Measuring child mortality from mobile phone surveys in countries facing security challenges: an assessment in Burkina Faso

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Abstract

Objectives: We evaluate the feasibility of Mobile Phone Surveys (MPS) for estimating child mortality in settings affected by conflicts and insecurity, comparing their effectiveness to traditional face-to-face surveys.

Methods: Utilizing the expanding mobile phone network coverage, we collected mortality data in Burkina Faso, originally to capture possible fluctuations in mortality during the COVID-19 pandemic. We also linked the mobile phone interviews with data from the High-Frequency Phone Surveys (LSMS-HFPS) conducted by the National Institute of Statistics and Demography with support from the World Bank. We compare mortality estimates from MPS with those from Demographic and Health Surveys (DHS), focusing on the security context of different regions. Direct mortality estimation methods and survival analysis are applied to understand regional mortality disparities.

Results: There are significant differences between mortality estimates from MPS and the face-to-face DHS. While DHS data suggest that under-five mortality declined from 129 per 1000 in 2010 to 48 per 1000 in 2021, MPS data indicates stagnating mortality rates in regions not affected by insecurity, and an increase in high-insecurity areas. We attribute these differences to the exclusion in the DHS sample of the most insecure areas. The analysis highlighted increased mortality in highly insecure regions post-2019, corresponding with the security crisis and COVID-19 pandemic. Poisson regression analysis identified the regional security context, the education level of the mother, the migratory status, and household food security as significant determinants of under-five mortality.

Conclusion: MPS offer a viable alternative to traditional surveys for estimating child mortality, particularly in insecure regions where conventional methods are impractical. MPS can capture critical mortality trends, especially in high-risk areas, that face-to-face surveys might miss. Our study also underscores the heightened food vulnerability of households in insecure regions and its effect on child mortality rates.

Funding: This study was supported by the Bill & Melinda Gates Foundation, as part of the Rapid Mortality Surveillance during COVID-19 (RaMMPS) Project (INV-023211).

Introduction

Burkina Faso faces significant challenges in data collection due to security issues, with around 40% of its territory being inaccessible due to terrorist control (1). These groups have displaced roughly 10% of the population and caused numerous civilian and military casualties, thereby complicating the execution of surveys and censuses (2). This situation affects access to healthcare, nutrition, and creates disparities in mortality rates among displaced populations, host communities, and those who remain in place. However, due to unreliable data, assessing the true extent of these impacts, especially on internally displaced persons (IDPs), is difficult.

Surprisingly, child mortality trends in Burkina Faso, based on Demographic and Health Surveys (DHS) and census data, suggest that mortality has declined despite the ongoing security crisis. For instance, under-five mortality rates dropped from 129 per 1,000 in 2010 to 48 per 1,000 in 2021. The UN IGME estimates also reflect a similar trend. However, these figures are likely biased due to the exclusion of hard-to-reach areas during face-to-face surveys and the absence of adjustments in UN IGME models for the current deterioration of the security.

In this context, there is an urgent need for faster, more cost-effective, and flexible data collection methods to bridge the gap between major household surveys and situations where face-to-face methods are impractical. The recent expansion of mobile phone networks offers a potential solution. Mobile phone penetration is high in low- and middle-income countries (LMICs), with global ownership rates at approximately 80% (3). In Sub-Saharan Africa, mobile phone ownership ranged between 61% and 73% in 2014-2015 and has been increasing (4). In Burkina Faso specifically, mobile subscriptions surged from 46 per 100 inhabitants in 2011 to 112 in 2021 (3). National sources also highlight widespread mobile phone ownership, with the 2019 census showing an 85% ownership rate, and the 2021 DHS indicating that 75% of women and 90% of men aged 15 to 49 own mobile phones (5). Recent improvements in telecommunications infrastructure, reduced call costs, and better communication quality have mitigated several limitations of mobile phone surveys (MPS), such as lower response rates, poorer interview quality, and higher refusal rates. Research has demonstrated that mobile phone interviews can be conducted at reduced costs, making them an attractive alternative to traditional methods (6–8). MPS can more easily reach populations affected by insecurity, compared to fieldworkers that would be put at risk in these areas.

Africa has seen a rise in MPS, although these have mainly been small-scale efforts like opinion polls (9). MPS are underutilized for assessing health interventions and monitoring demographic events (10–12). However, amidst crises like COVID-19 and Ebola, MPS have been used to evaluate impacts on household living conditions, preventive behaviors, and child nutrition indicators (13–16). Few MPS have been conducted in areas affected by both security and health crises, and even fewer have focused on collecting mortality data. One notable example is a Médecins Sans Frontières (MSF) study in Monrovia, which demonstrated the feasibility of using MPS to capture excess mortality during the Ebola outbreak (17). In India, a separate MPS indicated that COVID-19-related deaths were six to seven times higher than official reports by September 2021 (18). Similarly, in Matlab, Bangladesh, a population observatory recorded a 28% increase in excess deaths among the elderly during the early pandemic months (19).

Most studies conducted during conflicts rely on face-to-face data collection, with very few utilizing phone surveys. These studies often highlight the challenges and biases associated with different data sources in measuring conflict-related deaths (20–22). Some have outlined best practices for collecting mortality data during conflicts, while others have explored the impact of conflicts on healthcare access and usage (23,24). Additionally, studies have evaluated the direct or indirect impact of conflicts on malnutrition, child mortality, and maternal mortality (20,23,25–28). All these studies have used face-to-face data collection, either with key informants, household heads, community agents, or humanitarian organizations, except for one study conducted in Northern Cameroon by MSF and the Ministry of Health that compared mortality rates derived from phone interviews with those from face-to-face surveys, and finding higher rates from phone interviews (29). Yet these previous studies mostly based their estimates on reports of recent household deaths, are not representative at the national level, and there is a need to assess to what extent other instruments, such as birth or pregnancy histories and sibling histories can be used or adapted at national level for an MPS.

Transitioning to MPS introduces potential biases, affecting measurements and results (30). These biases mainly stem from selection and interviewer-respondent interactions but can be mitigated through post-stratification (31). However, the specific conditions of countries facing security crises remain underexplored. Some studies suggest that phone interviews may be more suitable for sensitive topics, allowing respondents to feel more comfortable (32). However, there is a lack of studies comparing data quality and reliability between phone and face-to-face methods, particularly for sensitive topics like child or family mortality. This study aims to assess the feasibility of using MPS to estimate child mortality and identify the advantages of this approach over traditional face-to-face surveys in contexts of health and security crises.

