

# Measurement of handwashing behaviour in Multiple Indicator Cluster Surveys and Demographic and Health Surveys, 1985–2008

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*With this paper, we aim to describe handwashing worldwide, as measured in Multiple Indicator Cluster Surveys (MICS) and Demographic and Health Surveys (DHS) in low- and middle-income countries between 1985 and 2008, and to explain the strengths, weaknesses and evolution of this data collection to inform future survey development.*

*We searched reports of DHS and MICS conducted before 2009 and analysed data on handwashing measurements. We examined data according to geographic region, as well as demographic characteristics such as wealth quintile, education of the household head, and rural/urban location.*

*Before 2009, eight MICS and 40 DHS included handwashing-related measurements, using a variety of self-reports and rapid observations. Internal triangulation of findings from surveys that collected multiple types of measurement shows that self-reports to closed questions overestimate behaviour. Observation-based data suggest low handwashing rates in many low- and middle-income countries with high prevalence of water and sanitation-related diseases, and high inter- and intra-country disparities. However, due to the widely disparate nature of the pre-2009 handwashing-related measurements, much of the data cannot be compared between countries, and only an incomplete picture of global rates can be formed.*

*Efforts to increase the prevalence of handwashing with soap and water need to be strengthened in many low- and middle-income countries, especially among poorer, rural populations and where the household head has less formal education. Closed questions asking for self-reports of handwashing behaviour should be avoided. Findings support instead the inclusion of uniform observation-based measurements, as were integrated as core modules of MICS and DHS in 2009.*

**Keywords:** handwashing, hygiene, soap, surveys, monitoring

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<http://dx.doi.org/10.3362/1756-3488.2015.028>, ISSN: 0262-8104 (print) 1756-3488 (online)

## Introduction

Pneumonia and diarrhoea are the leading causes of child mortality worldwide (Liu et al., 2012). Hand hygiene interventions can reduce gastrointestinal illnesses such as diarrhoea by up to 42 per cent and acute respiratory infections (ARI) by up to 34 per cent (Aiello et al., 2008). Handwashing with soap has also been shown to be associated with reduced neonatal mortality (Rhee et al., 2008) and skin infections (Luby et al., 2005). Handwashing with soap may be one of the most cost-effective interventions to improve public health.

Measuring people's handwashing behaviour is critical to understanding its impact on health. An understanding of handwashing behaviour at the global, national and sub-national levels would help explain the variability of gastrointestinal illnesses, ARI, neonatal mortality, and skin infections, and enable governmental and international organizations to prioritize funding and implementing handwashing promotion programmes.

But measuring handwashing behaviour can be extremely challenging. Nationally representative assessments in countries with high burdens of diarrhoea and ARI-related deaths have not typically been reported in the peer-reviewed literature. Most surveys of handwashing behaviour have been conducted at a small scale, in only a handful of communities. The various data collection methods each have unique validity issues: for example, observations of behaviour suffer substantial reactivity to the presence of the observer (Ram et al., 2011) as well as being impractical at a nationally representative scale. A study of 33 practical handwashing indicators found that only five were independently associated with reduced child diarrhoea or respiratory disease: mothers who, when asked opened questions about washing hands with soap, reported doing so before feeding a child; mothers who, when asked to demonstrate their usual handwashing after defecation, 1) used soap or 2) allowed their hands to air dry; children having visibly clean finger pads; and the observed presence of water where the respondents usually washed hands after defecation (Luby et al., 2011). The presence of soap at the place for handwashing is also associated with reduced disease risk (Luby and Halder, 2008).

Two major nationally representative cross-sectional survey programmes represent an opportunity to collect data that would allow this analysis: the UNICEF-supported Multiple Indicator Cluster Surveys (MICS) and the USAID-supported Demographic and Health Surveys (DHS). These surveys are conducted generally at regular intervals in low- and middle-income countries, and serve as the principal source of nationally representative maternal and child health data at the household level for many of those countries. Since the first DHS survey was implemented in 1985, more than 500 DHS and MICS surveys have been carried out in over 100 countries.

Each survey in each survey network has the same core modules in order to collect comparable data on maternal and child health and demographics, but the core modules are refined between rounds of surveys and questions of unique interest to the survey country are sometimes added. Handwashing measurements became

part of the core DHS and MICS survey modules in 2009. However, a number of low- and middle-income countries had previously integrated questions to assess handwashing behaviour.

