OVERSAMPLING OF CHILDREN UNDER-FIVE IN LOW FERTILITY SETTINGS

MICS METHODOLOGICAL PAPERS

Paper No. 7, 2018

Data and Analytics Section
Division of Data, Research and Policy

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About MICS

The Multiple Indicator Cluster Surveys, MICS, is one of the largest global sources of statistically sound and internationally comparable data on children and women. MICS data are gathered during face-to-face interviews in representative samples of households. The surveys are typically carried out by government organizations, with technical support from UNICEF.

Since the mid-1990s, MICS has supported more than 100 countries to produce data on a range of indicators in areas such as health, education, child protection and HIV/AIDS. MICS data can be disaggregated by numerous geographic, social and demographic characteristics.

As of 2016, five rounds of surveys have been conducted: MICS1 (1995-1999), MICS2 (1999-2004), MICS3 (2004–2009), MICS4 (2009–2012) and MICS5 (2012-2015). The sixth round of MICS (MICS6) is scheduled to take place in 2016–2018. Survey results, tools, reports, micro-data and information on the MICS programme are available at <*mics.unicef.org*>.

About the MICS Methodological Papers

MICS Methodological Papers are intended to facilitate exchange of knowledge and to stimulate discussion on the methodological issues related to the collection, analysis, and dissemination of MICS data; in particular, the papers document the background methodological work undertaken for the development of new MICS indicators, modules, and analyses. The findings, interpretation and conclusions do not necessarily reflect the policies or views of UNICEF.

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1

Introduction

The Multiple Indicator Cluster Surveys (MICS) measure a range of indicators for various age groups. Many of the MICS indicators have children under the age of 5 years or subsets of this age group as their denominators. For example, the prevalence of wasting is measured for all children under the age of five, while immunization rates are calculated for children age 12 to 23 months, and exclusive breastfeeding is measured for children under 6 months of age.

One of the challenges in developing the sampling strategy for the MICS surveys in some countries is ensuring sufficient cases for sub-groups of children under-five. Sample sizes must be calculated and sampling procedures constructed in such a way that there will be a sufficient number of sample children under the age of 5 years to provide reliable indicators for all children in this age group as well as for specific age subsets of this population. This issue is particularly salient in countries which have been through the demographic transition, where fertility rates are relatively low and the average household size is small. This phenomenon is found in, but not limited to, many countries in Europe and Central Asia, as well as Latin America and the Caribbean. To resolve the issue of small denominators for child indicators in these surveys, the MICS programme recommends that countries oversample households where there are children under the age of five. This practice began with a few countries during MICS4, continued with more countries in MICS5 and became a standard recommendation (where applicable) in MICS6.

At the individual survey level, the oversampling technique has been examined mainly to see if indicators have sufficient cases for analysis and reporting in the MICS final reports. Thus far, the MICS survey programme has not explicitly studied how well oversampling of under-fives has worked across countries. The overall purpose of this study is therefore to examine how the oversampling strategy has worked in different settings. In this report, we outline the implementation of the oversampling strategy, comparing the results across several countries. The MICS surveys chosen for this study are Belarus, Costa Rica, Uruguay (MICS4 surveys), Serbia and Cuba (MICS5 surveys). These surveys are selected as they cut across the range of country experiences that MICS covers and reflect the variability in the different oversampling strategies employed. The results of this study will be used to develop guidelines for countries planning to use the oversampling approach.

2

Overview of MICS sampling strategies

MICS surveys collect data from households, using probability-based sampling at every stage of selection, an adequate sampling frame and a listing component which updates the sampling frame (as needed). Further, no replacement of sample clusters or households is allowed, and the number of sample households per cluster is held at moderate levels. These and other factors ensure that results from a MICS survey are representative and unbiased, and that design effects are kept relatively low.

Overview of the standard sampling approach in MICS

Following the determination of the sample size and the number of required clusters, the sample for the survey is implemented typically using a two-stage design, though three stages have been used in a few surveys prior to MICS6. In the first stage, using an appropriate sampling frame such as the national census, Enumeration Areas (EAs) are selected often using probability proportional to size (*pps*), where the measure of size is based on the number of households in the frame for each EA. Then, the selected EAs are listed and from within this listing, households are selected using random systematic sampling. At each stage, the probabilities of selection are known and hence, weights can be calculated.

Overview of oversampling of households with under-fives in MICS

Oversampling of households with under-fives follows a similar approach to the standard MICS approach, wherein sample sizes and the number of EAs are first calculated, although it is necessary to consider the oversampling strategy on the number of under-fives expected in the sample. Sampling specialists first examine the number of under-fives that a usual sample would yield and then examine various oversampling rates to determine the gains of the strategy. One of these sampling rates is then selected, often based on a pragmatic approach to balance cost and feasibility against potential statistical gains. After the census enumeration areas are selected (i.e. the first stage sampling), for the listing of the households, the listing form is designed to identify which households have children under-five. Then, the surveys select these households with a higher sampling rate compared to the households without children under-five.

During the listing, some sample clusters may have less than the target number of households with children. In these cases, all households with under-fives are selected with certainty, and the number of households without children to be selected is determined by subtracting the number of households with children from the total number of households to be selected in the cluster. For example, if 20 households are to be selected per cluster and the target number of sample households with children per cluster is 8, 12 households without children would be selected. If there are only 6 households with children in the listing for a sample cluster, they would all be selected, and the remaining 14 households would be selected from the stratum of households without children.

