A multi-country comparison between mobile phone surveys (NCD-MPS) and face-to-face household surveys (WHO STEPS) to estimate prevalence of noncommunicable diseases behavioral risk factors in low-and middle-income settings

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ACKNOWLEDGEMENTS

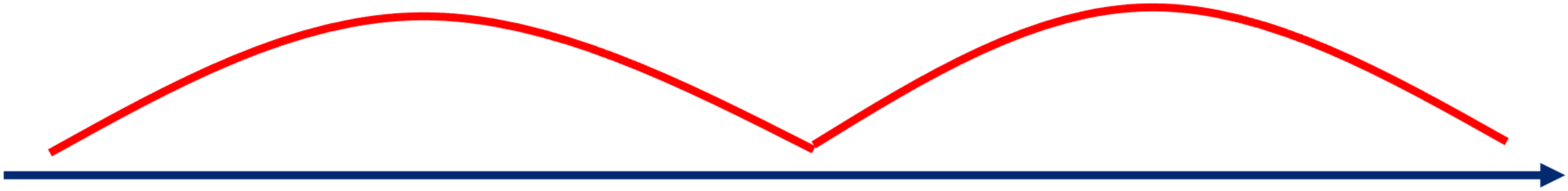
- Bloomberg Philanthropies
- Centers for Disease Control and Prevention
- CDC Foundation
- Governments of Ecuador, Malawi, Morocco, Mumbai, Sri Lanka, and Zambia
- World Health Organization
- The thousands of respondents

- This work conducted under the Bloomberg Philanthropies Data for Health Initiative
- Data collected from 2017 to 2022

The Opportunity

In low-income countries, **household surveys** are the gold standard for collecting population representative estimates

- Cons: Infrequent, costly, human-resource intensive, hard to use in pandemics
- Pros: Minimize selection and nonresponse biases; can clarify questions and responses, collect specimens

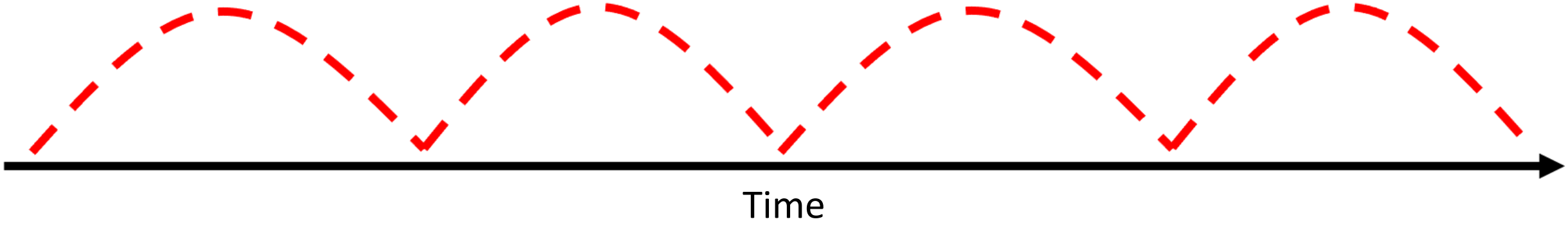


Time

The Opportunity

In low-income countries, household surveys are the gold standard for collecting population representative estimates

- Need a way to ***complement*** these face-to-face surveys with more **frequent**, representative data



PURPOSE AND OBJECTIVE

To explore the performance of Mobile Phone Surveys (MPS) in comparison to traditional face-to-face surveys, comparative analyses at the national level in different countries and settings.

We compared estimates of NCD behavioral risk factors between NCD-MPS and nationally representative household (WHO STEPS) surveys in six LMICs: Ecuador, Morocco, Malawi, Zambia, Mumbai (India) and Sri Lanka.