2. Data and methods

2.1 Data

This research draws on national face-to-face data, including the Population and Housing Census conducted in 2019, Demographic and Health Surveys (DHS) carried out in the country, and data from MPS conducted by the National Institute of Statistics and Demography (INSD) between 2020 and 2024. Additionally, we draw on the rapid mobile phone survey conducted during the COVID-19 pandemic (RaMMPS). The 2019 census collected data on child and parental survival, as well as deaths occurring in households during the 12 months preceding the census, enabling both direct and indirect estimates of mortality levels. Several Demographic and Health Surveys have been conducted in Burkina Faso over the past few decades, specifically in 1993, 1998, 2003, 2010, and 2021. These surveys provide valuable data for estimating child mortality, adult mortality, and maternal mortality.

2.1.1 High-Frequency Phone Survey (HFPS) 2020-2024

The High-Frequency Phone Survey (HFPS) in Burkina Faso, conducted from June 2020 to July 2024 by the National Institute of Statistics and Demography (INSD) in collaboration with the World Bank, aimed to assess the pandemic's impact on households and businesses. The survey is a follow-up to the 2018/19 Harmonized Survey on Household Living Conditions (EHCVM). It targeted 1,800 households, eventually contacting 2,500, with 1,968 households interviewed in the first phase. To ensure national representation, especially in rural areas, additional households were included in later phases.

Each month, the same households were re-contacted via mobile phones to answer questions about COVID-19's impact on demographics, access to services, food security, employment, income, and household shocks. Over time, new modules addressed issues like vaccination, mental health, and economic concerns. The preferred respondent was the household head, but any knowledgeable adult could participate if the head was unavailable. Pre-loaded household data helped interviewers accurately identify and track households across survey rounds, maintaining the integrity and continuity of the panel. This comprehensive survey provided critical insights into how COVID-19 affected various aspects of life in Burkina Faso.

2.1.2 The RaMMPS national survey

RaMMPS is an innovative survey program designed to estimate mortality during the COVID-19 pandemic across five middle- and low-income countries: the Democratic Republic of Congo (DRC), Malawi, Mozambique, Bangladesh, and Burkina Faso. In Burkina Faso[1], the survey was conducted by the Institut Supérieur des Sciences de la Population (ISSP) of Joseph Ki-Zerbo University, involving 21,339 respondents aged 15 and above.

Data collection took place through quarterly cross-sectional surveys from September 2021 to October 2022, using mobile phone interviews recorded on tablets via SurveyCTO. Two sampling strategies were employed: (1) a sample of around 6,000 individuals from the Harmonized Survey of Household Living Conditions (EHCVM) and (2) a sample of 9,000 individuals obtained through Random Digit Dialing (RDD). These sub-samples, referred to as the EHCVM arm and the RDD arm, respectively, allowed for comparison between the two recruitment methods.

Respondents provided verbal informed consent after being briefed in their preferred language about the survey's purpose and their rights to refuse or withdraw. The study protocol was approved by the Burkina Faso Health Ethics Committee. Information on household composition, recent household deaths, survival of close relatives, and COVID-19 vaccination was collected from consenting participants

[1] https://www.lshtm.ac.uk/research/centres-projects-groups/rapid-mortality-mobile-phone-survey

2.2 Methods

To compare the characteristics of the HFPS and RaMMPS survey samples, with a focus on the EHCVM branch, record linkage between the two databases was conducted. This was possible because both surveys utilized phone numbers initially collected during the face-to-face 2018/2019 EHCVM, along with household identifiers and respondents' line numbers. We calculated the time gap between the HFPS and RaMMPS data collection dates to identify households surveyed almost simultaneously by both surveys.

We used the linked datasets from the EHCVM branch of the RaMMPS survey and the HFPS to explore factors influencing mortality levels. Children's survival times were estimated by segmenting their life courses based on birth dates and ages at death. Each life segment marked by birthdays, calendar year changes, or completed years before the survey was compiled into a dataset representing unique combinations of age, sex, calendar year, and time prior data collection. Follow-up time and death counts for each period were calculated, applying sample weights. Child mortality indicators were estimated using a standard life-table approach, relying on birth histories to calculate survival probabilities and synthesize under-five mortality rates (5q0) (35). We used Poisson regression models, assuming an over-dispersed Poisson distribution, to analyze the relationship between mortality and food security status, with the logarithm of exposure time as an offset parameter. Deaths and person-years referring to periods located more than five years before the survey date were discarded. We used two models: one to obtain unadjusted estimates and another to obtain coefficients adjusted for factors such as maternal education, residential and migration status, age group, marital status, regional security contexts, and year of data collection.

2.3 RaMMPS post-stratification weighting

The unweighted sample characteristics of the MPS showed significant differences compared to the population distribution from the latest census (Table S2). These discrepancies could be attributed to selection bias and non-response errors during data collection. To address these issues, we used post-stratification, constructing weights based on household assets, residence, age, and education (6). These weights were adjusted to ensure that the sample distribution aligned with both the cross-classification of these variables and the marginal distribution within the population. After applying the post-stratification weights, the sample's marginal distributions for education, age, access to electricity, type of roof, access to drinking water, and residence type matched those of the 2019-2020 national census. To minimize variability, weights per individual were capped at a maximum of 2 (36,37).