Since it is necessary to identify households with and without children under-five in the listing, the listing operation is more complex, taking more time to solicit more information from respondents in the households. It may not be possible to contact some households during the listing, and the secondary source of data, such as neighbours, may be unreliable given that specific age group information is needed. Further, when listings are done much in advance of the fieldwork, children may age out of the specified age groups and new children can be born into the households. These can result in misclassification, which can impact the variability of weights and thus, increase the design effects and sampling errors. In the case of households where information is not available on whether they have children under-five, the standard practice is to include them in the stratum of households without children, since this is the predominant category. Further, once the households with and without children are identified in the listing, it is necessary to select a separate sample from each category, and some clusters only have a few households with children under-five that have to be selected with a probability of 1 at the second sampling stage.

In a standard MICS sample design, the overall sampling probabilities and corresponding weights vary by sample cluster (for example, enumeration area). However, when the listing is stratified at the second sampling stage by households with and without children under-five and a different sampling rate is used for each of these categories, it is necessary to calculate two different weights for each sample cluster. For each sample cluster, there will also be two women, child and men weights per cluster. In the case of misclassified households, the weight is calculated based on the probability of selection in the original stratum, so this information should be maintained in the survey data to ensure that the appropriate weights are assigned to the sample households.

MICS sampling tools for countries using the oversampling strategy
To facilitate the selection of households and the calculation of the weights in countries that use the strategy of oversampling households with under-five children, standard MICS sampling tools have been adapted. These are available on the MICS website (www.mics.unicef.org/tools).

A special version of the MICS listing sheet template includes a question on whether each household has at least one child under the age of 5 years. Two columns are included in the listing sheet for assigning different serial numbers for the households classified as with or without children under-five, since a separate sample of households is selected for each group.

The MICS template for the selection of households from the listing for each sample cluster includes a version for the oversampling of households with children under-five. In this spreadsheet, it is necessary to specify the total number of households to be selected in each cluster, and the target number of households with children under-five to be selected. There are two rows for each sample cluster, one for households with children under-five and the other for households without children in this age group. Based on the results of the listing, it is necessary to enter the total number of households listed, and the number of households with children under-five listed in each cluster; the number of listed households without children is calculated as the difference. The spreadsheet automatically generates the sampling interval, random start and serial numbers of the selected households with and without children under-five. When the total number of households with children under-five listed in a sample cluster is less than the target sample, all of these households are selected with a probability of 1, and the number of households without children to be selected is determined by subtracting the number of households with children from the total number of sample households to be selected in the cluster. When there is also the selection of a subsample of households for the water quality tests, the spreadsheet “pools” the sample households with and without children to select the households to be tested for water quality.

The MICS template for the calculation of weights also has a version for countries that use oversampling of households with children under-five. Given that separate weights are calculated for the households listed in each sample cluster as with or without children, there are also two rows for each sample cluster in the weighting spreadsheet. The first stage probability of selecting the cluster is the same for the households with and without children. However, the second stage probabilities are different for the households with and without children, since they depend on the number of households listed and selected for each group. It is necessary to enter the number of households listed with and without children in each sample cluster, as well as the number of sample households, women, children and men with completed interviews by cluster and stratum, separately for the households with and without children under-five.

In the questionnaires and the data files it is important to include a code to identify the second stage stratum in which the household was selected (with or without children under-five). The probabilities of selection and corresponding weights depend on the original stratum in which each household was selected, regardless of any misclassification.

3

Measures to study the effects of oversampling

Population characteristics

The strategy of oversampling households with children under-five is recommended only if a country has a relatively low fertility rate and/or a small average household size, given that in any randomly selected household, there is a relatively small probability of finding a child of the specified age. Further, we examine the percentage of households with an under-five and the average number of under-fives in a household with under-fives. These indicators provide a general idea of how applicable the sampling technique would be for these countries.

Sample design

Once it is decided to use the oversampling strategy, it is necessary to determine the level of oversampling that should be applied. A key decision that must be made is the number of sample households to be selected in each sample cluster, and the target number of households with children under-five to be selected per cluster. We discuss in the results section the cluster size, the intended target number of households with children under-five per cluster, and then examine the outcome of the sample design in terms of actual numbers of households with children under-five.

Misclassification of households with children under-five

To implement the oversampling strategy for households with children under-five, it is necessary to classify each household in the household listing as “with” or “without” at least one child under five years. This classification is based on a simple screening question in the listing sheet on whether the household has any member under the age of 5 years. Based on this classification, different household serial numbers are assigned to the households with and without children under-five, and a separate sample of households is selected from each of the two categories.

One potential problem is that at the listing stage some households can be misclassified; that is, a household identified as having a child under-five does not have such a child, or *vice versa*. The misclassification can be attributed to two main sources. The first is that incorrect information is collected during the listing exercise. For example, during the listing, a child under-five is found in a household but later, during the MICS interview, this information proves to be incorrect. The alternative of this scenario is also possible. A second source of error that results in misclassification is due to household compositional changes. In this case, the composition of the household changes from the time of the listing to the time of the interview. Some of this is expected as the household ages in this time period. This is especially salient when children who are under-five at the time of the listing ages out of this category by the time of the survey interview. Further to this, members of the household may appear (in the case of births, or migration to the household) or leave the household (in the case of deaths or migration to other households). Given these circumstances, it is important to have the household listing done as close in time as possible to the fieldwork, as these misclassifications decrease the effectiveness of the oversampling strategy.