METHODS

WHO STEPS survey

- STEPS is a standardized method for collecting, analyzing, and disseminating data on key NCD risk factors and conditions in countries
- The survey instrument of STEP 1 covers key behavioral risk factors: tobacco use, alcohol use, physical inactivity, unhealthy diet, history of NCDs
- Standardized questions and protocols used in each country with WHO support
- All countries drew nationally representative samples of adults aged 18-69 years, except Morocco where the sample had no upper age limit, by means of a multi-stage cluster sampling method

Mobile Phone survey

- Sampling frames for each country were generated using prefixes for each mobile network operator, screened to remove non-working numbers and random digit dialing (RDD).
- A subset of core STEPS questions adapted for IVR survey administration
- Standardized questions and protocols used in each country with CDC support
- All countries selected respondents if they were: 18 years+, the targeted sample size of the corresponding age-sex stratum had not been met and they consented to participate

INDICATORS BEING STUDIED (n=27)

Tobacco use: current and/or daily smoker and smokeless tobacco user

Alcohol consumption: current drinker (past 30 days) and heavy episodic drinking

Diet: mean number of days with fruit consumption a week, mean number of fruit servings consumed per day, mean number of days with vegetable consumption, mean number of vegetable servings consumed per day; less than five fruit or vegetable servings per day, adding salt during food preparation, adding salt while eating, and eating processed food with high salt content.

NCD-related outcomes :

1) Hypertension: previous diagnosis and being prescribed hypertension medication

2) Diabetes: previous diagnosis and being prescribed diabetes medication

ANALYTIC PLAN

- MPS and STEPS samples were weighted to population age-sex distribution
- Sociodemographic characteristics of participants were described for MPS and STEPS
- Population-level estimates for each indicator obtained by each survey were compared using the absolute and relative difference for each indicator with 95% confidence interval and graphical methods
- Using a combination of absolute and relative differences, NCD indicators were classified as having high, moderate, low, or very low agreement between NCD-MPS and WHO STEPS
  - E.g. Indicators with absolute difference >15% or relative difference <0.3 or >3.0 were considered very low
- Explored effect modification on NCD indicators by age, sex, and education

CLASSIFICATION OF AGREEMENT

STEPS indicator of p≥ 10%

Absolute Difference	Agreement
≤ 5%	High
> 5% and ≤ 10%	Moderate
> 10% and ≤ 15%	Low
> 15%	Very Low

STEPS indicator of p< 10% or means

Ratio of Estimates	Agreement
≥ 0.7 and ≤ 1.4	High
(≥ 0.5 and < 0.7) OR (>1.4 and ≤ 2.0)	Moderate
(≥ 0.3 and < 0.5) OR)>2.0 and ≤ 3.0)	Low
<0.3 or > 3.0	Very Low

- Large sample size → detect small significant difference between indicators, but not 'clinically significant'

DISPOSITION CODES

Disposition	Ecuador n= 50,740	Sri Lanka n= 131,140	Morocco n= 326,359	Zambia n= 339,073	Mumbai n= 401,278	Malawi n= 238,569
Complete Interview	2254 (4.5%)	2868 (2.2%)	1454 (0.5%)	3397 (1.0%)	2102 (0.5%)	3693 (1.6%)
Partial Interview	847 (1.7%)	1498 (1.1%)	2061 (0.6%)	2659 (0.8%)	1316 (0.3%)	2121 (0.9%)
Breakoff: Eligible	233 (0.5%)	3878 (3.0%)	389 (0.1%)	450 (0.1%)	5337 (1.3%)	494 (0.2%)
Ineligible: Underage	466 (0.9%)	2144 (1.6%)	69 (0.02%)	1816 (0.5%)	2068 (0.5%)	2504 (1.1%)
Ineligible: Quotas	1593 (3.1%)	11892 (9.1%)	5057 (1.6%)	4688 (1.4%)	7538 (1.9%)	5074 (2.1%)
Ineligible: Non-resident					13663 (3.4%)	
Refused	3578 (7.1%)	39083 (29.8%)	253 (0.08%)	7341 (2.2%)	26215 (6.5%)	2786 (1.2%)
Breakoff: unknown eligibility	1030 (2.5%)	4642 (3.5%)	20298 (6.8%)	12035 (3.6%)	26634 (6.6%)	12936 (6.2%)
No answer	40739 (80.3%)	65135 (49.7%)	296778 (90.9%)	306687 (90.5%)	316405 (78.8%)	208962 (87.6%)
Survey outcome rates						
Contact Rate 3	6912/47651 (14.5%)	47327/112462 (42.1%)	4157/300935 (1.4%)	13847/320534 (4.4%)	34970/351375 (10.0%)	9094/218056 (4.2%)
Refusal Rate 3	3811/47651 (8.0%)	42961/112462 (38.2%)	642/300935 (0.21%)	7791/320534 (2.4%)	31546/351375 (9.0%)	3280/218056 (1.5%)
Cooperation rate 3	3101/6912 (44.9%)	4366/47327 (9.2%)	3515/4157 (84.6%)	6056/13847 (43.7%)	3418/34970 (9.8%)	5914/9194 (64.3%)
Response Rate 6 *	9.9%	9.0%	8.3%	6.3%	3.1%	7.0%

