Prevalence of Antibiotic Use and Household Water-Sanitation Risk Factors of Acute Watery Diarrhea Among Children <5 Years: A Retrospective Analysis of Multicounty Health Survey Data, 2006-2018

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Research Article

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Abstract

A total of 12,69,944 under five years Children were included in this study among them 1,80,067 Children were acute watery diarrhea (AWD) and 19,502 Children were bloody diarrhea respectively. Among them, 47,755 Children were taken antibiotic treatment for AWD. The overall prevalence of acute watery diarrhea ~ 14% (prevalence = 0.142; 95% CI = 0.141, 0.142). On the other hand the prevalence of bloody diarrhea ~ 2% (prevalence = 0.015; 95% CI = 0.015, 0.016). The prevalence of antibiotic treatment for AWD was ~ 27% (prevalence = 0.27, 95% CI = 0.26, 0.27) among the under five years old children in DH survey regions in the world. The prevalence of acute watery diarrhea was higher ~ 17% (prevalence = 0.17, 95% CI = 0.16, 0.17) in the Latin America DHS survey region. The minimum prevalence of AWD was almost equal between South East Asia and Central Asia DHS survey regions ~ 12% (prevalence = 0.12, 95% CI = 0.11, 0.12) and ~ 12% (prevalence = 0.12, 95% CI = 0.10, 0.13) respectively. On the other hand the prevalence of AWD between Europe and West North and Central Africa DHS survey regions ~ 16% (prevalence = 0.16, 95% CI = 0.15, 0.16) and ~ 15% (prevalence = 0.15, 95% CI = 0.14, 0.15) correspondingly. In the central Asia of 15,089 under five Children were included in the survey. Among them 1,748 Children were AWD and 967 Children had taken antibiotic treatment for AWD. The highest prevalence of antibiotic use for AWD in Central Asia ~ 55% (prevalence=(967/1748) = 0.55, 95% CI = 0.52, 0.59) and Europe DH survey region ~ 44% (prevalence=(5483/12502) = 0.44, 95% CI = 0.43, 0.45). The lowest prevalence of antibiotic use for under five Child AWD was ~ 23% (prevalence=(11918/51328) = 0.23, 95% CI = 0.22, 0.24) in the DH survey region South East Asia. On the other hand the DH survey region Latin America and West North and Central Africa region the prevalence of antibiotic use for AWD were ~ 30% (prevalence=(7887/26396) = 0.30, 95% CI = 0.29, 0.31) and ~ 24% (prevalence=(21500/88093) = 0.24, 95% CI = 0.23, 0.24). The southeast Asia DH survey region countries DHS 2007 (Bangladesh), DHS 2014 and 2010 (Cambodia), DHS 2017 and 2012 (Indonesia), DHS 2009 (Maldives), DHS 2015–2016 (Myanmar), DHS 2012–2013 (Pakistan), DHS 2017 and 2013 (Philippines), and DHS 2009–2010 (Timor-Leste) were higher risks of AWD for drinking unimproved water sources. The prevalence of antibiotic use for u5c AWD was shown the highest prevalence in DHS 2007 (~ 44%), DHS 2012 (~ 49%), DHS 2016 (~ 40%), and DHS 2017 (~ 65%) from DH survey 2006 to 2018 in South East & Central Asia. The linear trend analysis showed an upward trend for using antibiotic of AWD in the South East & Central Asia DH survey region.

Introduction

Diarrhea is the state of loose, liquid, or watery bowel engagements three times or more a day. [1] If it will continue for a few days for a result creates severe dehydration. Among the low- and middle-income countries diarrhea is one of the foremost causes of antibiotic use for children. On the other hand, the vaccine may prevent diarrhea infections but they often consumed antibiotic treatment.[2] Of 13% prevalence for purchasing antibiotics without a prescription, ~ 2% were preferred by the regulars and ~ 11% were suggested by the pharmacists. [3] Cotrimoxazole was the most commonly prescribed drug (51%), followed by colistin sulfate (15.3%), norfloxacin (11%), and nalidixic acid (0.5%). The average number of antimicrobials per case of inpatients was higher than outpatients (1.15 vs 0.84, $p < 0.001$).

There was a trend toward prescribing norfloxacin in childhood diarrhea. [4] The last 20 years have shown that the prevalence of antibiotic resistance has increased remarkably. [5] It is a serious hazard for health among the global people. [6] The low income and middle-income countries are higher threatened than high-income countries for the depletion of antibiotics, prevalence, and confrontation of antibiotics against childhood diarrhea or diseases by the record. [7] Aggregate the numbers of peoples gaining access to antimicrobial resistance not only the formal health care but also increasing the antibiotic treatments by both formal and informal health care providers. [8, 9] Moderately a 3rd of patients admitted to hospital are specified by the antibiotic treatment according to the report by the worldwide Point Prevalence Survey. [10] Around 21% of antibiotics were used by oral pills or syrups and 3% by injections in the Demographic Health Survey (DHS) and Multiple Indicator Cluster Survey (MICS) data. The proportion of antibiotic treatments 3–78% for childhood diarrhea episodes among 38 included studies. [11] The main objective of this paper to estimate the prevalence of antibiotic use for acute watery diarrhea of under-five children (u5c), and retrospectives analysis of household water sanitation risk factors of the DHS multi-country survey from 2006–2018.