Resulting population structure using over-sampling

As the sample design increases the proportion of one age group (under-fives), the overall effect may be a decrease or increase in other age groups selected for the survey. This may be especially true for women with higher fertility who tend to be younger. Such changes in the distribution of the sample population can create imbalances in the overall age structure of the unweighted sample, and weights must be calculated based on the different sampling rates to compensate. In this report, we compare the weighted and unweighted proportions of key populations sampled in the survey data to understand if the over-sampling technique has led to population imbalances in the unweighted data. The weighted population provides an estimate of the actual population distribution while the unweighted numbers provide estimates of the actual sample. Thus, a comparison of these can indicate in which age groups any potential imbalances in the overall structure of the sample population occurs. We examine several age groups. The first is a sub-set of children under-five (12-23 months) which provides some indication of effectiveness of the oversampling procedure for this group. We also consider women and men age 15-49 which represent an aggregate figure related to how the oversample operates and then women age 20-24 which we expect to have some level of oversampling due to their higher fertility compared to other age groups. Finally, we examine children age 5-17 years for which MICS6 introduced a new questionnaire.

Design effect (DEFF) and variability in sampling weights

While the oversampling strategy will improve the sample size for indicators for children under-five, at the same time the strategy will increase the variability in the weights, which is marked by an increase in the design effects and the sampling errors for other indicators. The design effect (DEFF) is defined as the ratio of the variance of an estimate based on the actual sample design (including the oversampling of households with children in a stratified multi-stage sample design) and the corresponding variance of the estimate based on a simple random sample of the same size. The DEFF is therefore a measure of the relative efficiency of the sample design. The standard error of an estimate based on a simple random sample would be multiplied by the square root of the DEFF. As such, higher design effects will increase the margins of error of the survey estimates, and result in wider confidence intervals.

In order to study the effect of the variability in the weights on the design effects, the DEFF can be decomposed into the unequal weighting effect (*UWE*) and the clustering effect ($DEFF_C$), as follows [1]:

$$DEFF = UWE \times DEFF_C$$

where:

$$UWE = \frac{n \times \sum_h \sum_i \sum_j w_{hij}^2}{\left(\sum_h \sum_i \sum_j w_{hij} \right)^2}$$

n = total number of observations (sample households, women or children)

w_{hij} = weight for the j-th sample unit in the i-th sample cluster in stratum h

$$DEFF_C = 1 + \rho \times \left(\bar{m} - 1 \right)$$

ρ = intraclass correlation coefficient, or measure of homogeneity of the units (households, women or children) within clusters

$\bar{m}$ = average number of observations per cluster

In a two-stage sample design, the largest component of the DEFF is generally the clustering effect. However, if there is an extreme variability in the weights, the UWE component can also be large. To examine this component of the design effect for the MICS estimates for different countries, we calculated the value of UWE from the normalized household weights. These results are presented and discussed in Section 4 of this report.

4

Results

Population characteristics

Table 1 presents key population characteristics considered when determining and designing the strategy of oversampling households with children under-five. Total Fertility Rates (TFRs) are reported from official UNICEF sources [1] while the other indicators are calculated from weighted and unweighted MICS data for each country. In the five countries, TFRs are all low and in the majority of countries, well below replacement levels. Uruguay has the highest TFR (2.0) while Belarus, Serbia and Cuba have identical fertility rates (1.6). On average, Belarus has the smallest household size with only 2.5 persons per household. Serbia, Cuba and Uruguay have somewhat larger household sizes (around 3 members) and Costa Rica has the largest household size (3.7). Within each of the countries, there is less than 10% of under-fives in the population, ranging from a low of 4 percent in Cuba to 9 percent in Costa Rica. Table 1 also shows that under-fives are present in very few households, ranging from only 5 percent in Serbia to 9 percent in Uruguay. Within the households with at least one under-five child, there is an average of 1.1-1.2 children under-five. Overall, these countries meet some of the basic criteria for using the oversampling strategy.

Table 1. Population characteristics by country

Characteristic	Belarus	Serbia	Costa Rica	Cuba	Uruguay
Total Fertility Rate	1.6	1.6	1.8	1.6	2.0
Average persons per household	2.5	3.1	3.7	3.1	3.0
Percentage of U5* in population	7.0	4.7	8.7	3.9	7.1
Average number of U5 in households with U5	1.1	1.2	1.2	1.1	1.2

*U5- refers to under-five children

Sample design

Table 2 shows a comparison of the oversampling procedures used by the different countries and indicators of the resulting effectiveness of the design. Overall, there was discernable variability in how the oversampling procedure was implemented. The MICS guidelines recommend the selection of about 20-25 households per cluster. This was seen across countries, with the exception of Uruguay and Serbia, where fewer households were selected (15 and 18 households per cluster, respectively). The target number of households with children under-five ranged from 40 percent in Belarus (8 households out of 20 in each cluster) to 67 percent in Uruguay (10 households out of 15 in each cluster).

Table 2 shows the number of households selected per cluster and the target number of sample households with children per cluster specified for the overall sample design. However, in some countries the numbers actually varied considerably by stratum. Using the microdata, we calculated the number of households selected by cluster and stratum for the various countries (data not shown in tables). In the case of Uruguay, the actual number of households selected per cluster varied from 6 to 44, and the number of households with children selected per cluster varied from 1 to 36. The sampling scheme for Cuba differed to that of Uruguay. Exactly 10 households without children were selected in each sample cluster, and the number of households with children under-five selected varied from 2 to 15, depending on the number of households with children found in the cluster. Therefore, the total number of households selected per cluster varied from 12 to 25.

In examining the distribution of the households with and without children per cluster in the Serbia MICS, it was found that although the target number of households with children under-five selected per cluster was 9, most of the sample EAs had less than 9 households with children, so these households were selected with certainty in most of the sample clusters. At the same time, the number of households with children under-five selected in some EAs was increased beyond 9 to "compensate" for the sample clusters that had less than 9 households with children. The maximum number of households with children selected in a cluster was 20. In the case of sample clusters with 14 or more households with children selected, a fixed sample of 4 households was selected from the stratum without children. Therefore, the total number of households selected in a sample cluster was as high as 24, while most sample clusters had a total of 18 households selected.