Data are n (%) or n/N (%). Contact rate #3, Refusal rate #3, Cooperation rate #3, and Response rate #6 were calculated using the standard definitions proposed by the American Association for Public Opinion Research. *
Adjusted by design. The sampling design involved two Phases. Each phase had a response rate. The final response rate was the product of Phase I and Phase II response rates.

CROSS-COUNTRY: SAMPLE CHARACTERISTICS

	Ecuador		Sri Lanka		Morocco		Zambia		Mumbai		Malawi	
	NCD- MPS	WHO STEPS	NCD- MPS	WHO STEPS	NCD- MPS	WHO STEPS	NCD- MPS	WHO STEPS	NCD- MPS	WHO STEPS	NCD- MPS	WHO STEPS
Sex												
Male	48.6 (46.8;50.4)	48.9 (47.2;50.6)	47.3 (45.8;48.8)	46.5 (45.0;48.0)	48.5 (46.5;50.5)	49.5 (47.9;51.1)	48.8 (47.3;50.3)	49.0 (47.3;50.7)	54.3 (54.3;54.3)	54.2 (52.6;55.8)	47.9 (46.4;49.4)	48.3 (44.3;52.3)
Female	51.4 (49.6;53.2)	51.1 (49.4;52.8)	52.7 (51.2;54.2)	53.5 (52.0;55.0)	51.5 (49.5;53.4)	50.5 (48.9;52.1)	51.2 (49.7;52.7)	51.0 (49.3;52.7)	45.7 (45.7;45.7)	45.8 (44.2;47.4)	52.1 (50.6;53.6)	51.7 (47.7;55.7)
Age (years)												
18-29	31.5 (29.9;33.2)	30.1 (28.4;31.8)	26.9 (26.8;27.1)	23.9 (22.5;25.4)	30.6 (28.9;32.3)	32.2 (30.6;33.9)	47.1 (45.6;48.5)	46.8 (44.8;48.9)	35.6 (35.6;35.6)	42.3 (40.3;44.4)	44.3 (42.8;45.7)	45.5 (42.9;48.1)
30-44	31.4 (29.8;33.0)	31.6 (29.9;3.2)	31.8 (31.6;32.0)	29.4 (28.1;30.7)	35.3 (33.3;37.1)	33.7 (32.2;35.2)	33.8 (32.5;35.2)	34.2 (32.3;36.2)	34.0 (34.0;34.0)	30.1 (28.6;31.6)	33.6 (32.2;35.0)	33.5 (31.2;35.8)
45-69	37.0 (35.3;38.8)	38.4 (36.5;40.3)	41.3 (41.0;41.7)	46.7 (45.2;48.2)	34.1 (32.2;36.0)	34.1 (32.7;35.5)	19.1 (17.8;20.5)	19.0 (17.6;20.4)	30.3 (30.3;30.3)	27.6 (25.7;29.7)	22.1 (20.4;23.8)	21.0 (18.8;23.4)
Education												
Up to primary	21.5 (19.4;23.6)	48.2 (44.9;51.7)	4.1 (3.2;4.9)	13.5 (12.1;15.1)	32.6 (28.3;36.8)	61.3 (58.6;64.1)	22.6 (20.0;25.2)	51.8 (48.0;56.0)	38.6 (35.9;41.3)	23.1 (19.9;26.7)	23.1 (21.2;25.1)	41.2 (36.8;46.0)
More than primary to up to secondary	43.7 (41.9;45.4)	36.2 (34.3;38.1)	36.4 (34.1;38.7)	62.0 (59.2;64.8)	41.1 (38.5;43.7)	27.7 (26.2;29.2)	36.8 (34.9;38.6)	39.9 (37.0;43.0)	16.2 (14.9;17.5)	31.4 (29.3;33.6)	56.4 (53.7;59.1)	55.7 (49.6;62.2)
More than secondary	34.8 (31.5;38.1)	15.6 (13.1;18.6)	59.5 (56.7;62.3)	24.5 (22.6;26.6)	26.3 (24.0;28.5)	11.0 (9.9;12.2)	40.6 (38.7;42.5)	8.3 (7.0;10.0)	45.3 (42.3;48.1)	45.5 (40.9;50.4)	20.5 (19.2;21.7)	3.0 (2.0;4.5)