Methods

Data sources

In this paper, we used 112 Demographic Health Survey (DHS) data. On the period of household surveys, mothers were asked detailed questions about the management of diarrhea episodes. And those under-5 children were included whose 2-weeks diarrhea episodes earlier the survey date. Of 112 countries 12,69,944 under five Children (u5c) datasets were collected from Demographic and Health Survey (DHS) programmed surveys from 2006 to 2018 (<https://dhsprogram.com/Data/>). The cross-sectional study design was used for the DHS survey data collection. The detailed sampling strategy and methodology discussed in the DHS website and published reports.

Statistical Analysis Method

The dataset was collected from the Demographic and Health Survey (DHS) programmed from 2006 to 2018 survey year. There were 12,69,944 under five Children suffering from acute watery diarrhea (had diarrhea last 24 hours or last two weeks) were analyzed as a study variable or dependent variable. Also analyzed the prevalence of antibiotic use for under-five child acute watery diarrhea. The logistic regression was used to estimate the crude odds ratio (COR) of household drinking water (Improved as reference category) sources and sanitation (Improved as reference category) risk factors with a 95% confidence interval. The *p*-value was estimated for the prediction of significant risk factors of under-five childhood watery diarrhea. The multiple logistic regression was used to estimate the adjusted odds ratio (AOR) of the age in months and sex of the children with a 95% confidence interval. All the statistical analysis was implemented using the open source software R statistical programming language (<https://www.r-project.org/>). The classification of household sanitation and water risk factors are as follows:

Improved Sanitation Facility Group:

- i. flush - to piped sewer system
- ii. flush - to septic tank
- iii. flush - to pit latrine
- iv. flush - don't know where
- v. pit latrine - ventilated improved pit (VIP)
- vi. pit latrine - with slab
- vii. composting toilet

Unimproved Sanitation Facility Group:

- i. flush - to somewhere else
- ii. pit latrine - without slab / open pit
- iii. bucket toilet
- iv. hanging toilet/latrine
- v. other

Improved Drinking Water Sources Group:

- i. piped into dwelling piped to yard/plot
- ii. public tap/standpipe
- iii. piped to neighbor
- iv. tube well or borehole
- v. protected well
- vi. protected spring
- vii. rainwater
- viii. tanker truck, cart with small tank
- ix. bottled water

Unimproved Drinking Water Sources Group:

- i. unprotected well
- ii. unprotected spring
- iii. surface water (river/dam/lake/pond/stream/canal/irrigation channel)
- iv. other

Results

Overall Characteristics: A total of 12,69,944 under five years Children were included in this study among them 1,80,067 Children were acute watery diarrhea (AWD) and 19,502 Children were bloody diarrhea respectively. Among them, 47,755 Children were taken antibiotic treatment for AWD. The overall prevalence of acute watery diarrhea ~14% (prevalence=0.142; 95% CI=0.141, 0.142). On the other hand the prevalence of bloody diarrhea ~2% (prevalence=0.015; 95% CI=0.015, 0.016). The prevalence of antibiotic treatment for AWD was ~27% (prevalence=0.27, 95% CI=0.26, 0.27) among the under five years old children in DH survey regions in the world.

Socio-economic and Demographic characteristics: The wealth index is a significant measurement of socio-economic status. The median (robust measures of central tendency with 50% outliers tolerate) prevalence of antibiotic use for acute watery diarrhea (AWD) was almost equal among the poorest (~22%) and poorer (~22%) group Children respectively. But among the richest people prevalence of antibiotic use was ~14% for AWD. Therefore, the box plot (**Figure-1(A)**) showed that the prevalence of antibiotic use trend was decreasing from poorest to richest (**Supplementary Table-1**).

The mother's education plays a significant role for under five childhood acute watery diarrhea. The prevalence of AWD among the primary and secondary education child-mother was higher ~31% (median) and ~28% (median) respectively. Comparatively lower prevalence of AWD among the no education child-mother group ~20% (median) than the primary and secondary education child mother. However, the prevalence of AWD remarkably lowers ~2% among the higher education mother (**Figure-1(B)** and **Supplementary Table-2**).

The prevalence of AWD was higher among the age group 6-12 months and 12-18 months ~19% (median) and ~18% (median) respectively. The very low prevalence of AWD among the age group 42-48 months and 48-54 months were ~5% (median) and ~5% (median) respectively (**Supplementary Table-3**). The box plot (**Figure-1(C)**) showed that the prevalence of AWD was decreasing trend from age group 6-12 months to 48-54 months.

Prevalence of acute watery diarrhea (AWD):

The prevalence of acute watery diarrhea was higher ~17% (prevalence=0.17, 95% CI=0.16, 0.17) in the Latin America DHS survey region. The minimum prevalence of AWD was almost equal between South East Asia and Central Asia DHS survey regions ~12% (prevalence=0.12, 95% CI=0.11, 0.12) and ~12% (prevalence=0.12, 95% CI=0.10, 0.13) respectively. On the other hand the prevalence of AWD between Europe and West North and Central Africa DHS survey regions ~16% (prevalence=0.16, 95% CI=0.15, 0.16) and ~15% (prevalence=0.15, 95% CI=0.14, 0.15) correspondingly (**Table-1**).