Table 2. Comparison of sample designs and selected indicators of sampling effectiveness

Sampling strategy and effectiveness indicators	Belarus	Serbia	Costa Rica	Cuba	Uruguay
Number of households selected per cluster*	20	18	20	25	15
Target number of households with U5 selected per cluster*	8	9	10	15	10
Percentage of households with U5 in final MICS sample from unweighted data (A)	37.4	35.9	34.6	53.9	38.1
Percentage of households with U5 from weighted data (B)	15.6	11.8	25.7	10.1	17.2
Net gain in households with U5 (A/B)	2.4	3.0	1.3	5.4	2.2

*In the case of Uruguay, Cuba and Serbia there were exceptions to this specified number of sample households per cluster and target number of sample households with U5, as explained in the text.

The total number of children under-five in the final MICS sample for a country using an oversampling strategy depends on the percentage of the households selected from the listing stratum "with children under-five" and the average number of children under-five in those households, as well as the misclassification rate in the listing. In the case of Serbia, where 18 households were selected per sample cluster (with exceptions as stated above), the target was to select 9 households with children under-five (that is, 50%). Of the 400 clusters selected, 256 had 8 or less households with children under-five listed, so this reduced the percent of households with children under-five in the final sample to 35.9%, as shown in Table 2. This final percentage of the households with children under-five in the sample is also affected by the misclassification of the households in the listing (discussed later).

From the MICS data, one can estimate the percentage of households with children under five in the population (using the weighted data) and the unweighted percentage of households with an under-five in the sample. A ratio of these compares what is expected at the national level (weighted data) against what the sampling strategy produces (unweighted data). This ratio indicates the level of increase in the number of households in sample with children due to the oversampling strategy. For example, it can be seen in Table 2 that the estimated percentage of households with children in the population for Serbia was 11.8% (the lowest percentage for the five countries). Table 2 also shows that the percent of households with children in the final sample was increased to 35.9%, implying that the number of households with children under-five in the sample was increased by a factor of 3 due to the oversampling strategy (after considering the misclassification in the listing and the sample clusters with less than the target number of households with children under-five). The increase due to the oversampling strategy is particularly high in Cuba (more than a five-fold increase) and fairly modest in Costa Rica (ratio of 1.3).

Misclassification of households with and without children under-five in the Listing

Table 3 presents the level of misclassification for each of the five countries included in this study. This includes the percentage of households classified as “with children” in the household listing where no child under-five was found during the MICS interview and households classified as “without children” where a child of the specified age was found during the interview. The overall misclassification rate is calculated as the percent of all sample households that were misclassified either way among all the sample households. All these percentages are unweighted to reflect the experience in the field.

Table 3. Misclassification of households with and without children under-five

Type of misclassification by stratum	Belarus	Serbia	Costa Rica	Cuba	Uruguay
Stratum: Households with U5s: percentage with no U5s (false positives)	17.3	17.4	48.4	13.6	47.7
Stratum: Households without U5s: percentage with U5s (false-negatives)	6.5	3.5	19.6	5.3	8.4

Overall, Table 3 shows that misclassification differs by country, though classifying false-positives in the listing occur much more often than false negatives. False-positives range from 14 percent in Cuba to 48 percent in Costa Rica and Uruguay. The range for false-negatives is from 4 percent in Serbia to 20 percent in Costa Rica. Table 3 also shows two cases of extreme misclassification, Uruguay and Costa Rica. In Uruguay, almost half of the households classified as having a child under-five did not have any child under-five in the survey (which was conducted in 2012-13). This is possible as a new listing was not conducted prior to the survey, and households were selected from the 2011 census list of households for each EA (a non-standard practice in MICS surveys). These results indicate the unreliability of ageing a population from the census for the MCIS oversampling procedure. At the same time, only 8 percent of the households classified from the 2011 Census as not having children had children under-five in the MICS data.

Resulting population structure using over-sampling

In the below figures, we show the unweighted and weighted data for all ages by single years. Across the countries, the unweighted cases of under-fives are higher than the weighted cases, indicating a gain the number of sample children under-five due to the oversampling technique. These increases are quite sharp across the countries as expected. The only exception is Costa Rica where the gains are marginal. The graphs also reveal that certain age groups of women are over-sampled because of the technique. In Belarus, women of ages 22-38 are oversampled, while in Serbia, this occurs in the age range 25 to 40. These peaks roughly correspond to the peak years of fertility for women in each country and accordingly vary by country. In Costa Rica, where the sampling strategy did not yield significant increases in children under-five, there is no noticeable oversampling of women of various ages.

Using the MICS data for the five countries included in this study, the ratios of the unweighted and weighted number of persons in different age subgroups were examined in Table 4. A ratio greater than 1 indicates oversampling for that particular subgroup, while a ratio smaller than 1 indicates under-sampling.

