women (15-49)

Self-Response Protocol:	Benchmark: Adj Self Report	Unadjusted Self Report			Adj Self Report	
Scenario	1W All Women	1W All Women	2Wc Convenience Random - Women	2Ws Strict Random - Women	2Wc Convenience Random - Women	2Ws Strict Random - Women
Age†	30.592	5.1 ***	3.9 ***	2.7 ***	-0.5	-1.5 *
Age 15-24	0.353	-7.0 ***	-5.2 ***	-4.7 ***	0.7	1.0
Age 25-49	0.647	7.0 ***	5.2 ***	4.7 ***	-0.7	-1.0
Female	1.0	0.0	0.0	0.0	0.0	0.0
Head	0.062	1.6 ***	1.8 ***	2.4 ***	0.2	0.7 **
Spouse of head	0.547	5.5 ***	4.2 ***	4.3 ***	-0.3	0.2
Child of head	0.298	-5.6 ***	-4.7 ***	-5.8 ***	-0.1	-1.7
Married	0.58	5.7 ***	4.4 ***	4.2 ***	-0.3	-0.1
No education	0.313	0.8 **	-0.3	0.8	-1.5 ***	-0.4
Primary education	0.275	-1.1 ***	0.1	1.1	0.8	2.0 **
Secondary education	0.281	-0.5	-0.5	-1.1	0.6	-0.3
Tertiary education	0.132	0.8 **	0.7	-0.8	0.1	-1.3 **
Can read and write	0.685	-1.1 ***	-0.5	-1.5 *	0.9 *	0.0
Owns working cellphone	0.573	1.8 ***	1.1 *	-0.4	-0.2	-1.9 **
Worked in agriculture	0.034	0.1	0.3	0.6 *	0.0	0.2
Worked in non-farm enterprise	0.309	3.2 ***	3.3 ***	3.1 ***	0.5	0.4
Worked for wages	0.079	0.6 ***	0.3	0.0	0.0	-0.4
Any income-generating work	0.411	3.6 ***	3.8 ***	3.6 ***	0.5	0.1
Dependency ratio†	0.885	2.8 ***	2.8 ***	9.7 ***	0.0	6.6 ***
Eligible adults†	3.725	-2.7 ***	-2.7 ***	-8.2 ***	-1.2 **	-6.8 ***
Eligible females†	2.279	-4.2 ***	-4.2 ***	-11.3 ***	-1.6 **	-9.1 ***
Lowest wealth quintile	0.16	0.4	0.4	1.3 ***	-0.1	0.9 **
Second wealth quintile	0.204	0.8 **	0.8 **	2.2 ***	-0.2	1.1 **
Third wealth quintile	0.194	-0.5	-0.5	-0.2	-0.2	-0.1
Fourth wealth quintile	0.207	-0.2	-0.2	-1.4 **	0.1	-1.0
Highest wealth quintile	0.235	-0.5	-0.5	-1.9 ***	0.4	-1.0
No land ownership	0.157	0.0	0.0	0.3	0.4	0.8
Smallest quintile of land area	0.165	-0.2	-0.2	-0.3	0.0	0.1

Self-Response Protocol:	Benchmark:	Unadjusted Self Report			Adj Self Report	
	Adj Self Report					
Scenario	1W All Women	1W All Women	2Wc Convenience Random - Women	2Ws Strict Random - Women	2Wc Convenience Random - Women	2Ws Strict Random - Women
Second quintile of land area	0.139	0.2	0.2	0.4	0.1	0.0
Third quintile of land area	0.177	-0.2	-0.2	-0.6	-0.3	-0.7
Fourth quintile of land area	0.178	-0.2	-0.2	0.0	-0.5	-0.4
Largest quintile of land area	0.184	0.4	0.4	0.3	0.4	0.3
Self response	1.0	0.0	0.0	0.0	0.0	0.0
Urban resident	0.373	0.6	0.6	-0.1	0.0	-0.6
Total absolute difference		61.1	47.9	73.6	5.1	32.0

Notes: Table presents mean for the benchmark scenario and difference between the benchmark and all alternative scenarios. Difference is expressed as percentage points from the mean for binary variables and proportion difference for continuous indicated by †. Statistics account for complex survey design. Significance levels: * p<0.10, ** p<0.05, *** p<0.01.

Source: Authors' calculations using GHS (2023/24) data.