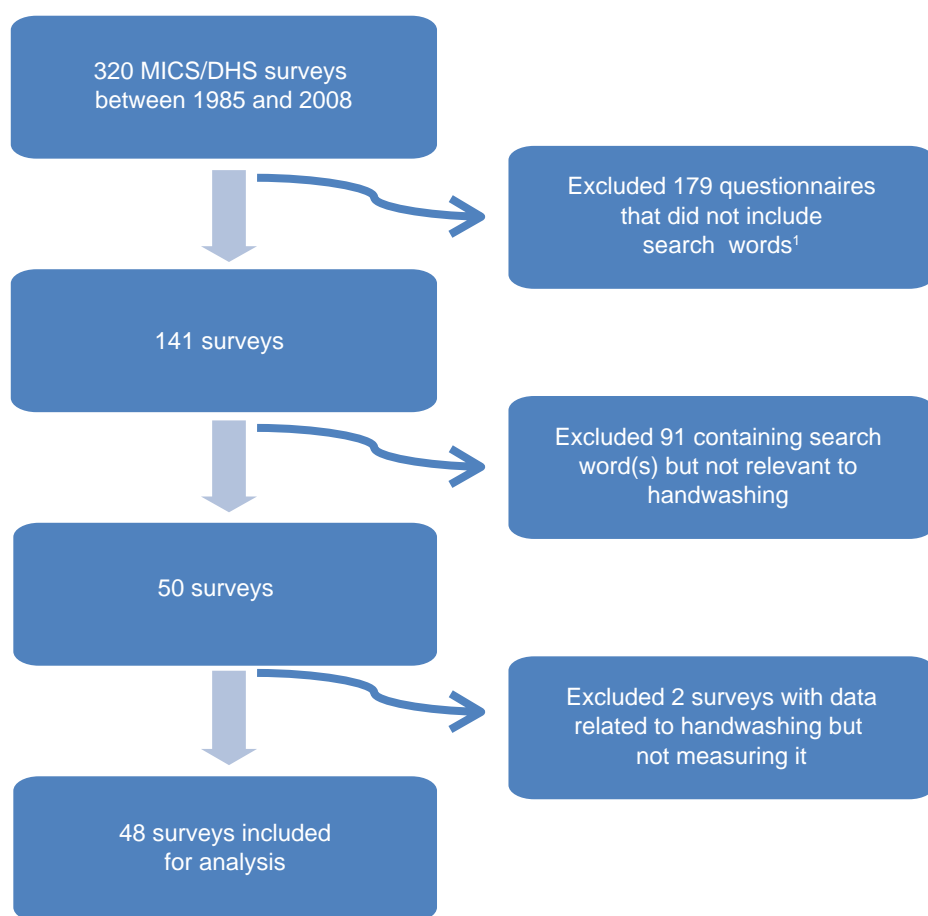
This article provides the first systematic analysis describing the findings on handwashing collected worldwide by these survey networks and documenting data collection issues that should be avoided in future data collection. The authors aim to describe handwashing worldwide, as measured in MICS and DHS in low- and middle-income countries between 1985 and 2008, and to explain the evolution of this data collection in order to help prevent the replication of problematic methodology in future collection efforts. This article is based on a review of all pre-2009 MICS and DHS reports, and will be followed by a subsequent article by the authors on the standardized set of data collected since the core modules integrated handwashing measurement in 2009.

## Methods

We downloaded the questionnaires of all MICS and DHS reports with data collected prior to 2009 available on the survey networks' respective websites. The lead author (Loughnan) conducted a computerized word search of each report for the following English, French, and Spanish words: 'soap', 'savon', 'jabon', 'wash', 'lavar', 'laver', 'limpiar', 'nettoyer', 'hands', 'mains' and 'manos'. Reports that were not electronically searchable were visually inspected.

We excluded questionnaires that mentioned one or more of the words solely in reference to topics other than handwashing, for example in reference to washing clothes or to using hands in the context of child discipline (see Figure 1). We also excluded questionnaires that referred to handwashing only in asking respondents about their water sources: 'What is the main source of water used by your household for other [non-drinking] purposes such as cooking and handwashing?', since the data collected using these questions could not be disaggregated to obtain handwashing-related information specifically. The Somalia 2006 MICS listed 'wash hands before collecting water' as a possible response category to a question asking what people do to prevent drinking-water contamination. The Liberia 1986 DHS asked whether the respondent had purchased soap (among other things) in the past four weeks. The primary purpose in collecting these two measurements was not clearly related to handwashing, and thus these surveys were excluded.