Figure 1. Weighted and unweighted ages by single years, Belarus MICS 2012

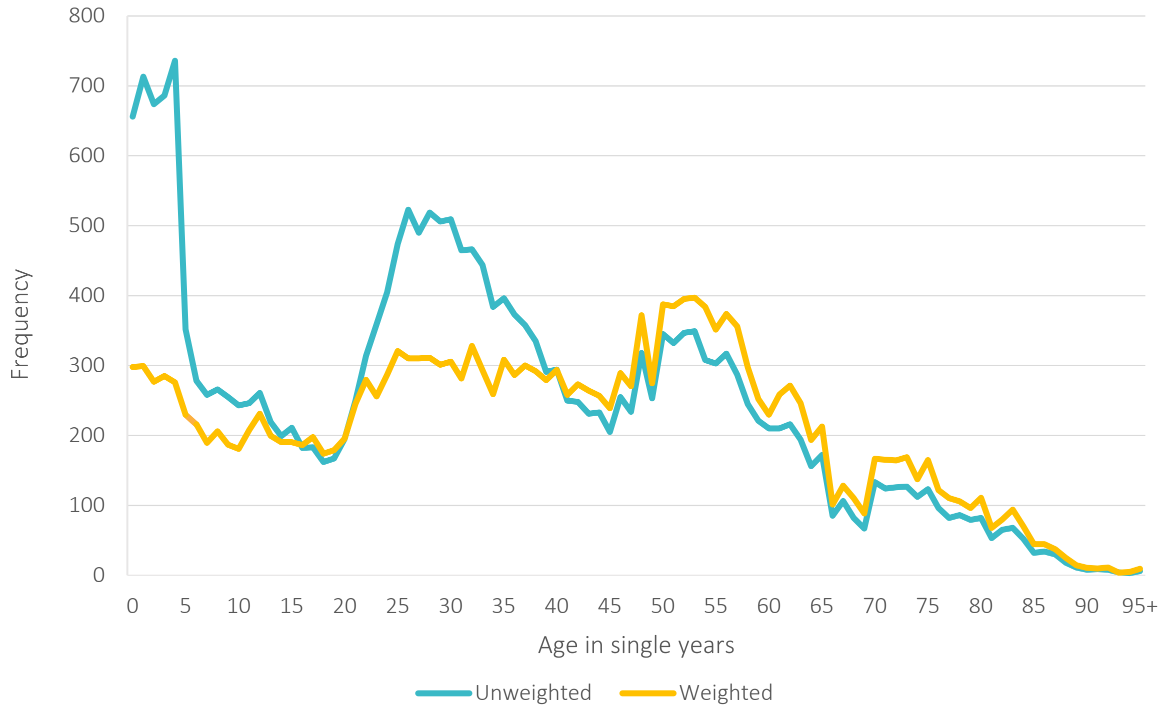

Figure 2. Weighted and unweighted ages by single years, Serbia MICS 2014

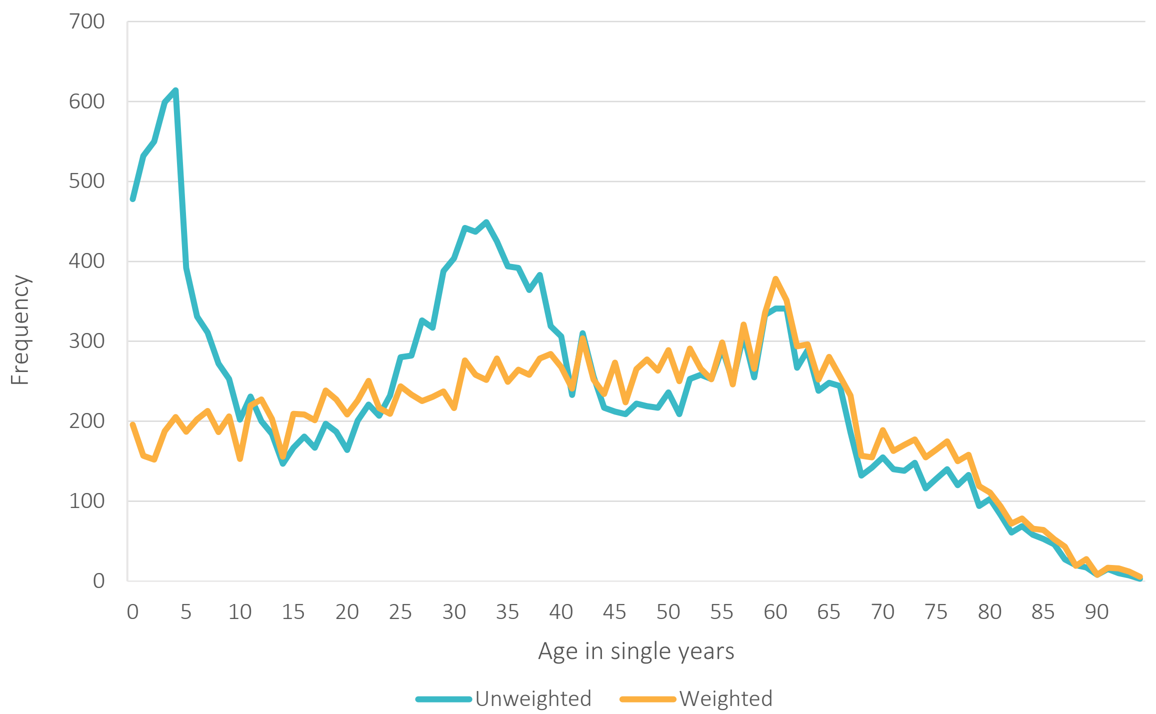

Figure 3. Weighted and unweighted ages by single years, Costa Rica MICS 2011

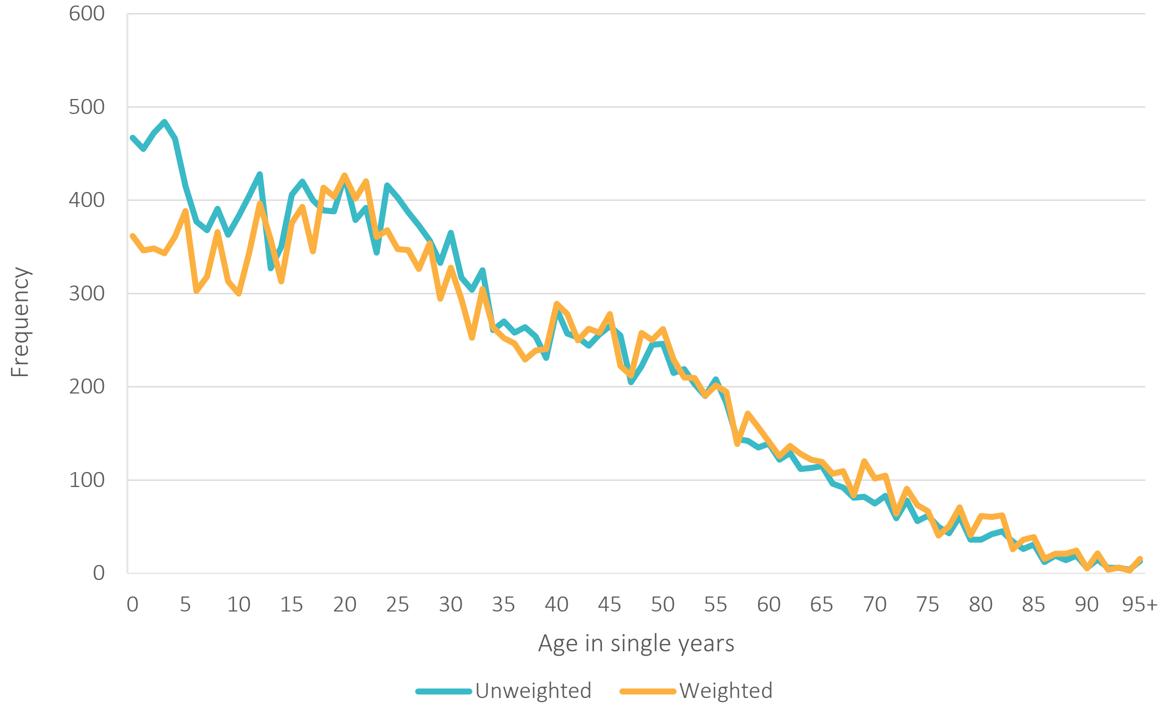

Figure 4. Weighted and unweighted ages by single years, Cuba MICS 2014

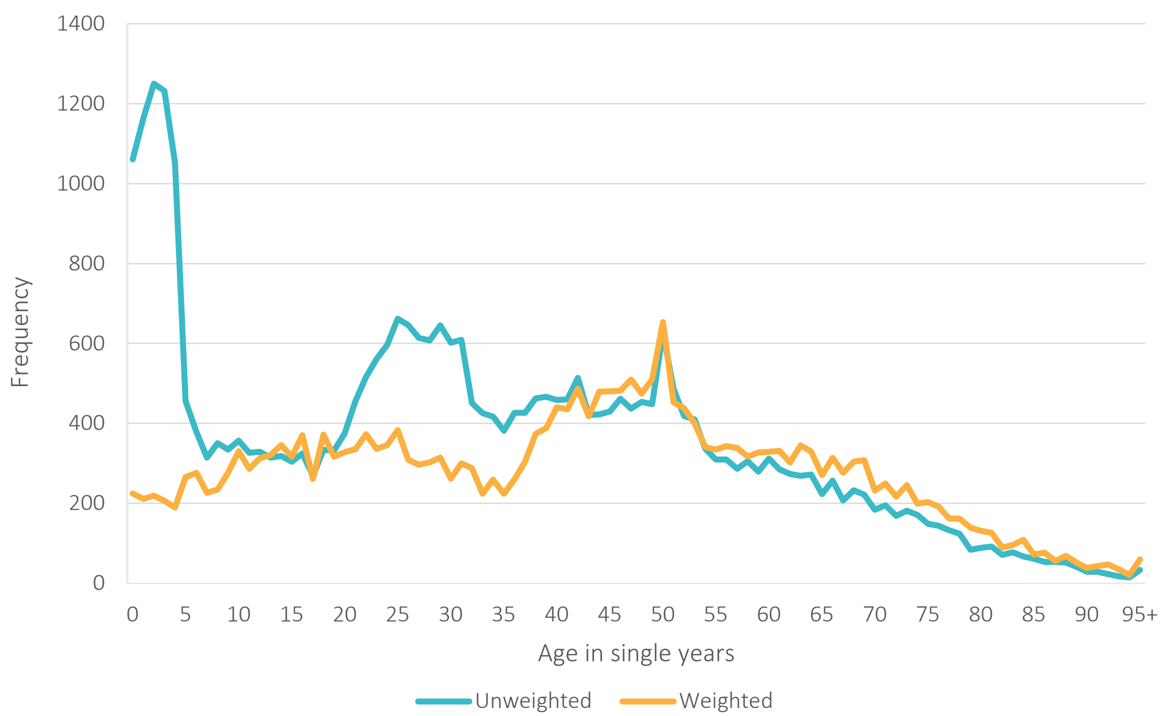

Figure 5. Weighted and unweighted ages by single years, Uruguay MICS 2012-13

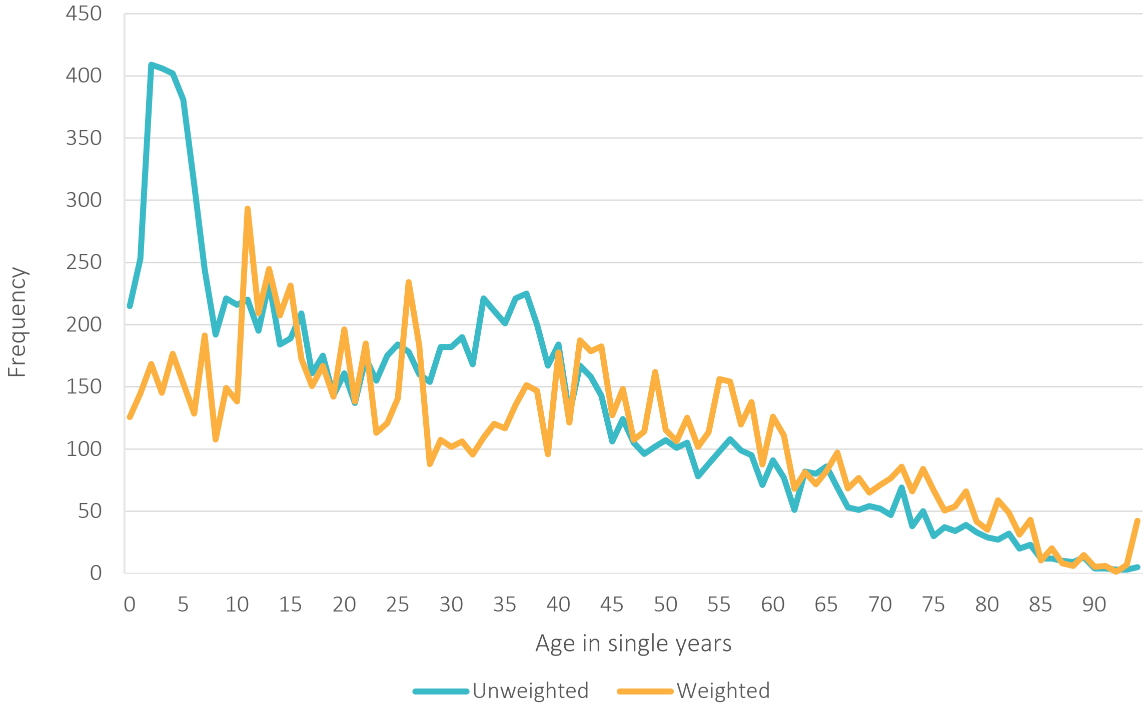

Table 4. Resulting population structure of using the oversampling strategy					
Population sub-group	Belarus	Serbia	Costa Rica	Cuba	Uruguay
% children 12-23 months (unweighted)	3.0	2.4	2.1	3.4	2.1
% children 12-23 months (weighted)	1.5	0.8	1.7	0.8	1.3
Ratio unweighted/weighted children 12-23 months	2.1	2.9	1.3	4.3	1.5
% women 15-49 years (unweighted)	25.0	22.5	26.9	26.9	25.3
% women 15-49 years (weighted)	23.1	22.1	27.3	24.3	24.9
Ratio unweighted/weighted women 15-49 years	1.1	1.0	1.0	1.1	1.0
% men 15-49 years (unweighted)	23.6	22.2	25.4	20.9	22.3
% men 15-49 years (weighted)	23.3	22.6	25.7	22.7	22.1
Ratio unweighted/weighted men 15-49 years	1.0	1.0	1.0	0.9	1.0