Data are % (95%CI) and are weighted estimates for age-sex distribution of the population

SUMMARY OF FINDINGS – ECUADOR

COUNTRY OVERVIEW	
World Bank Income Category	Upper-middle
Adult Literacy	93%
Mobile Penetration	88%
Urban residents	64%

Survey	NCD MPS	WHO STEPS
Year	2020	2018
Sample Size	3,101	4,638
Response Rate	9.9%	69%
Mode	IVR	CAPI
Language	Spanish	

Population estimates convergence – high (n=13) moderate (n=6) low (n=2) very low (n=5)

Indicators – High: fruit and vegetable (7/9), tobacco use (3/8), hypertension (2/2), and alcohol consumption (1/2); Very Low: tobacco use (3/8) and salt intake (2/3)

Stratified analysis - results remained largely unchanged

Conclusion: NCD-MPS performed well in Ecuador and is recommended to be repeated, as is, in country

SUMMARY OF FINDINGS – SRI LANKA

COUNTRY OVERVIEW	
World Bank Income Category	Lower-middle
Adult Literacy	92%
Mobile Penetration	139%
Urban residents	19%

Survey	NCD MPS	WHO STEPS
Year	2021	2021
Sample Size	4,356	6,267
Response Rate	7.6%	81%
Mode	IVR	CAPI
Languages	English, Sinhala and Tamil	

Population estimates convergence – high (n=10) moderate (n=11) low (n=2) very low (n=3)

Indicators – High: in tobacco use (2/9), alcohol consumption (1/2), fruit and vegetable consumption (3/9), salt intake (1/2), hypertension (2/2), and diabetes (1/2); Very Low: fruit and vegetable consumption (2/9), and salt intake (1/2)

Stratified analysis – tobacco, alcohol and hypertension differed by sex; fruit and vegetable, salt hypertension and diabetes differed by education

Conclusion: NCD-MPS performed well in Sri Lanka and is recommended to be repeated, as is, in country

SUMMARY OF FINDINGS – MOROCCO

COUNTRY OVERVIEW	
World Bank Income Category	Lower-middle
Adult Literacy	100%
Mobile Penetration	128%
Urban residents	65%

Survey	NCD MPS	WHO STEPS
Year	2019	2017
Sample Size	3,515	5,429
Response Rate	8.3%	89%
Mode	IVR, SMS	CAPI
Languages	Arabic and French	

Population estimates convergence – high (n=9) moderate (n=6) low (n=2) very low (n=9)

Indicators – High: fruit and vegetable consumption (5/8), tobacco use (3/9), and diabetes (1/2) Very low: tobacco use (3/9), alcohol consumption (2/2), salt intake (3/3), and diabetes (1/2)

Stratified analysis – results remained largely unchanged

Conclusion: Repetitions of NCD-MPS are feasible in Morocco, although modifications to survey design are needed.

SUMMARY OF FINDINGS – ZAMBIA

COUNTRY OVERVIEW	
World Bank Income Category	Low
Adult Literacy	87%
Mobile Penetration	80%
Urban residents	45%

Survey	NCD MPS	WHO STEPS
Year	2017	2017
Sample Size	6,056	4,302
Response Rate	6.3%	74.3%
Mode	IVR, SMS	CAPI
Languages	English, Bemba, Nyanja, Tonga, Luvale, Lozi, Kaonde, Lunda	

Population estimates convergence – high (n=8) moderate (n=7) low (n=) very low (n=8)

Indicators – High: tobacco use (3/9), fruit and vegetable consumption (4/9), and salt intake (1/3) Very low: tobacco use (2/9), alcohol consumption (1/2), fruit and vegetable consumption (2/9), salt intake (2/3), and diabetes (1/2)

Stratified analysis – sex and education differences across several indicators

Conclusion: Repetitions of NCD-MPS are feasible in Zambia, although modifications to survey design are needed.