We extracted and collated all information on handwashing behaviour or cleansing materials used to wash hands from each survey report accompanying a questionnaire that met the inclusion criteria. We analysed the survey questionnaires for identical or approximate measurements to determine which surveys used comparable questions to collect handwashing data. We categorized the measurements by type (see Table 1), and then ordered the entire set chronologically to see if any changes in the measure over time were discernible. All analyses are based on unit data and incorporate the appropriate sampling



**Figure 1** Inclusion of MICS and DHS in systematic analysis of handwashing-related measurements, 1985–2008

Note: <sup>1</sup> The following search words were used: ‘soap’, ‘savon’, ‘jabon’, ‘wash’, ‘lavar’, ‘laver’, ‘limpiar’, ‘nettoyer’, ‘hands’, ‘mains’ and ‘manos’.

and population weights to generate population-weighted rates of relevant handwashing indicators.

DHS and MICS typically collect data on a number of potential sources of disparity, such as wealth, level of education, religion, and geographic region (urban/rural, sub-national region), and a number of indicators that handwashing data could be correlated with, such as the main source of drinking water. We explore possible correlations by describing the rates disaggregated by education status, sub-national region, wealth quintile, urban and rural location, and availability of piped water on premises. Regions referred to in this article are defined by the United Nations Children’s Fund (UNICEF, 2012).

**Table 1** Date and type of handwashing-related measurements in MICS and DHS, 1985–2008

Country	Closed questions of respondent's-household having handwashing items* or a place for handwashing	Closed questions collecting respondent's behavior after their or their child's toileting†	Closed questions collecting respondent's behavior before food preparation/ eating/feeding*	Closed or open questions collecting reports of respondent's behavior (other)‡	Closed questions collecting reports of other's behavior* behavior	Closed or open questions collecting reports of respondent's knowledge	Observation of soap* in household	Observation of household's handwashing place, and the presence there of soap/other local cleaning agent and water
<b>1986–1990</b>								
Dominican Republic DHS 1986	•							
Burundi DHS 1987	•							
<b>Mali DHS 1987</b>	•							
Thailand DHS 1987	•							
Trinidad & Tobago DHS 1987	•							
Kenya DHS 1989	•							
<b>Uganda DHS 1988–89</b>	•							
<b>1991–1995</b>								
<b>Yemen DHS 1991–92</b>								
Turkey DHS 1993	•				•			
<b>1996–2000</b>								
<b>Senegal MICS 1996</b>		•						
<b>Yemen DHS 1997</b>		•						
Kazakhstan DHS 1999			•					•

Country	Closed questions of respondent's report of household having handwashing items* or a place for handwashing	Closed questions collecting respondent's behavior after their or their child's toileting†	Closed questions collecting respondent's behavior before food preparation/ eating/feeding *	Closed or open questions collecting reports of respondent's behavior (other)‡	Closed questions collecting reports of other's behavior*	Closed or open questions collecting reports of respondent's knowledge	Observation of soap# in household	Observation of household's handwashing place, and the presence there of soap/other local cleaning agent and water
Zimbabwe DHS 1999		•	•					•
<b>Egypt DHS 2000</b>								•
Ethiopia DHS 2000		•	•					
<b>Malawi DHS 2000</b>		•	•					•
Namibia DHS 2000			•					
Rwanda DHS 2000		•	•					•
Turkmenistan DHS 2000								•
Yugoslavia MICS 2000					•			
<b>2001–2005</b>								
Armenia DHS 2001								•
<b>Benin DHS 2001</b>			•					•
<b>Mali DHS 2001</b>			•					•
<b>Nepal DHS 2001</b>			•					
Nicaragua DHS 2001			•	•		•		
<b>Uganda DHS 2001</b>								•
Burkina Faso DHS 2003								•
<b>Egypt DHS 2003</b>								•

(Continued)



Country	Closed questions of respondent's-report of household having handwashing items* or a place for handwashing	Closed questions collecting report of respondent's behavior after their or their child's toileting†	Closed questions collecting reports of respondent's behavior before food preparation/ eating/feeding *	Closed or open questions collecting reports of respondent's behavior (other)‡	Closed questions collecting reports of other's behavior*	Closed or open questions collecting reports of respondent's knowledge	Observation of soap# in household	Observation of household's handwashing place, and the presence there of soap/other local cleaning agent and water
<b>Indonesia DHS 2007</b>			•					
Jordan DHS 2007					•			
Mauritania MICS 2007	•				•			
Swaziland DHS 2006–07			•					
<b>Egypt DHS 2008</b>						•		

Note: Countries with multiple pre-2009 surveys are bolded.

# These measurements either focused exclusively on soap or expanded to also include washing powder/liquid. None except Nigeria DHS 2003 also collected data on alternative local cleansing products such as ash.

‡ Some of these measurements were specifically about handwashing with soap, others also considered handwashing with other materials such as ash, and others did not define handwashing.