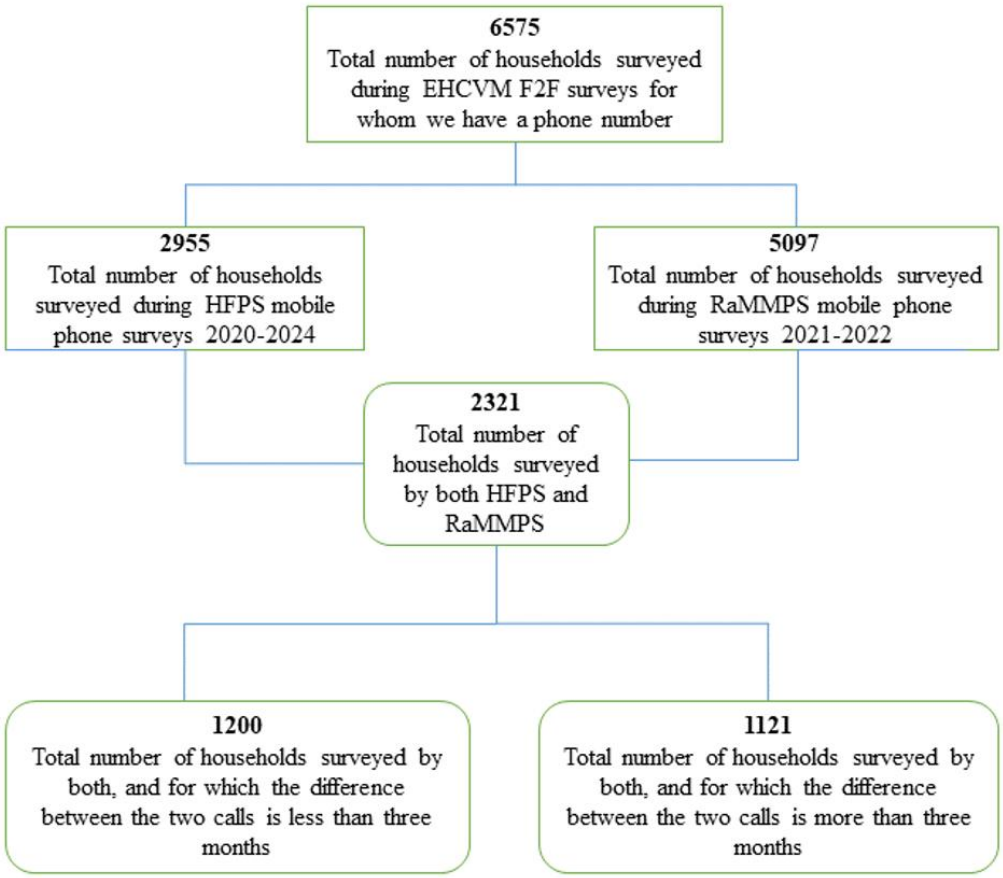
3. Results

3.1 Characteristics of study participants

The figure below illustrates the selection process to establish our dataset of analysis, made of 1200 households.

Overall, the HFPS surveyed 2,955 households, while EHCVM arm of the RAMMPS survey covered 5,097 households, all drawn from the 6,575 households with phone numbers collected during the 2018/2019 original face-to-face survey. Among these, 2,321 households were surveyed by both HFPS and RaMMPS simultaneously. An analysis of the time intervals between the HFPS and RaMMPS phone calls reveals that 1,200 households were surveyed within less than three months, while 1,121 households were surveyed three months or more apart.

Figure 1: Flow chart of the study enrollment process



3.2 Under-five mortality levels and trends

Figure 2 presents mortality rates derived from the DHS (2021) and RaMMPS surveys, stratified by the regional security context and categorized according to the period before or during the COVID-19 pandemic (2020-2022). In general, the RaMMPS survey indicates an increase in under-five mortality rates, although the difference is not significant with the period pre-COVID, whereas the DHS survey reveals a declining trend, although not significant. These variations in levels are particularly notable in high-security risk areas compared to secure regions.

Figure 2: Under-five mortality rates disaggregated by areas with and without conflict, and by period

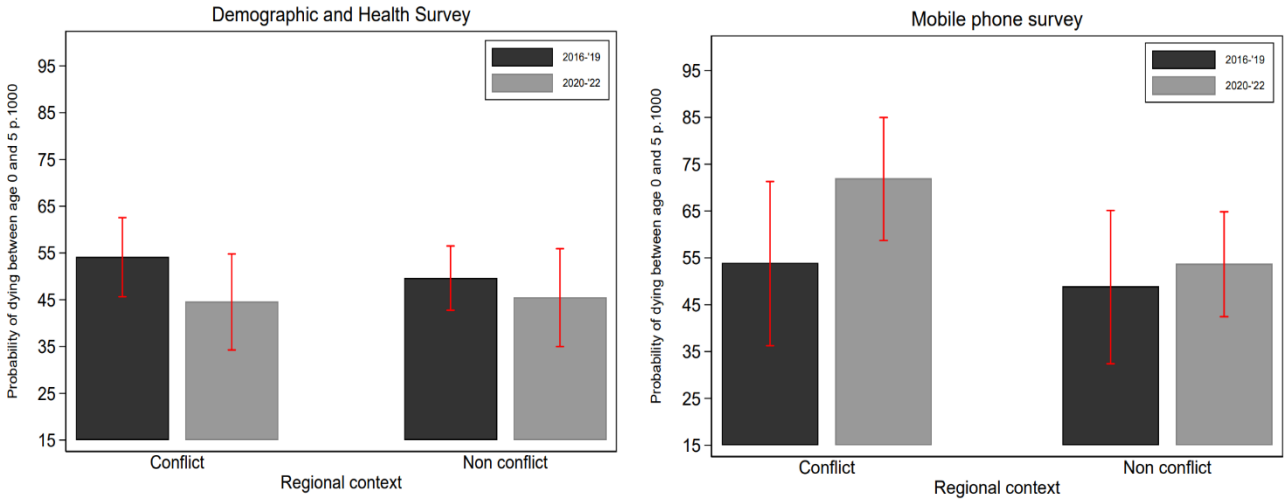
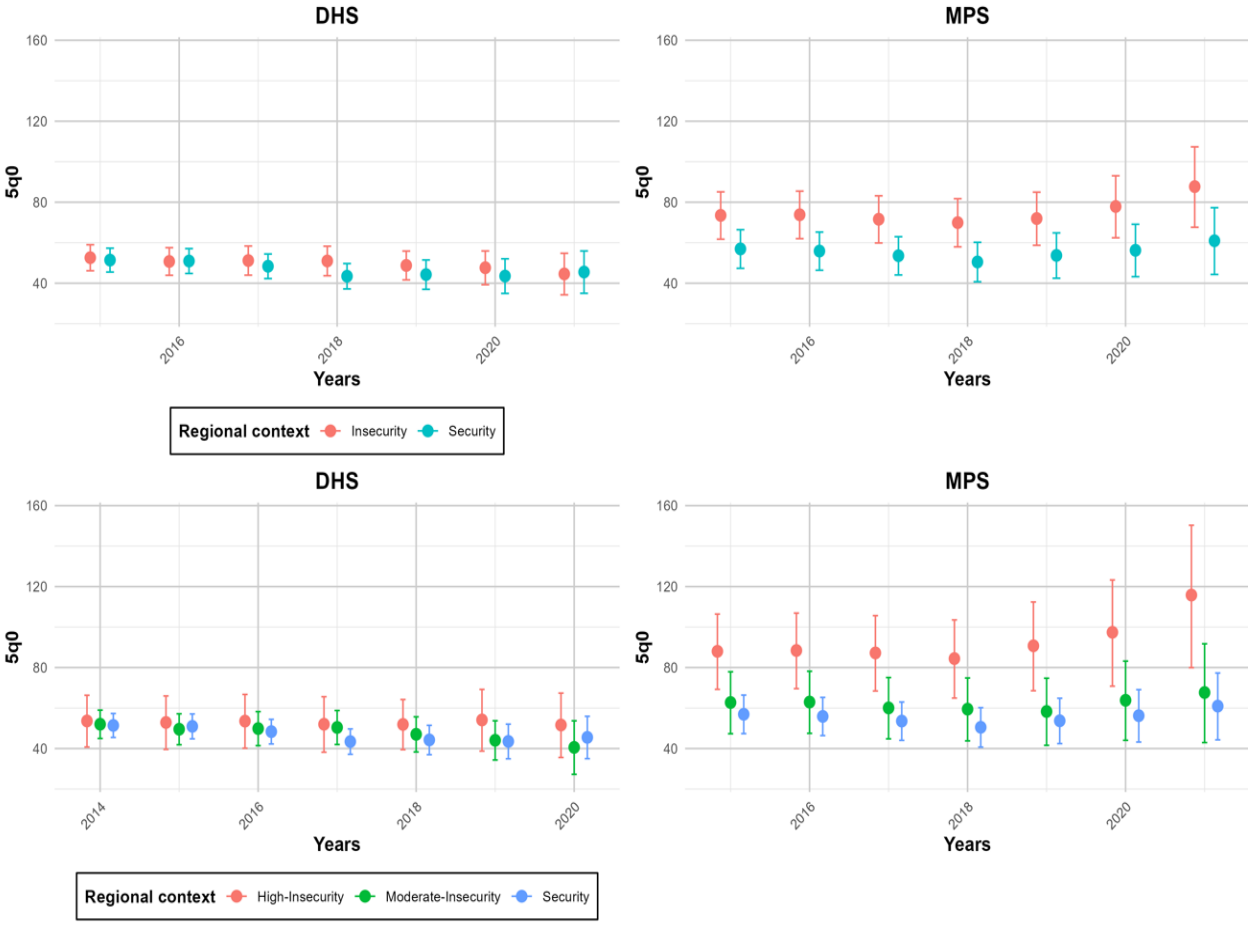