SUMMARY OF FINDINGS – MUMBAI

COUNTRY OVERVIEW	
World Bank Income Category	Low-Middle
Adult Literacy	75%
Mobile Penetration	84%
Urban residents	35%

Survey	NCD MPS	WHO STEPS
Year	2021	2021
Sample Size	3,418	5,199
Response Rate	3.1%	87%
Mode	IVR	CAPI
Languages	English, Hindi, and Marathi	

Population estimates convergence – high (n=9) moderate (n=6) low (n=2) very low (n=9)

Indicators – High: fruit and vegetable consumption (5/8), tobacco use (3/9), and diabetes (1/2) Very low: tobacco use (3/9), alcohol consumption (2/2), salt intake (3/3), and diabetes (1/2)

Stratified analysis – results remained largely unchanged

Conclusion: Repetitions of NCD-MPS are feasible in Mumbai, although modifications to survey design are needed.

SUMMARY OF FINDINGS – MALAWI

COUNTRY OVERVIEW	
World Bank Income Category	Low-Income
Adult Literacy	62%
Mobile Penetration	52%
Urban residents	17%

Survey	NCD MPS	WHO STEPS
Year	2019	2017
Sample Size	5,814	4,187
Response Rate	7.0%	82.3%
Mode	IVR	CAPI
Languages	English, Chichewa, & Tumbuka	

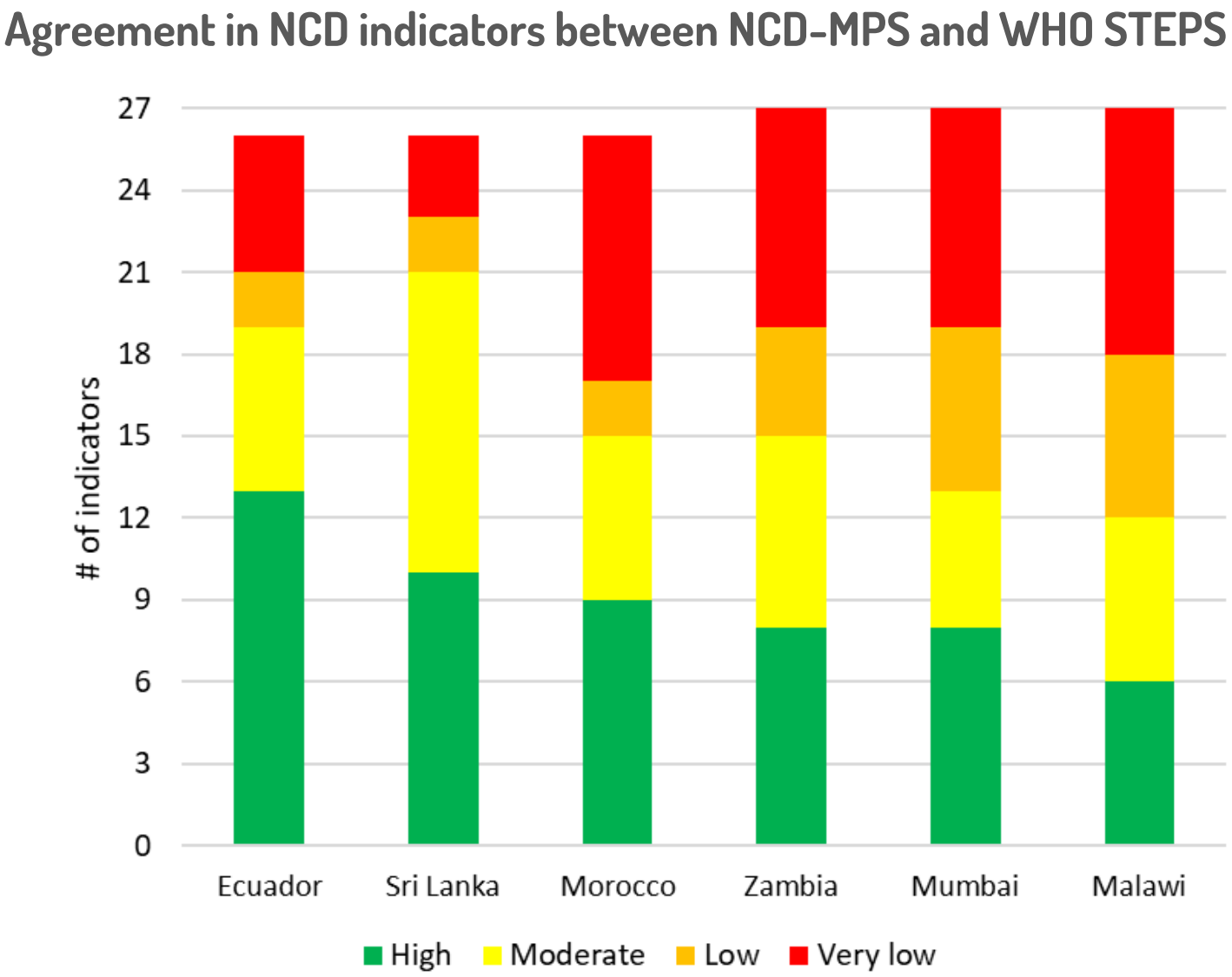
Population estimates convergence – high (n=6) moderate (n=6) low (n=6) very low (n=9)