\* These measurements did not mention any specific handwashing material, except Somalia MICS 2006, Mali DHS 2006 and Mauritania MICS 2007.

^ This measure differed somewhat from the column heading. It was based on the observation of a place for handwashing with water outside toilet



## Results

### *Nationally representative household survey data*

Between 1985 and 2008, 320 MICS and DHS were conducted. Of these, 48 (15%) collected measurements of handwashing (see inclusion criteria in Figure 1). Of these, 26 were conducted in sub-Saharan African countries; six in the Middle East/North Africa; five each in East Asia/Pacific region and in Central and Eastern Europe/Commonwealth of Independent States; and three each in Latin America/Caribbean and South Asia. Eight of the 48 surveys were MICS and the remainder DHS surveys.

Measurements of handwashing behaviour included respondent reports of handwashing materials in the household that were not verified through visual inspection (10 surveys), self-reports of behaviour (29 surveys), or knowledge (two surveys) (see Table 1). Proxy measures included observations of the household's place for handwashing and materials found there (18 surveys) and observation of soap anywhere in the household (one survey) (see Table 1).

In the course of collecting data on handwashing, enumerators in 18 surveys mentioned 'soap' or 'soap (washing powder/liquid)' (examples provided in Table 2). For example, enumerators in Gambia MICS 2005–06 asked, 'Do you use soap after toilet or when you remove waste/faeces from children?'. In no questionnaire was the enumerator directed to also mention local alternative cleansing products, such as ash or mud, for consideration, but 12 surveys did list them as possible response categories.

In nine countries, handwashing was measured in multiple survey rounds. Thirteen surveys measured handwashing behaviour in multiple ways.

### *Shifts in type of handwashing measurement*

Some general shifts in the measurement type are discernible over time. All seven surveys that collected information on handwashing before 1990 obtained self-reported data on whether the interviewee had soap on the premises, and only three subsequent surveys did.

Eight surveys included self-reported information on handwashing after toileting or cleaning a child who had defecated, mainly between 1996 and 2000. Sixteen surveys, mainly between 1999 and 2005, included a self-report of the respondent's handwashing behaviour before food preparation, feeding, or eating. Data from nine of them were readily comparable, all conducted since 2000.

A direct observation of the place for handwashing was added for the first time to two surveys in 1999. From then until the end of 2008 over half the surveys with handwashing measurements included observations of the handwashing place (18 of 30). Among the 11 sub-Saharan Africa surveys with comparable observational data, 10 allowed for disaggregation by education level of the household head (see Figure 2) and four allowed for disaggregation by wealth quintiles (Figure 3). Due to low data availability for other regions, and the high prevalence of water and sanitation-related diseases in sub-Saharan Africa, our cross-country comparisons below focus on sub-Saharan Africa.

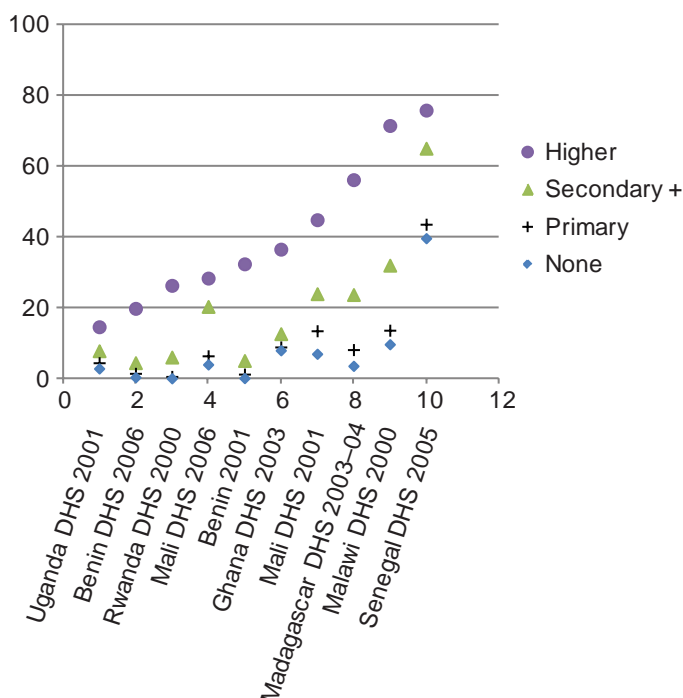
**Table 2** Examples of the most common approaches to measuring handwashing in MICS and DHS, 1985–2008