Southeast Asia: In Afghanistan 2015 demographic health survey (DHS) 30,951 Childs were included in this survey. Among them 7990 Childs were AWD. It is the highest prevalence ~26% (prevalence=0.26, 95% CI=0.25, 0.26) in the DH survey region South East Asia. The DH survey 2012-2013 and 2017-2018 in Pakistan were higher prevalence of AWD ~21% (prevalence=0.21, 95% CI=0.20, 0.22) and ~18% (prevalence=0.18, 95% CI=0.17, 0.18). But the Maldives 2009 and 2016-2017 DH survey showed that the lowest prevalence of AWD ~5% (prevalence=0.05, 95% CI=0.04, 0.06) and ~4% (prevalence=0.04, 95% CI=0.03, 0.05) respectively (**Table-1**). The details prevalence of AWD in South Asia was shown in the global mapping **Figure-2(A)**.

Central Asia: The highest prevalence of AWD was ~15% (prevalence=0.15, 95% CI=0.14, 0.16) in Tajikistan DH survey 2012. On the other hand, the lowest prevalence of AWD was ~5% (prevalence=0.05, 95% CI=0.05, 0.06) in the Kyrgyz Republic DH survey 2012 (**Table-1** and **Figure 2(B)**) in the DH survey region Central Asia.

Europe: In the DH survey 2015-2016 and 2017-2018 in Albania was lowest prevalence of AWD ~4% (prevalence=0.04, 95% CI=0.03, 0.15) and ~5% (prevalence=0.05, 95% CI=0.05, 0.06). The highest prevalence of AWD ~31% (prevalence=0.31, 95% CI=0.30, 0.32) in Yemen 2013 DH survey (**Table-1** and **Figure-2(C)**) in the DH survey region Europe.

Latin America: The demographic and health survey 2008 in Bolivia and 2005-2006 in Haiti were highest prevalence of AWD ~25% (prevalence=0.25, 95% CI=0.24, 0.26) and ~22% (prevalence=0.22, 95% CI=0.21, 0.23) respectively. The lowest prevalence of AWD was ~10% (prevalence=0.10, 95% CI=0.09, 0.11) in Guyana 2009 DH survey in the Latin America region (**Tabel-1** and **Figure-2(D)**).

West North and Central Africa: The lowest prevalence of AWD was ~6% (prevalence=0.06, 95% CI=0.06, 0.07) in Benin 2011-2012 DH survey. The demographic health survey 2006 and 2011 in Uganda and Burundi 2010 DH survey were highest prevalence of AWD ~26% (prevalence=0.26, 95% CI=0.25, 0.27), ~23% (prevalence=0.23, 95% CI=0.22, 0.24), and ~25% (prevalence=0.25, 95% CI=0.24, 0.26) respectively (**Table-1** and **Figure-2(E)**) in the West North and Central Africa.

Prevalence of Antibiotic use for AWD:

In the central Asia of 15,089 under five Childs were included in the survey. Among them 1,748 Children were AWD and 967 Childs had taken antibiotic treatment for AWD. The highest prevalence of antibiotic use for AWD in Central Asia ~55% (prevalence=(967/1748)=0.55, 95% CI=0.52, 0.59) and Europe DH

survey region ~44% (prevalence=(5483/12502)=0.44, 95% CI=0.43, 0.45). The lowest prevalence of antibiotic use for under five Child AWD was ~23% (prevalence=(11918/51328)=0.23, 95% CI=0.22, 0.24) in the DH survey region South East Asia. On the other hand the DH survey region Latin America and West North and Central Africa region the prevalence of antibiotic use for AWD were ~30% (prevalence=(7887/26396)=0.30, 95% CI=0.29, 0.31) and ~24% (prevalence=(21500/88093)=0.24, 95% CI=0.23, 0.24) (**Table-1**).

South East Asia: The demographic health survey 2017-2018 in Pakistan and 2007 in Indonesia were highest prevalence of antibiotic use for AWD in the South East Asia. The estimated prevalence were ~47% (prevalence=0.47, 95% CI=0.44, 0.50) and ~44% (prevalence=0.44, 95% CI=0.41, 0.46) respectively. The lowest prevalence of antibiotic use for AWD in the Maldives DH survey 2016-2017 was ~5% (prevalence=0.05, 95% CI=-0.18, 0.27) and Timor-Leste DH survey 2009-2010 was ~5% (prevalence=0.05, 95% CI=0.0, 0.11) respectively (**Table-1**) and the details prevalence shown in the global mapping **Figure-3(A)**.

Central Asia: In the Central Asia DH survey region more than ~40% prevalence of antibiotic use for AWD. The DH survey 2017 in Tajikistan highest prevalence ~65% (prevalence=0.65, 95% CI=0.61, 0.69) of antibiotic use for Child AWD in the Central Asia region (**Table-1** and **Figure-3(B)**).

Europe: In the DH survey 2012 in Jordan and 2006 in Azerbaijan were highest prevalence of antibiotic use for AWD ~54% (prevalence=0.54, 95% CI=0.50, 0.57) and ~49% (prevalence=0.49, 95% CI=0.40, 0.58). On the other hand the lowest prevalence of antibiotic use for AWD ~15% (prevalence=0.15, 95% CI=-0.01, 0.30) in the Europe DH survey region (**Table-1** and **Figure-3(C)**).