Indicators – High: tobacco use (2/9), alcohol consumption (1/2), fruit and vegetable consumption (1/9), salt intake (1/3) and hypertension (1/2) Very Low: tobacco use (5/9), fruit and vegetable consumption (2/9), salt intake (1/3), and diabetes (1/2)

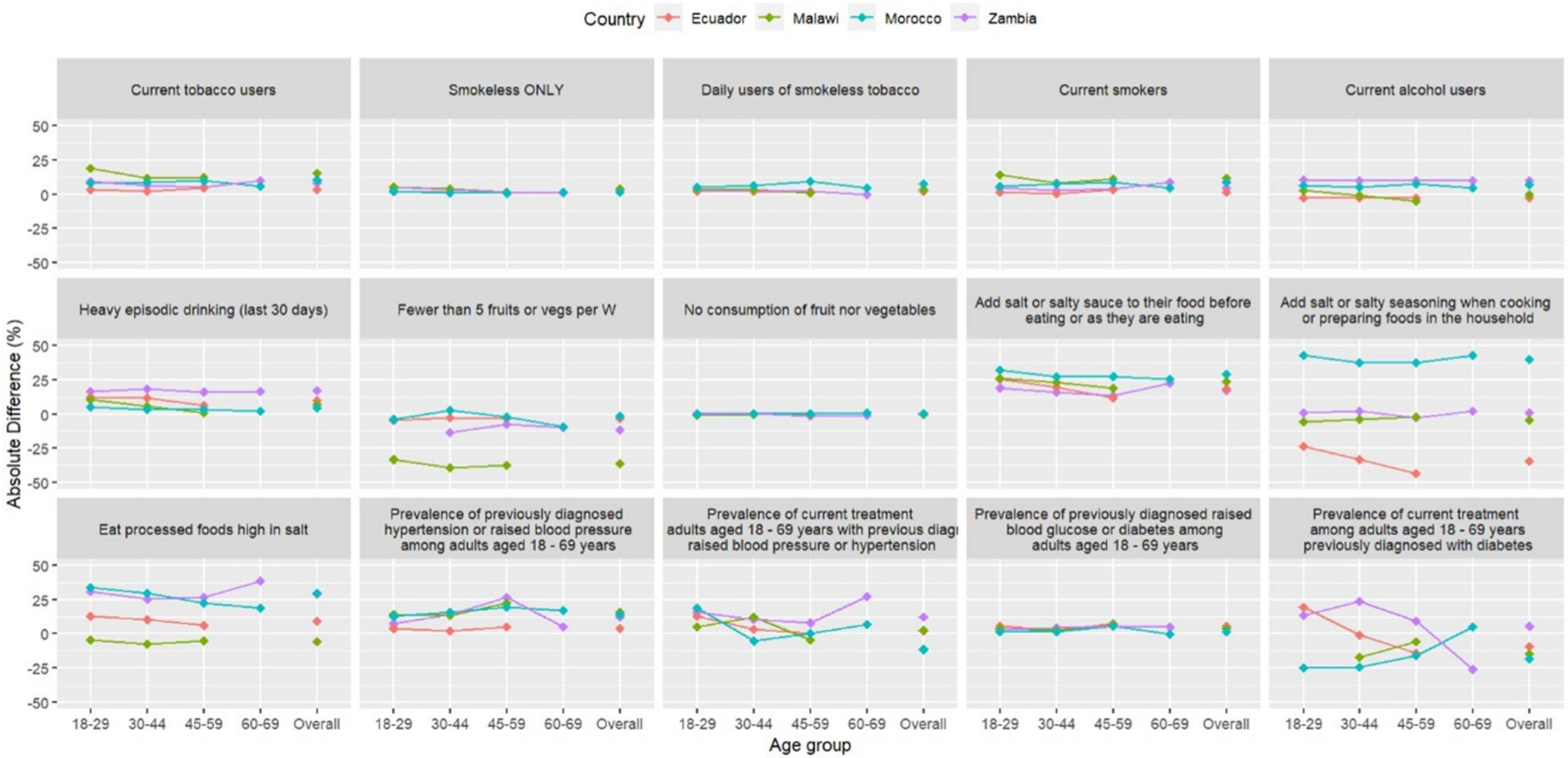
Stratified analysis – sex and age differences across several indicators