<i>Used in five surveys 1999–2000</i> (Kazakhstan DHS 1999, Turkmenistan DHS 2000, Zimbabwe DHS 1999, Benin DHS 2001, and Rwanda DHS 2000)	
Does your household have any place which is used for handwashing?	YES NO
ASK TO SEE THE PLACE USED MOST OFTEN FOR HANDWASHING AND OBSERVE IF THE FOLLOWING ITEMS ARE PRESENT	WATER/TAP SOAP, ASH OR OTHER WASHING AGENT BASIN
<i>Used in five surveys 2000–03</i> (Malawi DHS 2000, Senegal DHS 2005, Ghana DHS 2003, Mali DHS 2001, and Uganda DHS 2001)	
Where do you usually wash your hands?	IN DWELLING/YARD/PLOT SOMEWHERE ELSE NOWHERE
ASK TO SEE THE PLACE AND OBSERVE IF THE FOLLOWING ITEMS ARE PRESENT	WATER/TAP SOAP, ASH OR OTHER CLEANSING AGENT BASIN
<i>Used in nine surveys 2000–07</i> (Benin DHS 2001, Indonesia DHS 2007, Mali DHS 2006, Madagascar DHS 2003–04, Mali DHS 2001, Nicaragua DHS 2001, Philippines DHS 2003, Indonesia DHS 2003–04, and Guinea DHS 2005)	
The last time you prepared a meal for your family, before starting did you wash your hands?	YES NO NEVER PREPARED MEAL
<i>Used in three surveys 1999–2000</i> (Zimbabwe DHS 1990, Malawi DHS 2000, and Rwanda DHS 2000)	
The last time you had to clean (your child/one of your children) after he/she defecated, did you wash your hands immediately afterwards?	YES NO NEVER CLEANED CHILD(REN)

***Differences between findings by measurement type***

In the 13 surveys which measured handwashing behaviour in multiple ways, we found substantial inconsistency between self-reported behaviour and the observation of handwashing materials. For example, in Zimbabwe DHS 1999, among households with a child under five years of age, 84 per cent of caregivers said they washed their hands immediately before they last fed their children; however, only 22 per cent actually showed survey personnel a place for handwashing with water. In Mali 2006 DHS, among households that reported they had a place for handwashing on the premises and where the majority of household members washed their hands with soap when they left the toilet, only 41 per cent were observed to actually have soap or another cleansing product at their place for handwashing.

The most recent self-reported data of the respondent's handwashing behaviour before food preparation, feeding, or eating is from Indonesia DHS 2007, where



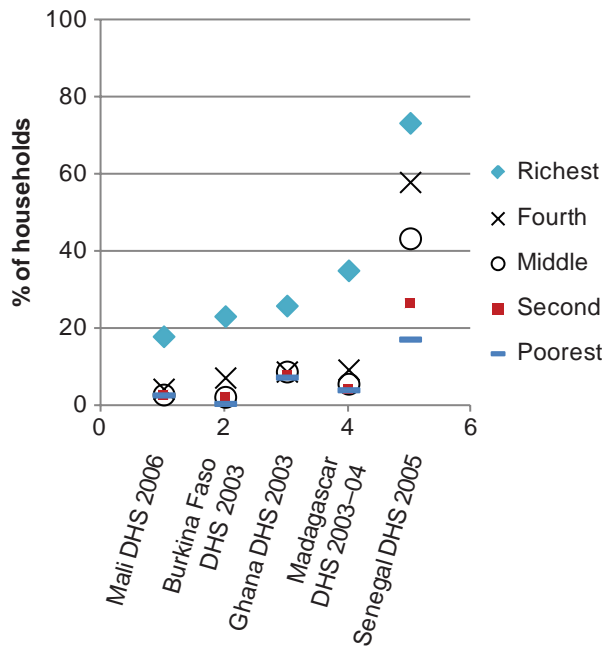
**Figure 2** Percentage of households observed to have a place for handwashing with both water and soap/other local cleansing product present, by education level of the household head, sub-Saharan Africa, 2000–06

97 per cent of respondents reported that they washed their hands before preparing their family's most recent meal.