Figure 3 shows annual under-five mortality trends using data from RaMMPS and DHS, categorized by the security context of the region where the mother was interviewed. The first row shows general upward mortality trends in insecure regions (East, North, Sahel, Centre-North, Centre-East, Boucle du Mouhoun) based on RaMMPS data, while DHS data suggests stagnation or decline. Mortality rates in insecure regions are higher in the RaMMPS survey compared to DHS, although confidence intervals overlap. Secure regions show no significant mortality differences between the two data sources either, and the point estimates are much closer.

Further stratification highlights that regions with high-security risks (Sahel, North, East) experience significantly higher child mortality rates than moderate-risk or secure regions, especially after 2019, coinciding with heightened security and COVID-19 crises. In contrast, moderate or secure regions initially saw declining mortality rates possibly thanks to the free distribution of healthcare for children under five introduced in 2016, but an increase after 2019. This disparity is not captured by the DHS, likely due to the exclusion of severely affected enumeration areas. RaMMPS data thus seem to better reflect the impact of security crises on child mortality than the DHS.

Figure 3: Trends in under-five mortality based on regional security context, derived from RaMMPS survey and 2021 DHS



3.3 Effects of household and mother characteristics on mortality differentials

Table 1 below presents the coefficients from the Poisson regression for under-five mortality, distinguishing between unadjusted and adjusted coefficients. Unadjusted coefficients suggest that the regional security context, the education level of the mother, migration status, and household food security status significantly influence under-five mortality rates. Unsurprisingly, the risk of death increases as households experience food insecurity or reside in insecure regions or received new members in his household because of insecurity, and decreases with higher maternal education levels. For instance, children in households with severe food insecurity have a mortality risk more than double (2.126 times) that of children in food-secure households. Children living in secure regions have about a 24% lower chance of dying compared to those in insecure regions. Even after controlling for other variables, children from households with severe food insecurity have nearly twice the risk of dying (2.012 times) compared to those from food-secure households. It is also worth noting that the risk for children living in families hosting migrants due to security reasons is more than four times higher (4.862 times) compared to other children in different households. However, the difference is no longer statistically significant concerning the child's region of residence. Additionally, maternal

education remains an important determinant in explaining mortality differences, even after controls.

Table 1 Poisson regressions on under-five mortality, adjusted and unadjusted coefficients

Variables	*Unadjusted coefficients*	*Adjusted coefficients*
	Under-five mortality	
Food security		
Secure (ref)	1	1
	(.)	(.)
Moderate	1.864***	1.768**
	(2.67)	(2.40)
Severe	2.126***	2.012**
	(2.58)	(2.25)
Migration		
No migrant (ref)	1	1
	(.)	(.)
Not due to insecurity	0.335***	0.295**
	(-2.59)	(-2.44)
Due to insecurity	3.266***	4.862***
	(3.37)	(2.85)
Education		
None (ref)	1	1
	(.)	(.)
Primary	0.777	0.861
	(-0.88)	(-0.43)
Secondary or more	0.387**	0.402**
	(-2.53)	(-2.23)
Age group of mother		
Less than 29 (ref)	1	1
	(.)	(.)
30-59 yrs	0.599	0.971
	(-1.38)	(-0.06)
60 yrs and above	0.975	1.505
	(-0.06)	(0.83)
Marital status		
Unmaried	1	1
	(.)	(.)
Married or cohabiting	0.942	0.376
	(-0.10)	(-1.46)
Regional context		
Insecurity	1	1
	(.)	(.)
Security	0.761*	0.738
	(-1.44)	(-1.37)
Year of survey		
2020 (ref)	1	1
	(.)	(.)
2021	1.048	0.742
	(0.06)	(-0.39)
2022	1.399	1.216
	(0.47)	(0.27)
2023/24	1.358	0.966
	(0.42)	(-0.05)
N	468	468
Pseudo R²	0.0158	0.0576

Exponentiated coefficients; t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

4. Discussion

This study explores the feasibility of MPS for estimating child mortality and highlights advantages over traditional face-to-face surveys. It also examines vulnerability factors affecting children during security crises. Data from the RaMMPS survey, conducted in Burkina Faso during the COVID-19 pandemic, and the High-Frequency Phone Surveys (LSMS-HFPS), carried out by the National Institute of Statistics and Demography with World Bank support from 2020 to 2024, were used for this analysis. We compared child mortality levels from RaMMPS to those from Demographic and Health Surveys (DHS), focusing on the security context of respondents' regions. Direct mortality estimation methods and survival analysis identified factors contributing to variations in mortality across different security regions.