Conclusion: NCD-MPS repetitions are not currently viable (low rates of mobile phone penetration, adult literacy rate and urbanicity)

CROSS-COUNTRY: OVERALL INDICATOR AGREEMENT



CROSS-COUNTRY: AGREEMENT (Absolute Diff) BY INDICATOR



Absolute differences in NCD indicators between NCD-MPS and WHO STEPS

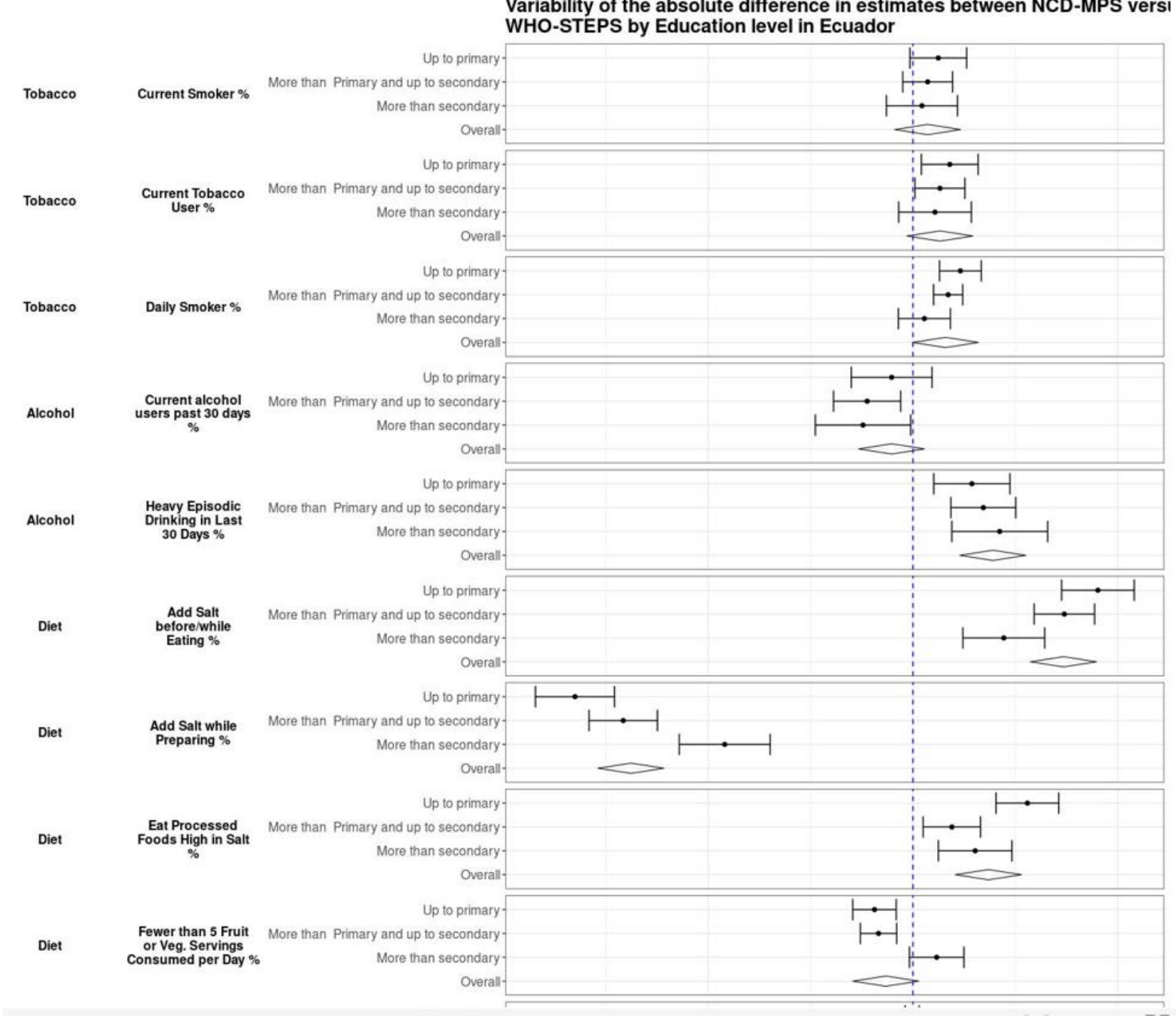
Indicator agreement by country

	Ecuador	Sri Lanka	Morocco	Zambia	Mumbai	Malawi
# of "High" Convergence Indicators	13	20	10	9	8	6
# of "High/Mod" Convergence Ind.	19	21	16	16	13	12
Mobile subscriptions/100	88	141	128	78	84	47
GNI per capita	$5,530	$3,666	$3,020	$1,160	$1,900	$580
Adult Literacy Rate (+15 years)	93.0	92.4	100.0	86.7	74.4	62.2
Current smokers						
Current users of smokeless tobacco						
Daily users of tobacco						
Daily smokers						
Daily users of smokeless tobacco						
Current tobacco users						
Smoke ONLY						
Smokeless ONLY						
Both smoked AND smokeless						
Current drinker						
Heavy episodic drinking						
Poor fruit and diet						
No consumption of fruit/veg						
Mean servings fruit/veg/day						
No consumption of fruit						
Mean servings of fruit/day						
Mean days fruits/week						
No consumption of veg						
Mean servings of veg/day						
Mean days veg/week						
Add salt while eating						
Add salt while cooking						
Eat processed foods high salt						
Hypertensions dx						
Hypetension trt						
Diabetes dx						
Diabetes trt						

High
Moderate
Low
Very Low

Estimates by age, sex, education

Some differences, no obvious trends/patterns



CONCLUSIONS

- This is one of the first studies to compare risk factor estimates collected from IVR surveys and face-to-face interviews using nationally representative surveys in various low- and middle-income country settings
- Although all the countries studied are LMICs, their geographic, cultural, and socioeconomic contexts are different, which could explain some of the discrepancies found in survey estimates between countries, as well as the differences between the modalities in all the studied countries
- IVR estimates for NCD indicators typically higher than household estimates.