Latin America: The DH survey region Latin America the highest prevalence of antibiotic use for AWD in Guatemala 2014-2015 survey ~42% (prevalence=0.42, 95% CI=0.39, 0.45). Also in the Bolivia DHS 2008, Peru DHS 2009, Peru DHS 2011, Peru DHS 2012 were high prevalence of antibiotic use for AWD. The estimated prevalence for those DHS countries were ~40% (prevalence=0.40, 95% CI=0.37, 0.43), ~40% (prevalence=0.40, 95% CI=0.36, 0.44), ~39% (prevalence=0.39, 95% CI=0.35, 0.44), and ~38% (prevalence=0.38, 95% CI=0.34, 0.43) respectively. The lowest prevalence of antibiotic use for AWD was ~10% (prevalence=0.10, 95% CI=0.05, 0.15) in Haiti 2012 DHS in the DH survey region Latin America (**Table-1** and **Figure-3(D)**).

West North and Central Africa: The lowest prevalence of antibiotic use for AWD in the DH survey region West North and Central Africa in Burundi DHS 2016-2017 and Zimbabwe DHS 2005-2006 were ~6% (prevalence=0.06, 95% CI=0.02, 0.09) and ~6% (prevalence=0.06, 95% CI=-0.02, 0.14) respectively. The higher prevalence of antibiotic use for AWD in Congo DHS 2011-2012 and Liberia DHS 2013 were ~59% (prevalence=0.59, 95% CI=0.56, 0.63) and ~59% (prevalence=0.59, 95% CI=0.56, 0.62) respectively. On the other hand, Sierra Leone DHS 2013 and 2008, DHS 2010 in Tanzania were also higher prevalence of antibiotic use for AWD of under five children. The estimated prevalence were ~48% (prevalence=0.48, 95% CI=0.44, 0.52), ~44% (prevalence=0.44, 95% CI=0.38, 0.50), and ~47% (prevalence=0.47, 95% CI=0.43, 0.52) correspondingly (**Table-1** and **Figure-3(E)**).

Household water and sanitation risk factors analysis of under-five children AWD:

The multiple logistic regression was used to estimate the odds ratio for measuring water sanitation risk factors of under-five children AWD.

Drinking water sources and sanitation toilet risk factor:

Southeast Asia: The southeast Asia DH survey region countries DHS 2007 (Bangladesh), DHS 2014 and 2010 (Cambodia), DHS 2017 and 2012 (Indonesia), DHS 2009 (Maldives), DHS 2015-2016 (Myanmar), DHS 2012-2013 (Pakistan), DHS 2017 and 2013 (Philippines), and DHS 2009-2010 (Timor-Leste) were higher risk of AWD for drinking unimproved water sources.

The DH survey 2007 in Bangladesh was ~1.10 times (aOR=1.1, 95% CI=1.09, 1.11) higher risk of u5c AWD for using unimproved drinking water sources. The DHS 2014 ~1.4 times (aOR=1.40, 95% CI=1.39, 1.42) and 2010 ~1.11 times (aOR=1.11, 95% CI=1.10, 1.12) more risk of u5c AWD in Cambodia for using unimproved drinking water sources. Similarly, ~1.26 times in DHS 2017 and ~1.18 times in 2012 (Indonesia), ~1.65 times in DHS 2009 (Maldives), ~1.21 times in DHS 2015-2016 (Myanmar), ~1.11 times in DHS 2012-2013 (Pakistan), ~1.24 times in DHS 2017 and ~1.18 times in 2013 (Philippines), and ~1.18 times in DHS 2009-2010 (Timor-Leste) higher risk of u5c AWD due to use unimproved drinking water sources respectively (**Table-2** and **Supplementary Figure-1 (a)**).

Most of the countries in the South East Asia region were at higher risk of u5c AWD for using unimproved sanitation toilets. On the other hand, DHS 2015 in Afghanistan, DHS 2015-2016 in Myanmar, and DHS 2016 in Timor-Leste were lower risk of AWD (**Table-2** and **Supplementary Figure-3(a)**).

Central Asia: The DH survey 2012 in Tajikistan was ~1.4 times (aOR=1.14, 95% CI=1.13, 1.15) higher risk of u5c AWD for drinking unimproved water sources (**Table-2** and **Supplementary Figure-1(b)**). On the other hand, the DHS 2012 in Tajikistan was ~4% (aOR=1.04, 95% CI=1.03, 1.04) more risk of AWD using unimproved sanitation toilet (**Table-2** and **Supplementary Figure-3(b)**).

Europe: The DHS 2010 in Armenia, DHS 2016 in Azerbaijan, and DHS 2008 in Egypt were ~2 times (aOR=1.90, 95% CI=1.85, 1.95), ~5 times (aOR=4.54, 95% CI=4.35, 4.73), and ~1.31 times (aOR=1.31, 95% CI=1.28, 1.33) were higher risk of AWD for drinking unimproved water sources (**Table-2** and **Supplementary Figure-1(c)**).

The risk of AWD for using unproved sanitation toilets was higher among Armenia (DHS-2010), Azerbaijan (DHS-2006), and Jordan (DHS-2012). The estimated adjusted odds ratio (aOR) was aOR=2.54 (95% CI=2.47, 2.61), aOR=1.42 (95% CI=1.39, 1.46), and aOR=1.47 (95% CI=1.45, 1.48) respectively (**Table-2** and **Supplementary Figure-3(c)**).