Interestingly, while national trends from DHS, RaMMPS, and census data in Burkina Faso indicate a decline in under-five mortality, these trends mask significant regional disparities. Phone survey data suggest increased mortality during COVID-19 compared to pre-pandemic levels, though this increase is not statistically significant when considering confidence intervals. Face-to-face surveys like DHS did not capture this increase, showing instead a decline.

In examining under-five mortality trends across different security contexts using data from RaMMPS, and DHS, we classified regions as insecure (East, North, Sahel, Centre-North, Centre-East, and Boucle du Mouhoun) and further subdivided them into high-security risk (Sahel, North, East) and moderate-security risk (Boucle du Mouhoun, Centre-East, Centre-North). RaMMPS data shows a general increase in mortality rates in insecure regions, while DHS data indicates stagnation or decline. The RaMMPS survey reveals significantly higher mortality rates in insecure regions compared to DHS, likely due to the latter excluding the most affected areas. Child mortality levels sharply increased in high-security risk regions post-2019, coinciding with the security crisis and the COVID-19 pandemic. Conversely, secure and moderately insecure areas experienced a decline in mortality until 2019, followed by an increase due to recent crises. These findings highlight the importance of phone surveys to reach physically inaccessible populations. They also show that the security crisis impacts not only those directly exposed to conflicts but also residents in secure areas. These findings suggest that face-to-face surveys may be less effective in producing accurate results during health or security crises.

Regarding the direct or indirect effects of the security crisis on child mortality differences, our findings indicate that mortality risks vary depending on household food security, migration status and the mother's education level. Children from food-insecure households, households hosting migrants due to security reasons or with uneducated mothers face a higher risk of death compared to children from food-secure households, no migrant or those with educated mothers. Several studies have confirmed this relationship between food insecurity trough malnutrition, and high mortality rates, particularly among children under five (38,39). Ogbu et al. (2022) investigated the relationship between vaccination coverage, global acute malnutrition, and under-five mortality rates (U5DR) in humanitarian emergency settings. They found that both measles vaccination coverage and malnutrition were associated with excess mortality rates,

particularly among internally displaced persons (IDPs) and affected residents. Our results further indicate that the elevated mortality rates in regions facing security crises are indirectly driven by the worsening food security situation. It is well-documented that malnutrition in children leads to higher under-five mortality rates and that prolonged armed conflicts exacerbate food insecurity (40,41).

Our study has a number of limitations, many of which are well-known challenges inherent to phone surveys. Compared to face-to-face interviews, MPS are more prone to sampling and non-sampling biases. Given the disparities in mobile phone ownership, selection biases are expected (6,42). Specifically, MPS tend to overrepresent younger, urban, and male respondents with higher education levels (43) and have higher non-response rates (44). However, to limit the impact of these selection biases, we implemented quota sampling and created post-stratification weights. Additionally, data quality and non-response can be affected by connectivity issues and network quality, as well as the limitations of mobile phone interviews in establishing rapport between the interviewer and the respondent (45–47). Another limitation of our study is that the HFPS survey did not collect certain key variables, and other information is limited over time.

Despite these limitations, our study successfully demonstrates that MPS can be effectively used not only to collect data on child mortality during health and security crises, but also to provide valuable insights for policymakers on the impact of these crises on child mortality levels based on the proximity of the parents' residence to conflict zones. Face-to-face surveys conducted during the same period failed to show this. Furthermore, our research highlights the determinants of differences in under-five mortality in Burkina Faso. Specifically, our study found that the mother's education level, the reception of internal migrants and household food insecurity were the primary determinants of high child mortality.

Conclusion

MPS offer a viable alternative to traditional surveys for estimating child mortality, particularly in insecure regions where conventional methods are impractical. MPS can capture critical mortality trends, especially in high-risk areas, that face-to-face surveys might miss. The findings underscore the heightened vulnerability of households in insecure regions to food insecurity and its link to elevated child mortality rates. Policymakers should consider integrating MPS into national data collection strategies to ensure comprehensive and timely information, especially during health and security crises.

Declarations

Ethics approval and consent to participate

The study protocol was reviewed Ethics Committee of the Ministry of Health of Burkina Faso. All participants provided oral consent for the survey, including consent for storing anonymized data in a public repository and consent to audio record the interview.

Availability of data and materials

Burkina Faso RaMMPS data can be requested via email to the corresponding author or rammps@lshtm.ac.uk.

Funding

This study was made possible with financial support from the *Bill and Melinda Gates Foundation* (INV-023211). The funder had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Authors' contributions

KD analyzed the survey data and drafted the manuscript. All authors read and approved the final version of the manuscript.

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6. Appendix

6.1 Tables

Table S1: Distribution of sampled, collected, and uncollected clusters by region for the 2021 DHS survey

Region	Sampled clusters			Surveyed	Non surveyed
	Urban	Rural	Both		
Boucle du Mouhoun	11	41	52	45	-7
Cascades	11	25	36	28	-8
Centre	50	18	68	68	0
Centre-Est	14	33	47	45	-2
Centre-Nord	11	34	45	35	-10
Centre-Ouest	14	33	47	47	0
Centre-Sud	7	29	36	36	0
Est	10	37	47	27	-20
Hauts-Bassins	27	29	56	56	0
Nord	13	35	48	39	-9
Plateau-Central	8	30	38	38	0
Sahel	10	31	41	13	-28
Sud-Ouest	9	30	39	37	-2

Table S2: Composition of the RaMMPS-BF sample, by study arm, and comparison with characteristics of the population enumerated in the 2019-2020 census