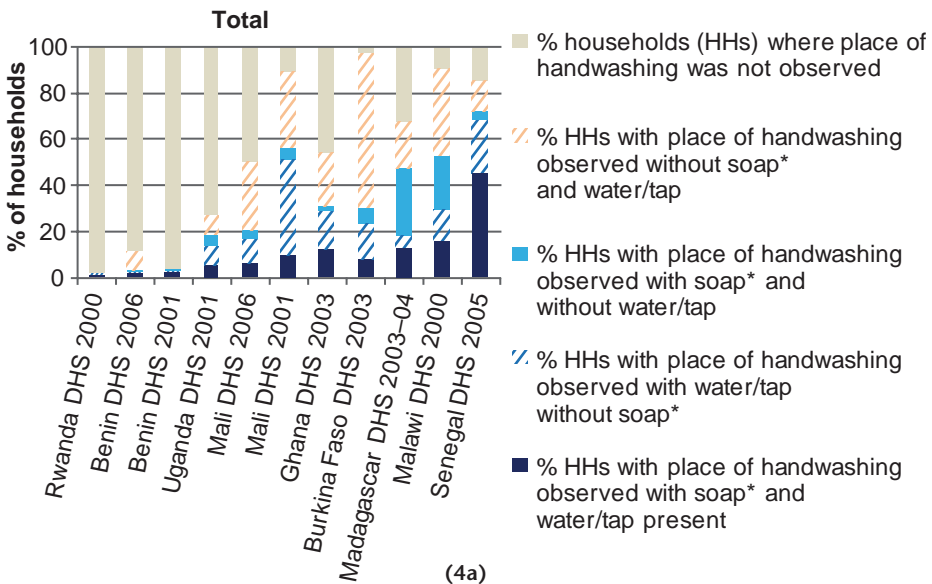
### *Differences between countries and sub-populations*

Stark inter- and intra-country differences were identified. For example, among the 11 comparable measurements collected in sub-Saharan Africa: in Burkina Faso, only 3 per cent of households did not have an observed place for handwashing; in Rwanda, 98 per cent did not (Figure 4a). In Burkina Faso, although 97 per cent of households had an observed place for handwashing, 67 per cent were still missing a vital component of handwashing: 'water/tap' or 'soap, ash or other cleansing product'. None of these 11 sub-Saharan surveys checked for the availability of soap or other cleansing products elsewhere in the household.

Across these 11 countries, a population-weighted average of 22 per cent (range: 7–59%) of the urban population and 8 per cent (range 0–31%) of the rural population had an observed place for handwashing with 'water/tap' plus soap or an alternative cleansing product present (Figures 4b and 4c). Prevalence was highest in Senegal in both urban and rural areas. The two countries in which the question was asked somewhat differently (Rwanda and Benin) were found to have substantially lower frequencies of households with a designated handwashing station (Figures 4a, 4b and 4c).

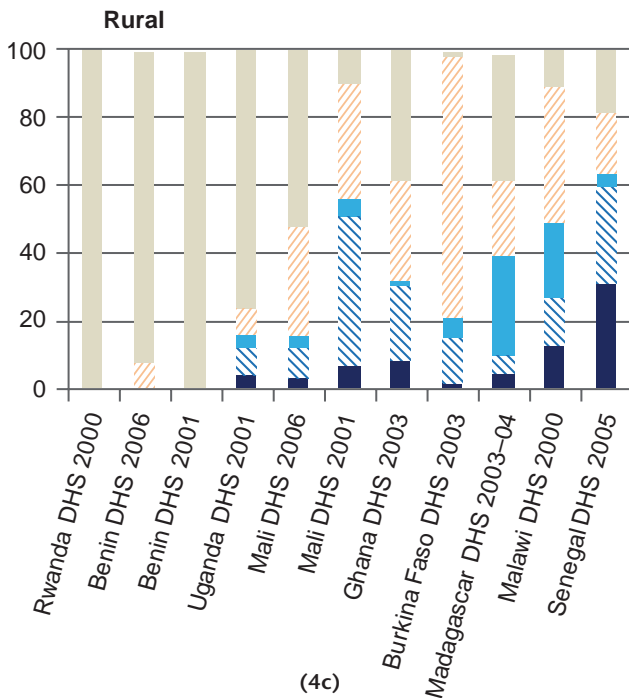
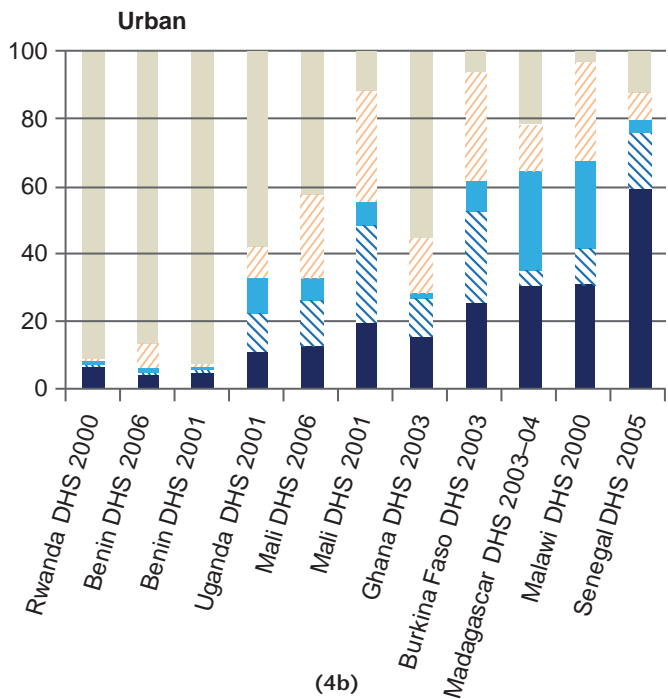