% women 20-24 years (unweighted)	3.6	2.5	4.8	4.7	3.6
% women 20-24 years (weighted)	2.9	2.8	4.8	3.2	3.7
Ratio unweighted/weighted women 20-24 years	1.2	0.9	1.0	1.5	1.0
% children 5-17 years (unweighted)	13.3	13.7	23.6	12.8	24.2
% children 5-17 years (weighted)	12.8	13.4	22.2	14.3	22.1
Ratio unweighted/weighted children 5-17 years	1.0	1.0	1.1	0.9	1.1

As expected, the oversampling of households with children under-five increases the number of sample children age 12 to 23 months for all countries, since this is a subset of the children under-five. The highest increase for this subgroup was in Cuba, with a factor of 4.3. The lowest increase in the percent of children 12 to 23 months was found in Costa Rica, with a factor of 1.3 (see Table 4), which is the same as the level of increase for children under-five for that country (found in Table 2).

For the women age 15 to 49 years there is little difference between the unweighted and weighted percentages. The oversampling of households with children under-five does not have a highly discernable effect on the percent of men age 15 to 49 years either, with ratios close to 1 for all countries except for Cuba, with a ratio of 0.9, indicating that this group is slightly under-sampled.

The oversampling of children under-five results in a slight increase in the percent of sample children age 5 to 17 years for all countries except for Cuba, where there is an interesting decrease by a factor of 0.9. In the case of women age 20 to 24, it is expected that in most countries the oversampling of households with children under-five would increase the sample for this subgroup as they tend to have higher fertility. The largest increase was in Cuba, with a factor of 1.5. This is consistent with the lower ratio for children 5 to 17 years, since these younger women are less likely to have children older than 5. However, the women age 20 to 24 years is actually under-sampled in Serbia, perhaps indicating an older child-bearing age on average in that country. The ratio was also slightly lower than 1 in Uruguay, perhaps for the same reason.

Design effect (DEFF) and variability in sampling weights

Table 5 includes the indicator "component of DEFF due to differential weights" (see Methods chapter for definition). It can be seen in the values of this indicator for the five countries that this component increases according to the level of oversampling, with a high value of 5.9 for Uruguay, indicating extreme variability in the weights. The lowest value is seen in Belarus (1.4).