Latin America: The DHS 2008 in Bolivia (aOR=1.69; 95% CI=1.67, 1.71), DHS 2010 in Colombia (aOR=1.23; 95% CI=1.22, 1.24), DHS 2014-2015 in Guatemala (aOR=1.31; 95% CI=1.29, 1.33), DHS 2016-2017 (aOR=1.16; 95% CI=1.29, 1.33) and DHS 2012 (aOR=1.76; 1.71, 1.80) in Haiti, DHS 2012 (aOR=1.49;

95% CI=1.45, 1.48), DHS 2009 (aOR=1.59; 95% CI=1.57, 1.61), DHS 2007-2008 (aOR=1.55; 95% CI=1.53, 1.57), and DHS 2004-2006 (aOR=1.40; 95% CI=1.38, 1.41) in Peru were highest risk of u5c AWD for drinking unimproved water sources (**Table-2** and **Supplementary Figure-1(d)**).

All the DH survey in the DH survey region in Latin America was a higher risk of AWD for using unimproved sanitation toilets. But the DHS 2016-2017 in Haiti was a lower risk of AWD (aOR=0.99; 95% CI=0.99, 0.99) for using unimproved sanitation toilets (**Table-2** and **Supplementary Figure-3(d)**).

West North and Central Africa: Most DH survey countries were at higher risk of AWD of u5c for using unimproved drinking water sources and unimproved sanitation toilets in the West North and Central Africa DH survey regions. The detailed results were shown in **Table-2** (drinking water sources & sanitation toilet), **Supplementary Figure-2** (drinking water sources), and **Supplementary Figure-4** (sanitation toilet).

The trend of Antibiotic use for AWD

South East & Central Asia: The prevalence of antibiotic use for u5c AWD was shown the highest prevalence in DHS 2007 (~44%), DHS 2012 (~49%), DHS 2016 (~40%), and DHS 2017 (~65%) from DH survey 2006 to 2018 in South East & Central Asia. The linear trend analysis showed an upward trend for using antibiotic of AWD in the South East & Central Asia DH survey region (**Figure-4 (A)**).

Europe: The prevalence of antibiotic use for u5c AWD was shown the highest prevalence in DHS 2007 (~50%), DHS 2012 (~54%), DHS 2014 (~47%), and DHS 2018 (~32%) from DH survey 2006 to 2018 in Europe DH survey region. The linear trend analysis showed a downward trend for using antibiotic of AWD in the Europe DH survey region (**Figure-4 (B)**).

Latin America: The prevalence of antibiotic use for u5c AWD was shown the highest prevalence in DHS 2006 (~37%), DHS 2008 (~40%), DHS 2009 (~40%), and DHS 2015 (~32%) from DH survey 2006 to 2018 in Latin America DH survey region. The linear trend analysis showed a downward (decreasing pattern) trend for using antibiotic of AWD in the Latin America DH survey region (**Figure-4 (C)**).

West North and Central Africa: The prevalence of antibiotic use for u5c AWD was shown the highest prevalence in DHS 2008 (~44%), DHS 2010 (~47%), DHS 2012 (~59%), DHS 2013 (~48%), and DHS 2018 (~8%) from DH survey 2006 to 2018 in West North and Central Africa DH survey region. The linear trend analysis showed a downward (decreasing pattern) trend for using antibiotic of AWD in the West North and Central Africa DH survey region (**Figure-4 (D)**).

Discussion & Conclusions

Antibiotic use for acute watery diarrhea among under-five children is a common phenomenon in low and middle-income countries. The overall prevalence of diarrhea among South East Asia and Central Asia are equally distributed among the under child watery diarrhea. The highest prevalence of antibiotic use of under-five children diarrhea among Central Asia on the other hand the lowest prevalence of antibiotic use among the West North and Central Africa DH survey region. According to the trend analysis shown that

the prevalence of antibiotic use for under-five children diarrhea was the increasing trend among the South East and Central Asia DH survey regions. However, all the other DH survey regions (Europe, Latin America, and West North and Central Africa) were decreasing the trend of antibiotic use for under-five children diarrhea.

Declarations

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Author contributions

All the statistical analysis and write & revised the manuscript and provided important intellectual content. The author approved the final version of the manuscript.

Competing interests

The author(s) declare no competing interests.

Data Availability

The study data are available upon request from the Demographic and Health Surveys program (<https://dhsprogram.com/>).

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Tables

Table-1: Prevalence of diarrhea of under-five child (u5c) among 112 DHS national survey 2006-2018