- Although the sample size of countries (n=6) in our study does not allow making global inferences, in our analysis the two countries with the best socioeconomic indicators and best macro health indicators are the same countries with less differences in the estimates obtained between MPS and STEPS

CONCLUSIONS

Potential drivers of the divergence between MPS and STEPS estimates could include:

1. Demographic characteristics of the fielded population, specifically differences in educational attainment.
2. Structural characteristics, such as mobile phone penetration, urbanicity, adult literacy rate, GNI per capita, of the countries where the surveys were conducted.
3. Extremely low prevalence for certain indicators.
4. Differences in question format, eg: tobacco questions in MPS did not contain a filtering question like STEPS
5. Social desirability, especially for those indicators that evaluate information that could be deemed as sensitive by the participant (e.g. alcohol consumption).
6. The presence of exogenous variables related to both the outcome and participation in the survey, which can lead to a possible selection bias.

MOVING FORWARD

- IVR surveys are unlikely to yield population representative estimates in countries with low mobile phone penetration like Malawi due to high coverage bias.
- More efforts are needed to make MPS surveys more representative at a national level in LMICs where these surveys would be more useful in real-world conditions.
  - This could include adjustments to the sampling plan to include additional demographic variables such as geography, or urban-rural residency or education where such data are available.
- Continue to explore revisions to the core NCD-MPS questionnaire. Some NCD indicators had NCD-MPS and WHO STEPS estimates that were consistently divergent across the six countries.
- Continue to explore sampling strategies where STEPS collects phone numbers from the household samples and for these to be used as the sampling frame for an MPS survey.
- Consider use of alternative survey modalities (e.g., CATI).