**Figure 3** Percentage of households with an observed place for handwashing, with water and a cleansing product present, by wealth quintile, sub-Saharan Africa, 2003–06

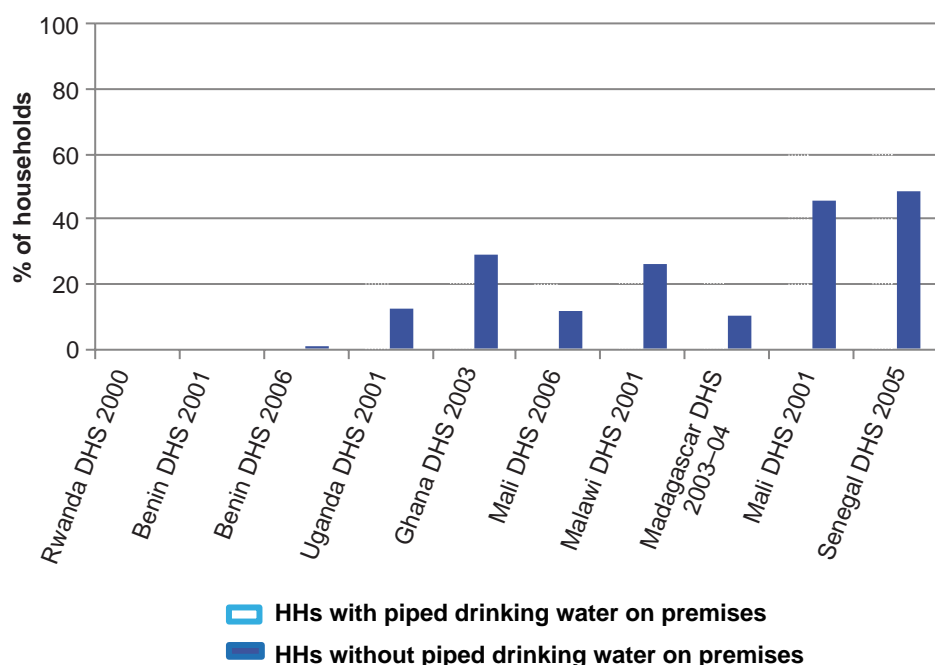


(4a)

**Figure 4** Percentage of total (4a), urban (4b), and rural (4c) households with a place for handwashing observed by presence of a cleansing product, water or both, sub-Saharan Africa 2000–06  
\* Soap, ash or other cleansing product (continued).



**Figure 4** Percentage of total (4a), urban (4b), and rural (4c) households with a place for handwashing observed by presence of a cleansing product, water or both, sub-Saharan Africa 2000–06  
\* Soap, ash or other cleansing product.



**Figure 5** Percentage of households where handwashing place was observed to have water, among those households with and without piped water on premises, in all sub-Saharan African countries with comparable prior to 2009 data

Among the 10 comparable sub-Saharan Africa surveys allowing disaggregation by education level of the household head or disaggregation by wealth quintiles, the Senegal data stood out in both analyses, showing relatively high percentages of households with an observed place for handwashing, with water and a cleansing product present in each wealth quintile and education level.

In calculating the proportion of households with water at a handwashing place separately for households that had piped water on the premises and those that did not, we found that households with water piped on premises were more likely than those without to have an observed handwashing place with water, with proportions of households with water at a handwashing place 14 percentage points (range 0–29) higher in households with piped drinking water on premises, compared to those without (Figure 5).

### *Prevalence over time*

In the nine countries where handwashing was measured in multiple survey rounds, the earlier and latter measurements were readily comparable in terms of interview methodology in only three: Mali, Benin, and Egypt. In Mali and Benin, less than 10 per cent of households in each of the successive surveys were observed to have a place of handwashing with water/tap and a cleansing product such as soap or ash. In Egypt the rate was 73 per cent in 2000 and 70 per cent in 2003.