Survey	EHCVM : head of household				RDD : population 15-64 years olds			
	Unweighted	Weighted		RGPH	Unweighted	Weighted		RGPH
Respondents caracteristics	%	%	95% CI	%	%	%	95% CI	%
Sexe								
Men	76.7	84.0	[82.0-85.7]	84.0	34.3	46.2	[44.7-47.8]	46.3
Women	23.3	16.0	[14.3-18.0]	16.0	65.7	53.8	[52.2-55.3]	53.7
Age group								
15-29 yrs	17.5	22.9	[20.7-25.1]	22.6	41.5	43.7	[42.2-45.3]	43.7
30-49 yrs	52.0	49.3	[46.8-51.9]	49.1	46.8	42.2	[40.7-43.8]	42.2
50 yrs &+	30.6	27.8	[25.6-30.2]	28.3	11.7	14.1	[13.0-15.2]	14.1
Education								
None	52.0	69.5	[67.1-71.8]	72,2	44.9	67.6	[66.1-69.0]	69,8
Primary	20.2	11.2	[9.7-12.9]	10	16.5	11.5	[10.5-12.5]	9,6
Secondary	21.4	13.7	[12.1-15.6]	13,5	29.5	15.7	[14.6-16.8]	15,93
Superior	6.4	5.6	[4.5-6.9]	4,2	9.0	5.2	[4.6-5.9]	3,6
Marital statut								
Married	83.6	83.3	[81.3-85.1]	84,2	75.4	77.5	[76.2-78.8]	72,5
Widowed	5.5	5.0	[4.0-6.2]	1,1	3.3	3.6	[3.1-4.3]	3,4
Divorced/sep	0.8	0.7	[0.4-1.3]	5,6	0.8	0.7	[0.5-1.0]	0,9
Single	10.1	11.0	[9.5-12.7]	9,1	20.4	18.2	[17.0-19.4]	23,2
Living place								
Ouaga	11.1	13.0	[11.4-14.8]	14,4	15.8	11.5	[10.6-12.4]	14,5
Bobo	6.1	3.4	[2.6-4.4]	5	6.7	3.8	[3.3-4.4]	5,2
Others town	40.2	13.5	[12.0-15.3]	11,9	14.3	9.3	[8.5-10.2]	11,4
Rural	42.6	70.1	[67.7-72.3]	68,7	63.2	75.4	[74.1-76.6]	69
Region of residence								
Boucle du Mouhoun	7.1	10.5	[9.0-12.2]	9,6	6.8	10.6	[9.6-11.7]	9,5
Cascades	7.4	4.3	[3.4-5.5]	3,9	4.1	4.1	[3.5-4.8]	4,1
Centre	15.7	16.8	[14.9-18.8]	18,4	24.3	13.4	[12.5-14.5]	18
Centre-Est	7.8	7.9	[6.6-9.4]	7,7	6.9	8.1	[7.3-9.1]	7,4
Centre-Nord	7.9	7.6	[6.4-9.1]	7	9.2	8.5	[7.6-9.4]	7,3
Centre-Ouest	6.8	7.4	[6.1-8.9]	7,8	7.6	8.3	[7.5-9.2]	8
Centre-Sud	5.6	4.5	[3.6-5.7]	4	4.3	4.6	[3.9-5.3]	3,9
Est	7.1	8.5	[7.2-10.1]	7,5	4.0	8.3	[7.5-9.3]	7,8
Hauts-Bassins	12.7	12.0	[10.4-13.7]	11,8	14.2	11.0	[10.1-11.9]	12
Nord	6.5	7.7	[6.4-9.2]	7,8	7.4	8.5	[7.6-9.4]	8,1
Plateau-Central	6.3	4.5	[3.6-5.7]	4,6	6.2	4.8	[4.2-5.6]	4,7
Sahel	2.9	3.8	[2.9-4.9]	5,3	1.7	5.4	[4.7-6.2]	4,6
Sud-Ouest	6.2	4.4	[3.5-5.6]	4,8	3.4	4.3	[3.7-5.0]	4,6
Household size								
1-4 pers	21.5	32.9	[30.5-35.3]	49.4	28.5	39.2	[37.6-40.7]	49.4
5-8 pers	43.0	37.4	[34.9-39.9]	36.5	41.9	33.7	[32.3-35.3]	36.5
9 pers&+	35.4	29.7	[27.4-32.1]	14.1	29.6	27.1	[25.7-28.6]	14.1

Test of proportional-hazards assumption

Table S3: Time function: Analysis time

	rho	chi2	df	Prob>chi2
1.reg_rec2	-0.08402	6.72	1	0.0095
2.reg_rec2	0.05515	2.96	1	0.0855
3b.reg_rec2	.	.	1	.
1b.mig_rea~n	.	.	1	.
2.mig_reason	0.02003	0.39	1	0.5322
3.mig_reason	-0.01805	0.31	1	0.5770
1b.tailmen	.	.	1	.
2.tailmen	0.00227	0.00	1	0.9441
3.tailmen	-0.00165	0.00	1	0.9602
1b.child14	.	.	1	.
2.child14	-0.03745	1.34	1	0.2472
3.child14	-0.03349	1.04	1	0.3067
1b.resp_sex	.	.	1	.
2.resp_sex	-0.01316	0.17	1	0.6824
Global test		16.13	9	0.0643

Table S4: Unweighted Poisson regressions on under-five mortality, adjusted coefficient

Variables	*Raw ffects*	*Net effects*
	Under-five mortality	
Food security		
Secure	1	1
	(.)	(.)
Moderate	1.639**	1.376
	(1.97)	(1.26)
Severe	2.104**	1.744*
	(2.54)	(1.82)
Migration		
None migrant	1	1
	(.)	(.)
Not insecurity	0.568	0.466
	(-1.53)	(-1.64)
Security reason	1.715	1.394
	(1.17)	(0.45)
Education		
None	1	1
	(.)	(.)
Primary	0.575*	0.564*
	(-1.84)	(-1.70)
Secondary or more	0.394***	0.308***
	(-2.88)	(-3.06)
Women age group		
less than 29	1	1
	(.)	(.)
30-59 yrs	0.679	0.877
	(-0.91)	(-0.25)
60 yrs and above	0.874	0.907
	(-0.29)	(-0.17)
Marital status		
Unmaried	1	1
	(.)	(.)
Married	1.164	0.525
	(0.21)	(-0.88)
Regional context		
Insecurity	1	1
	(.)	(.)
Security	0.711*	0.501
	(-1.68)	(-0.91)
Year of survey		
2020	1	
	(.)	
2021	0.595	0.501
	(-0.82)	(-0.91)
2022	0.671	0.710
	(-0.67)	(-0.47)
2023/24	0.591	0.583
	(-0.86)	(-0.70)
N	468	468
Pseudo R²	0.0158	0.0576