Table 5. Variability in sample weights

Sampling strategy and effectiveness indicators	Belarus	Serbia	Costa Rica	Cuba	Uruguay
Component of DEFF due to differential weights	1.4	1.7	2.6	2.8	5.9
Ratio of average household weights in strata with and without U5	5.1	6.4	3.7	21.8	11.0
Ratio of maximum and minimum household weights	27.7	114.6	282.2	316.6	2643.6

The ratio of the average household weights for the listing strata with and without children under-five indicates some effects of the oversampling on the weights. Table 5 shows that the effects of the oversampling strategy were low in Belarus, Serbia and Costa Rica but higher in Uruguay and extreme in Cuba. The highest value for this ratio was the Cuba MICS (21.8), which also used a higher level of oversampling. Taken together, an increase in the DEFF is accompanied by an increase in the ratio of the average household weights in the strata with and without children. The exception is Costa Rica where no such increase is evident. One reason why this occurs is because the level of oversampling was moderate, and there was a considerable amount of misclassification of households in the listing strata.

The last indicator in Table 5 is the ratio between the highest and lowest household weight, which is also a measure of variability in the weights. The differential weights are affected by the allocation of the sample to the different geographic strata as well as the oversampling of households with children under-five. For example, if a much higher sampling rate is used in some small geographic domains, this will also increase the variability in the weights. The most extreme ratio between the highest and lowest household weights is 2643.6 for Uruguay. This is due to a combination of the extreme level of oversampling as well as the large difference in the sampling rates by geographic strata. The smallest ratio was seen in Belarus (27.7).

5

Conclusions & recommendations

This paper is the first assessment of how well countries can effectively implement an oversampling strategy of households with children under-five, with the assistance of the MICS programme. Through the study of several key metrics, the paper derives several key conclusions and recommendations for countries who wish to use this technique. Based on the study of the demographic characteristics of the countries, these surveys were justified in using the over-sampling technique to boost the overall sample size of children under-five. The first major conclusion is that the effectiveness of the oversampling strategy is highly dependent on the quality of the classification of households (with and without children) in the listing exercise. A certain level of misclassification in the listing can be expected, but extreme misclassification (greater than 20 percent) can offset expected gains in the number of sample children under-five. The oversampling of households with children under-five also does not have a major impact on the percent of the sample population for other subgroups outside of this age range with a few exceptions. The results can vary considerably by country depending on factors such as the average age that women are married and begin childbearing. Further analysis of MICS data should be undertaken to quantify this relationship.

Our findings also show that the oversampling strategy has limits; an extreme level of oversampling can result in relatively high design effects and larger margins of error for MICS indicators. Therefore, it is recommended to use a more moderate level of oversampling during implementation. Based on the results of the five different countries included in this study, it is reasonable to say that the sampling strategy used for Belarus was for the most part, the most effective design, based on the demographic characteristics of the country. In this case, the target percent of sample households with children to be selected in each sample cluster was 40 percent (8 out of 20). This resulted in an increase in the number of sample households with children by a factor of 2.4 compared to the regular sample design where oversampling is not used. The ratio of the average weights for households without and with children for the Belarus MICS was 5.1, which is also within an acceptable range. Such a balance in statistical considerations should be taken into account as this strategy is planned.

Depending on the level of fertility in the country and the average household size, the target percent of households with children may be increased to a maximum of 50 percent. A more extreme oversampling strategy will result in relatively high design effects that will increase the margins of error for most survey estimates. In the case of Serbia, the original strategy was to select 9 households with children and 9 households without children under-five, corresponding to a target of 50 percent with children under-five. However, the variability in the weights increased also due to selecting additional households with children in some sample EAs to "compensate" for EAs with fewer households with children under-five. This approach is not recommended, although it is necessary to recognize the challenge of having many sample EAs with less than the target number of households with children under-five. This depends on the average size of the EAs in each country as well as the percent of households with children.

The countries where the oversampling strategies were less effective are Uruguay and Costa Rica. Both of these countries had a high misclassification rate, where almost half of the households in the listing stratum with children did not have any children under-five in the MICS data. Costa Rica used a more moderate level of oversampling (with a target of about 50% of sample households with children in each EA). However, because of the very high misclassification rate, the number of households with children under-five in the sample was only increased by a factor of 1.3 compared to not using the oversampling strategy. Of the five countries covered in this study Costa Rica also had the highest TFR (2.2) and average number of persons per household (3.7). It should be noted that in the case of Costa Rica, the main objective of the oversampling strategy was to decrease the overall sample size of households while still having a sufficient number of sample children under-five. In this respect, the survey has been successful, though this was not accompanied by a large increase in under-fives.

Based on this study, the following guidelines are recommended for countries considering the use of oversampling households with children under-five:

1. The most recent census data or previous MICS data can be used to examine the percent of the population under-five years and the overall percent of households with children under-five, as well as the average household size. This will help to determine the most effective oversampling strategy.

2. The most recent census data should be used to study the distribution of the EAs by the number of households and the number of households with children under-five. This will help to estimate the percent of EAs with less than the target number of sample households with children under-five. The census data can also be used for a simulation study by selecting the sample EAs and examining the distribution of the households with and without children under-five. This simulation can include the calculation of the weights to study the resulting variability in the weights.

3. The most effective percentage target for households with children under-five in each cluster is generally between 40 and 50 percent of the sample households. The sampling strategy should not exceed this level of oversampling, because it will increase the variability in the weights and result in higher design effects and margins of error.

4. Once the strategy for oversampling households with children under-five has been determined, this should be taken into account in determining the required number of sample households for the under-five indicators using the MICS sample size calculation template.

5. It is very important to increase the level of quality control for the listing operation in order to reduce the level of misclassification of households with and without children under-five years. It is recommended to test the listing procedures during the MICS pilot exercise in order to improve the quality control procedures and ensure that misclassification of households is held below 20 percent.

6

References

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