## Discussion

### *Use of prevalence data for strategizing handwashing campaigns*

In this first systematic analysis of handwashing measurements in DHS and MICS spanning more than two decades and several hundred surveys, we found evidence suggesting low handwashing rates in many low- and middle-income countries with high rates of childhood pneumonia, diarrhoea, and mortality. For example, Benin, Burkina Faso, and Mali are among the 30 countries with the highest under-5 mortality rates according to the UN Inter-agency Group for Child Mortality Estimation (2012), and all were found to have very low rates of handwashing in MICS and DHS. Stark inter- and intra-country differences existed, with prevalence lower in rural than urban areas, among poorer than richer households, and among less educated than more educated households.

Analysis of these disparities in the observational DHS and MICS data suggests where targeted handwashing promotion could reduce morbidity and mortality by the highest degree. Our analysis also makes clear that although the percentage of households with all necessary materials for handwashing is generally low, a high proportion of households may be missing just one of the necessary materials. For example, data from the Mali 2001 DHS suggest that soap provision alone could have provided an essential component of handwashing for 44 per cent of rural households. As additional surveys since 2009 collect rapid observations for some of the same countries, their results can be used to detect changes over time, as we attempted here for Benin, Mali, and Egypt. This analysis would be useful to handwashing campaign strategists today.

### *Hierarchy of measurement types*

Self-reporting is an efficient approach to collecting information and is thus widely used in large surveys. A comparison between direct observations of households' place for handwashing and self-reported data in surveys that collected both types of measurement (for example Zimbabwe DHS 1999 and Mali DHS 2006) calls into question the validity of self-reports as indicators of handwashing behaviour. The implausibly high prevalence of handwashing materials self-reported in Indonesia DHS 2007 also suggests that self-reported data on the availability of materials for handwashing suffer from over-reporting. Other researchers have also found that asking people to report their own hygiene behaviour invites substantial bias including systematic overestimation (Halder et al., 2010; Ram, 2013). In one study using closed questions, 26 per cent of female caregivers reported that they used soap before preparing food but only 1 per cent were observed to do so (Danquah, 2010).

Although observation of the household's place for handwashing is a proxy indicator and does not demonstrate for certain that people are washing their hands, it represents a more reliable, valid and efficient indicator for measuring handwashing behaviour than asking individuals to report their own behaviour (Ram, 2013). The presence of soap at the place for handwashing indicates that the

necessary tools for handwashing are present in the same place, and is associated with reduced disease risk (Luby and Halder, 2008). Observed presence of water at the most convenient place to wash hands also has been found to be associated with reduced acute respiratory illness (multivariate OR 0.84 [0.70, 0.99]) (Luby et al., 2011).

### ***Harmonization and rollout of measurement since 2009***

In 2008-09, extensive discussions were held between the Monitoring Group of the Public Private Partnership on Handwashing, UNICEF, MeasureDHS, and USAID to review the evidence base for the best measurements to assess or approximate handwashing behaviour using a household survey approach. After an extensive vetting process among technical experts, the MICS and DHS included an observation of the household's place of handwashing as standard in all subsequent surveys beginning in late 2009. MICS surveys now also include an observation of the presence of soap anywhere in the home. With the inclusion of these indicators in the MICS and DHS, globally comparable data related to handwashing are now becoming available.

### ***Study limitations***

This analysis has some limitations, including that the keywords were searched for only in English, Spanish and French. The MICS and DHS questionnaires published in other languages such as Russian and Arabic may have also collected handwashing measurements. The authors had to rely heavily on careful study of the data and questionnaires as the basis for their data interpretation, as information on the training of enumerators was not readily available given the time that has lapsed since the study period.

This study points to correlation through descriptive analyses and does not include controlling for possible confounders. The relationships explored could be quantified with greater precision through more statistical methodology, but this is beyond the scope of this article.

## **Conclusion**

Despite its substantial potential to impact public health, handwashing was not prioritized for standardized measurement in large nationally representative surveys such as MICS and DHS prior to 2009. Through internal triangulation of data from surveys (Zimbabwe DHS 1999 and Mali DHS 2006) that collected multiple types of handwashing measurement, our analysis confirms that self-reported behaviour, while efficiently collected, is invalid. Observation-based data suggest low handwashing rates in many low- and middle-income countries with high prevalences of water and sanitation-related diseases, particularly among the poorest rural residents. As well as being used to inform handwashing interventions for targeted areas where the necessary components of handwashing are missing and related



diseases are common, this data can be used to track changes in the availability of handwashing materials over time. Our findings underscore the need for inclusion of standard observation-based indicators in large-scale household surveys such as MICS and DHS. Globally comparable indicators on handwashing can serve as metrics for measuring progress on this health behaviour that is essential to achieving child mortality reduction goals.

## Acknowledgements

This work was supported by UNICEF on behalf of the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation ([www.wssinfo.org](http://www.wssinfo.org)).

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