DHS Survey Countries	Total No. of u5c	No. of u5c diarrhea	Diarrhea of u5c	No. of u5c antibiotic use for AWD	Antibiotic use for AWD
South East Asia	N	n	Prevalence (95% CI)	n	Prevalence (95% CI)
Afghanistan (2015)	30951	7990	0.26 (0.25, 0.26)	1522	0.19 (0.17, 0.21)
Bangladesh (2007)	5789	560	0.1 (0.09, 0.1)	56	0.1 (0.02, 0.18)
Cambodia (2014)	6970	855	0.12 (0.11, 0.13)	45	0.05 (-0.01, 0.12)
Cambodia (2010)	7820	1135	0.15 (0.14, 0.15)	83	0.07 (0.02, 0.13)
India (2015-2016)	247743	22500	0.09 (0.09, 0.09)	5464	0.24 (0.23, 0.25)
Indonesia (2017)	17263	2440	0.14 (0.14, 0.15)	306	0.13 (0.09, 0.16)
Indonesia (2012)	17323	2505	0.14 (0.14, 0.15)	321	0.13 (0.09, 0.16)
Indonesia (2007)	17891	2536	0.14 (0.14, 0.15)	1104	0.44 (0.41, 0.46)
Maldives (2016-2017)	3055	126	0.04 (0.03, 0.05)	6	0.05 (-0.18, 0.27)
Maldives (2009)	3759	188	0.05 (0.04, 0.06)	20	0.11 (-0.04, 0.25)
Myanmar (2015-2016)	4596	550	0.12 (0.11, 0.13)	219	0.4 (0.33, 0.46)
Nepal (2016)	4861	336	0.07 (0.06, 0.08)	102	0.3 (0.21, 0.39)
Nepal (2011)	5054	679	0.13 (0.12, 0.14)	93	0.14 (0.07, 0.21)
Nepal (2006)	5457	659	0.12 (0.11, 0.13)	61	0.09 (0.02, 0.17)
Pakistan (2017-2018)	11985	2107	0.18 (0.17, 0.18)	985	0.47 (0.44, 0.5)
Pakistan (2012-2013)	10935	2298	0.21 (0.2, 0.22)	829	0.36 (0.33, 0.39)
Philippines (2017)	10297	652	0.06 (0.06, 0.07)	171	0.26 (0.2, 0.33)

Philippines (2013)	7012	551	0.08 (0.07, 0.08)	194	0.35 (0.28, 0.42)
Philippines (2008)	6382	571	0.09 (0.08, 0.1)	139	0.24 (0.17, 0.32)
Timor-Leste (2016)	6950	700	0.1 (0.09, 0.11)	124	0.18 (0.11, 0.25)
Timor-Leste (2009-2010)	9294	1390	0.15 (0.14, 0.16)	74	0.05 (0, 0.11)
Total	441387	51328	0.12 (0.11, 0.12)	11918	0.23 (0.22, 0.24)
Central Asia					
Kyrgyz Republic (2012)	4236	223	0.05 (0.05, 0.06)	95	0.43 (0.33, 0.53)
Tajikistan (2017)	6019	802	0.13 (0.12, 0.14)	519	0.65 (0.61, 0.69)
Tajikistan (2012)	4834	723	0.15 (0.14, 0.16)	353	0.49 (0.44, 0.54)
Total	15089	1748	0.12 (0.10, 0.13)	967	0.55 (0.52, 0.59)
Europe					
Albania (2017-2018)	2755	149	0.05 (0.05, 0.06)	22	0.15 (-0.01, 0.3)
Armenia (2015-2016)	1709	68	0.04 (0.03, 0.05)	22	0.32 (0.12, 0.53)
Armenia (2010)	1450	128	0.09 (0.07, 0.1)	41	0.32 (0.17, 0.47)
Azerbaijan (2006)	2196	231	0.11 (0.09, 0.12)	113	0.49 (0.4, 0.58)
Egypt (2014)	15465	2010	0.13 (0.12, 0.14)	949	0.47 (0.44, 0.5)
Egypt (2008)	10595	979	0.09 (0.09, 0.1)	390	0.4 (0.35, 0.45)
Jordan (2017-2018)	10475	968	0.09 (0.09, 0.1)	312	0.32 (0.27, 0.37)
Jordan (2012)	10128	1540	0.15 (0.15, 0.16)	830	0.54 (0.5, 0.57)
Jordan (2007)	10237	1659	0.16 (0.15, 0.17)	836	0.5 (0.47, 0.54)
Yemen (2013)	15326	4770	0.31 (0.3, 0.32)	1968	0.41 (0.39, 0.43)

			0.32)		0.43)
Total	80336	12502	0.16 (0.15, 0.16)	5483	0.44 (0.43, 0.45)
Latin America					
Bolivia (2008)	8193	2055	0.25 (0.24, 0.26)	825	0.4 (0.37, 0.43)
Colombia (2010)	17443	2495	0.14 (0.14, 0.15)	549	0.22 (0.19, 0.25)
Dominican Republic (2013)	3605	637	0.18 (0.16, 0.19)	125	0.2 (0.13, 0.27)
Dominican Republic (2007)	10796	1773	0.16 (0.16, 0.17)	294	0.17 (0.12, 0.21)
Guatemala (2014-2015)	12068	2239	0.19 (0.18, 0.19)	946	0.42 (0.39, 0.45)
Guyana (2009)	2105	213	0.1 (0.09, 0.11)	36	0.17 (0.04, 0.3)
Haiti (2016-2017)	6120	1235	0.2 (0.19, 0.21)	202	0.16 (0.11, 0.21)
Haiti (2012)	6744	1415	0.21 (0.2, 0.22)	141	0.1 (0.05, 0.15)
Haiti (2005-2006)	5596	1217	0.22 (0.21, 0.23)	182	0.15 (0.1, 0.2)
Honduras (2011-2012)	10592	1919	0.18 (0.17, 0.19)	684	0.36 (0.32, 0.39)
Honduras (2005-2006)	10506	1797	0.17 (0.16, 0.18)	360	0.2 (0.16, 0.24)
Peru (2012)	9445	1254	0.13 (0.13, 0.14)	479	0.38 (0.34, 0.43)
Peru (2011)	8950	1312	0.15 (0.14, 0.15)	518	0.39 (0.35, 0.44)
Peru (2009)	10041	1475	0.15 (0.14, 0.15)	586	0.4 (0.36, 0.44)
Peru (2007-2008)	16730	2680	0.16 (0.15, 0.17)	980	0.37 (0.34, 0.4)
Peru (2004-2006)	16730	2680	0.16 (0.15, 0.17)	980	0.37 (0.34, 0.4)
Total	155664	26396	0.17 (0.16, 0.17)	7887	0.30 (0.29, 0.31)