Exponentiated coefficients; t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01

Table S5: unweighted Poisson regression results

	(1) Model 1: W~x	(2) Model 2: W~t
(sum) _d		
None migrant	1	1
	(.)	(.)
Not insecurity	0.562	0.495
	(-1.56)	(-1.52)
Security reason	1.911	1.351
	(1.40)	(0.42)
No	1	1
	(.)	(.)
Yes	0.759	0.583
	(-0.38)	(-0.74)
None	1	1
	(.)	(.)
Educated	0.474***	0.431***
	(-3.13)	(-3.12)
region2=0	1	1
	(.)	(.)
region2=1	0.778	0.818
	(-0.88)	(-0.65)
region2=2	0.650*	0.701
	(-1.71)	(-1.26)
Secure		1
		(.)
Moderate		1.386
		(1.28)
Severe		1.740*
		(1.85)
N	563	468
Pseudo RÂ²	0.0323	0.0504

Exponentiated coefficients; t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Model 1: Without food security; Model 2: With food security

Table S6: weighted Poisson regression results

	(1) Model 1: W~x	(2) Model 2: W~t
(sum) _d		
None migrant	1	1
	(.)	(.)
Not insecurity	0.340**	0.363**
	(-2.56)	(-2.05)
Security reason	4.055***	5.186***
	(3.90)	(3.19)
No	1	1
	(.)	(.)
Yes	0.548	0.418
	(-0.95)	(-1.34)
None	1	1
	(.)	(.)
Educated	0.523***	0.583*
	(-2.59)	(-1.91)
region2=0	1	1
	(.)	(.)
region2=1	1.073	0.958
	(0.26)	(-0.14)
region2=2	0.858	0.732
	(-0.60)	(-1.06)
Secure		1
		(.)
Moderate		1.720**
		(2.29)
Severe		1.949**
		(2.18)
N	563	468
Pseudo R^2	0.0475	0.0627

Exponentiated coefficients; t statistics in parentheses
* p<0.10, ** p<0.05, *** p<0.01
Model 1: Without food security; Model 2: With food security

Table S7 shows the composition of the weighted and unweighted RaMMPS-EHCVM samples and compares them to the characteristics of household heads in the World Bank's High-Frequency Phone Surveys (HFPS) conducted from 2020 to 2024. We observe more similarities than differences between the two samples, whether weighted or unweighted. The unweighted RaMMPS-EHCVM sample has a higher proportion of female household heads, younger household heads, and larger households compared to the HFPS sample. However, the gap in the total number of people in the household between the two samples decreases after weighting and considering new household residents in the HFPS sample. In the RaMMPS survey, there were no questions to identify household movements. Additionally, despite the weighting, significant differences in the ages of household heads remain between the two samples, particularly for those under 30 and over 50 years old.

Table S7: Composition of the RaMMPS-EHCVM sample in Burkina Faso, compared with the World Bank's High-Frequency Phone Surveys (HFPS) 2020-2024

	WBO			**RaMMPS-EHCVM**		
	Unweighted	**Weighted**	**Total**	**Unweighted**	**Weighted**	**Total**
	%	**%**		**%**	**%**	
Sex of respondant						
Men	85.1	87.1	1,975.0	78.0	84.3	1,810.0
Women	14.9	12.9	347.0	22.0	15.7	512.0
Respondents age group						
15-29 yrs	4.5	5.6	104.0	13.0	15.0	303.0
30-49 yrs	50.4	49.5	1,170.0	53.1	52.0	1,232.0
50 yrs &+	45.1	44.9	1,047.0	33.9	33.0	787.0
Household size						
1-4 Members	26.5	23.2	615.0	21.3	31.5	495.0
5-8 Members	47.9	48.7	1,113.0	45.0	39.7	1,044.0
9 Members&+	25.6	28.1	594.0	33.7	28.8	783.0
Household size [a]						
1-4 Members	28.6	24.3	665.0	21.3	31.5	495.0
5-8 Members	47.8	48.6	1,111.0	45.0	39.7	1,044.0
9 Members&+	23.5	27.1	545.0	33.7	28.8	783.0
Place of residence						
Urban	61.0	36.6	1,417.0	64.1	43.9	1,489.0
Rural	39.0	63.4	905.0	35.9	56.1	833.0
Strate						
Ouagadougou	13.8	14.8	321.0	15.4	23.7	358.0
Other urban	47.2	21.7	1,096.0	48.7	20.2	1,131.0
Rural	39.0	63.4	905.0	35.9	56.1	833.0
Region						
Boucle du Mouhoun	6.0	7.1	139.0	6.2	7.3	143.0
Cascades	6.9	4.1	161.0	7.3	4.0	169.0
Centre	17.8	17.6	414.0	19.5	27.9	453.0

Centre-Est	7.5	10.9	175.0	7.6	9.0	176.0
Centre-Nord	7.5	7.3	173.0	7.1	7.1	166.0
Centre-Ouest	6.3	8.3	146.0	6.2	7.0	145.0
Centre-Sud	6.0	5.3	140.0	5.9	4.5	138.0
Est	7.2	7.3	167.0	6.3	3.8	147.0
Hauts-Bassins	12.1	12.6	280.0	12.3	11.7	285.0
Nord	6.7	7.9	156.0	7.0	7.6	163.0
Plateau-Central	6.3	4.2	147.0	6.0	4.6	140.0
Sahel	3.4	3.7	78.0	2.5	1.3	57.0
Sud-Ouest	6.3	3.8	146.0	6.0	4.3	140.0
Total	100.0	100.0	2,322.0	100.0	100.0	2,322.0

a: exclude new members arrived in the household after EHCVM 2018/2019 survey

6.2 Figures

Figure S1: Trends in under-five mortality according to the RaMMPS survey by branch, 2021 DHS, 2019-2020 census, and UN IGME estimates (2022)