West North and

Central Africa

Angola (2015-2016)	13619	1891	0.14 (0.13, 0.14)	406	0.21 (0.17, 0.25)
Benin (2017-2018)	12651	1342	0.11 (0.1, 0.11)	101	0.08 (0.02, 0.13)
Benin (2011-2012)	12679	816	0.06 (0.06, 0.07)	163	0.2 (0.14, 0.26)
Burkina Faso (2010)	13716	2031	0.15 (0.14, 0.15)	576	0.28 (0.25, 0.32)
Burundi (2016-2017)	12472	2664	0.21 (0.21, 0.22)	151	0.06 (0.02, 0.09)
Burundi (2010)	7231	1787	0.25 (0.24, 0.26)	384	0.21 (0.17, 0.26)
Cameroon (2011)	10713	2078	0.19 (0.19, 0.2)	372	0.18 (0.14, 0.22)
Chad (2014-2015)	16837	3292	0.2 (0.19, 0.2)	474	0.14 (0.11, 0.18)
Comoros (2012)	3022	480	0.16 (0.15, 0.17)	91	0.19 (0.11, 0.27)
Congo (2011-2012)	8857	1531	0.17 (0.16, 0.18)	908	0.59 (0.56, 0.63)
Congo (2005)	4435	627	0.14 (0.13, 0.15)	203	0.32 (0.26, 0.39)
Congo Democratic Republic (2013-2014)	17188	2818	0.16 (0.16, 0.17)	939	0.33 (0.3, 0.36)
Congo Democratic Republic (2007)	7987	1287	0.16 (0.15, 0.17)	336	0.26 (0.21, 0.31)
Cote d'Ivoire (2011-2012)	7052	1276	0.18 (0.17, 0.19)	163	0.13 (0.08, 0.18)
Eswatini (2006-2007)	2537	347	0.14 (0.12, 0.15)	75	0.22 (0.12, 0.31)
Ethiopia (2016)	10006	1090	0.11 (0.1, 0.12)	150	0.14 (0.08, 0.19)
Ethiopia (2011)	10808	1620	0.15 (0.14, 0.16)	251	0.15 (0.11, 0.2)
Gabon (2012)	5747	981	0.17 (0.16, 0.18)	299	0.3 (0.25, 0.36)
Gambia (2013)	7788	1340	0.17 (0.16, 0.18)	325	0.24 (0.2, 0.29)

Ghana (2014)	5593	671	0.12 (0.11, 0.13)	243	0.36 (0.3, 0.42)
Ghana (2008)	2794	553	0.2 (0.18, 0.21)	201	0.36 (0.3, 0.43)
Guinea (2012)	6396	1071	0.17 (0.16, 0.18)	226	0.21 (0.16, 0.26)
Kenya (2014)	20069	2953	0.15 (0.14, 0.15)	505	0.17 (0.14, 0.2)
Kenya (2008-2009)	5706	946	0.17 (0.16, 0.18)	217	0.23 (0.17, 0.29)
Lesotho (2014)	2915	328	0.11 (0.1, 0.12)	52	0.16 (0.06, 0.26)
Liberia (2013)	7058	1675	0.24 (0.23, 0.25)	989	0.59 (0.56, 0.62)
Liberia (2007)	5305	1072	0.2 (0.19, 0.21)	148	0.14 (0.08, 0.19)
Madagascar (2008-2009)	11750	1006	0.09 (0.08, 0.09)	260	0.26 (0.2, 0.31)
Malawi (2015-2016)	16462	3402	0.21 (0.2, 0.21)	979	0.29 (0.26, 0.32)
Malawi (2010)	18360	3105	0.17 (0.16, 0.17)	717	0.23 (0.2, 0.26)
Mali (2012-2013)	9582	844	0.09 (0.08, 0.09)	140	0.17 (0.1, 0.23)
Mali (2006)	12388	1450	0.12 (0.11, 0.12)	335	0.23 (0.19, 0.28)
Mozambique (2011)	10291	1071	0.1 (0.1, 0.11)	313	0.29 (0.24, 0.34)
Namibia (2013)	4805	810	0.17 (0.16, 0.18)	156	0.19 (0.13, 0.25)
Namibia (2006-2007)	4841	576	0.12 (0.11, 0.13)	112	0.19 (0.12, 0.27)
Niger (2012)	11602	1591	0.14 (0.13, 0.14)	199	0.13 (0.08, 0.17)
Niger (2006)	8209	1669	0.2 (0.19, 0.21)	590	0.35 (0.31, 0.39)
Nigeria (2013)	28596	2968	0.1 (0.1, 0.11)	1121	0.38 (0.35, 0.41)
Nigeria (2008)	25273	2645	0.1 (0.1, 0.11)	849	0.32 (0.29, 0.35)