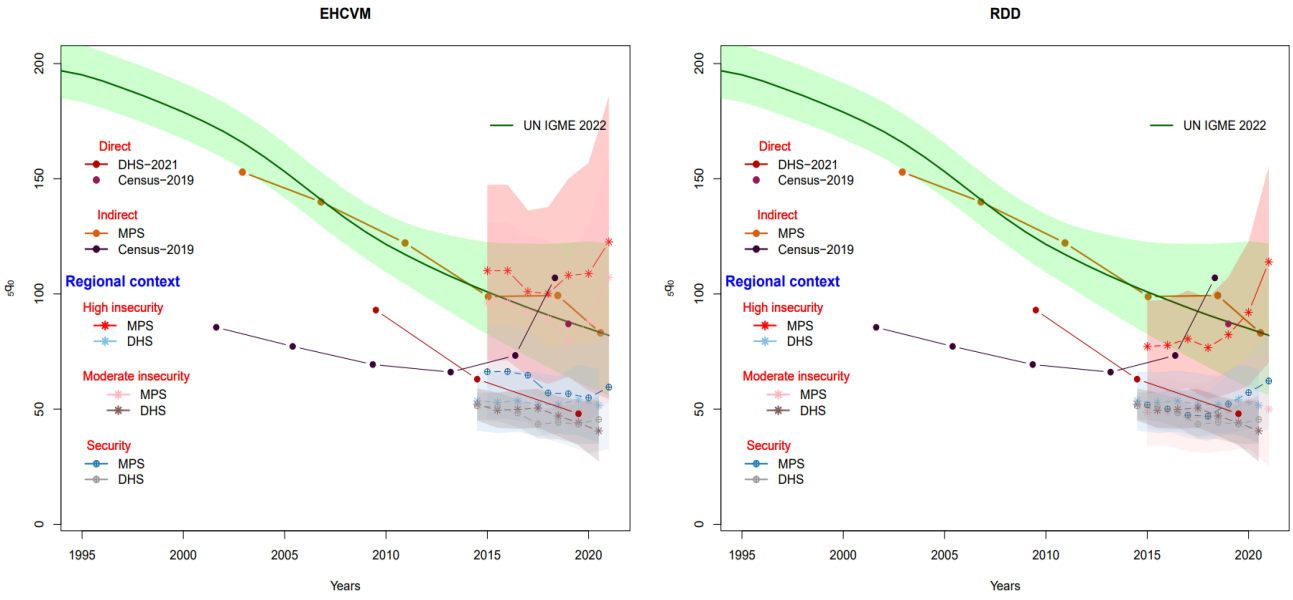
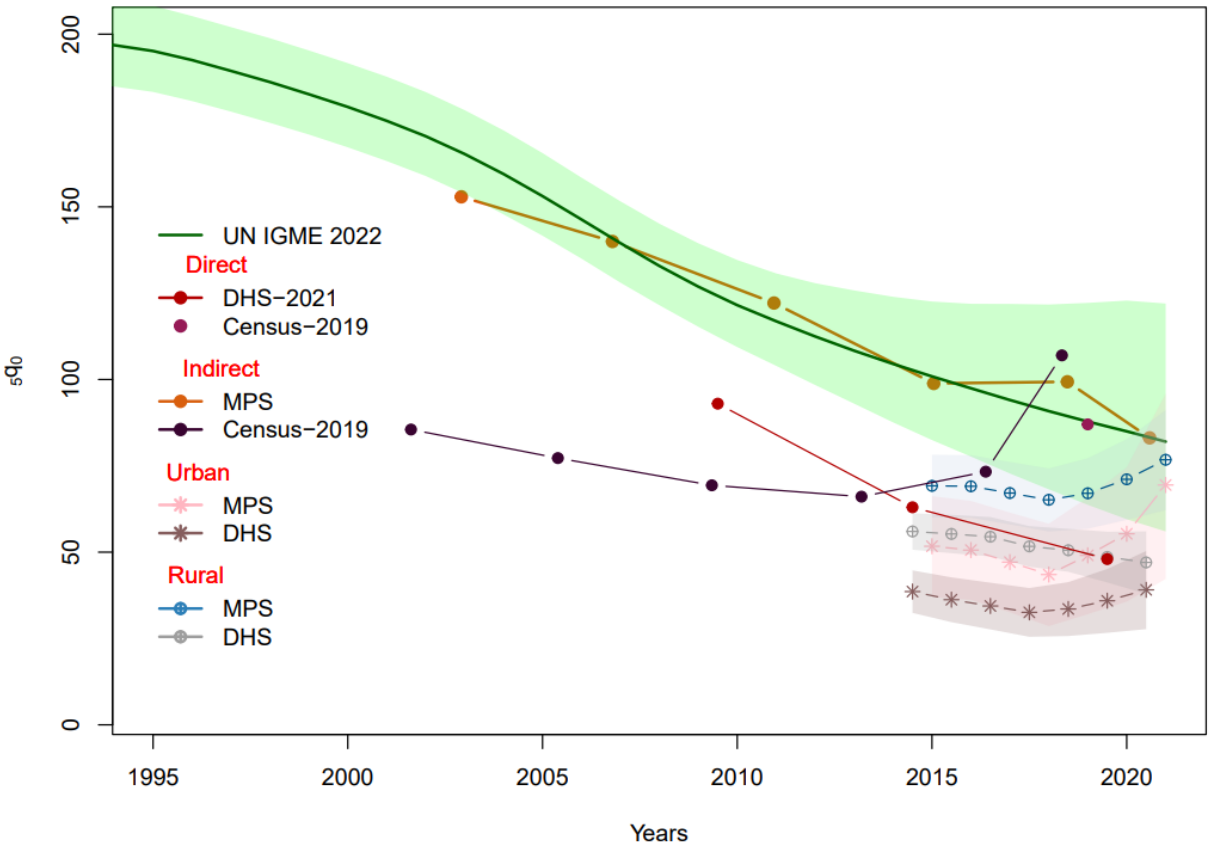


Figure S2: Trends in under-five mortality according to 2021 DHS, 2019-2020 census, UN IGME estimates (2022) and the RaMMPS survey by place of residence



The graph below shows the correspondence between the current ages of household heads reported by RaMMPS respondents and those recorded in the HFPS. In this graph, we only included HFPS household heads who had a matching record in the RaMMPS survey, and we focused on households that were interviewed by both surveys within a close timeframe (less than three months apart). We observe an almost perfect correlation between the ages collected by RaMMPS and HFPS ($R^2 = 0.96$). The discrepancies noted in the previous table are therefore likely due to the time elapsed between the two interviews, which was sufficient to cause significant changes in the household, including a potential change in the household head.

Figure S3: Correspondence between the current ages for household heads reported by RaMMPS respondents and HFPS records