Rwanda (2014-2015)	7556	905	0.12 (0.11, 0.13)	106	0.12 (0.06, 0.18)
Rwanda (2010)	8484	1109	0.13 (0.12, 0.14)	116	0.1 (0.05, 0.16)
Sao Tome and Principe (2008-2009)	1851	230	0.12 (0.11, 0.14)	61	0.27 (0.15, 0.38)
Senegal (2017)	11605	2212	0.19 (0.18, 0.2)	336	0.15 (0.11, 0.19)
Senegal (2016)	6417	1062	0.17 (0.16, 0.17)	164	0.15 (0.1, 0.21)
Senegal (2015)	6602	1359	0.21 (0.2, 0.22)	195	0.14 (0.09, 0.19)
Senegal (2014)	6526	1272	0.19 (0.19, 0.2)	186	0.15 (0.1, 0.2)
Senegal (2012-2013)	6540	972	0.15 (0.14, 0.16)	201	0.21 (0.15, 0.26)
Senegal (2010-2011)	11633	2196	0.19 (0.18, 0.2)	494	0.22 (0.19, 0.26)
Sierra Leone (2013)	10618	1214	0.11 (0.11, 0.12)	581	0.48 (0.44, 0.52)
Sierra Leone (2008)	5043	590	0.12 (0.11, 0.13)	258	0.44 (0.38, 0.5)
South Africa (2016)	3413	350	0.1 (0.09, 0.11)	37	0.11 (0, 0.21)
Tanzania (2015-2016)	9707	1125	0.12 (0.11, 0.12)	369	0.33 (0.28, 0.38)
Tanzania (2010)	7526	1015	0.13 (0.13, 0.14)	478	0.47 (0.43, 0.52)
Togo (2013-2014)	6530	1042	0.16 (0.15, 0.17)	251	0.24 (0.19, 0.29)
Uganda (2016)	14710	2923	0.2 (0.19, 0.21)	666	0.23 (0.2, 0.26)
Uganda (2011)	7355	1684	0.23 (0.22, 0.24)	589	0.35 (0.31, 0.39)
Uganda (2006)	7593	1956	0.26 (0.25, 0.27)	579	0.3 (0.26, 0.33)
Zambia (2013-2014)	12698	2045	0.16 (0.15, 0.17)	670	0.33 (0.29, 0.36)
Zambia (2007)	5844	909	0.16 (0.15, 0.17)	221	0.24 (0.19, 0.29)

			0.16)		0.3)
Zimbabwe (2015)	5807	931	0.16 (0.15, 0.17)	72	0.08 (0.01, 0.14)
Zimbabwe (2010-2011)	5203	674	0.13 (0.12, 0.14)	116	0.17 (0.1, 0.24)
Zimbabwe (2005-2006)	4867	614	0.13 (0.12, 0.14)	35	0.06 (-0.02, 0.14)
Total	577468	88093	0.15 (0.14, 0.15)	21500	0.24 (0.23, 0.24)
Grand Total	1269944	180067	0.142 (0.141, 0.142)	47755	0.27 (0.26, 0.27)

Table-2: Analysis of household water and sanitation risk factors using multiple logistic regression model ofu5c among 112 DHS national surveys 2006-2018 (Improved as reference category)

	Drinking water sources		Sanitation Toilet	
DHS Survey Countries	cOR (95% CI)	aOR (95% CI)	cOR (95% CI)	aOR (95% CI)
South East Asia				
Afghanistan (2015)	0.97 (0.97, 0.97)	0.97 (0.97, 0.97)	0.9 (0.9, 0.9)	0.9 (0.9, 0.9)
Bangladesh (2007)	1.09 (1.08, 1.1)	1.1 (1.09, 1.11)	1.12 (1.11, 1.13)	1.12 (1.12, 1.13)
Cambodia (2014)	1.39 (1.38, 1.41)	1.4 (1.39, 1.42)	1.41 (1.4, 1.43)	1.42 (1.4, 1.43)
Cambodia (2010)	1.11 (1.11, 1.12)	1.11 (1.1, 1.12)	1.47 (1.45, 1.49)	1.47 (1.45, 1.49)
India (2015-2016)	0.81 (0.81, 0.81)	0.81 (0.81, 0.81)	1.12 (1.11, 1.12)	1.12 (1.11, 1.12)
Indonesia (2017)	1.26 (1.25, 1.26)	1.26 (1.25, 1.26)	1.41 (1.4, 1.42)	1.41 (1.4, 1.42)
Indonesia (2012)	1.17 (1.17, 1.18)	1.18 (1.17, 1.19)	1.18 (1.17, 1.19)	1.17 (1.17, 1.18)
Indonesia (2007)	0.7 (0.7, 0.71)	0.7 (0.69, 0.71)	1.17 (1.17, 1.18)	1.17 (1.17, 1.18)
Maldives (2009)	1.65 (1.62, 1.68)	1.65 (1.61, 1.68)	1.98 (1.93, 2.02)	1.97 (1.93, 2.02)
Myanmar (2015-2016)	1.21 (1.19, 1.22)	1.21 (1.19, 1.22)	0.99 (0.99, 1)	0.99 (0.99, 1)
Nepal (2016)	1.03 (1.02, 1.03)	1.03 (1.02, 1.03)	1.24 (1.23, 1.26)	1.24 (1.23, 1.26)
Nepal (2011)	0.97 (0.96, 0.97)	0.97 (0.96, 0.97)	1.1 (1.09, 1.11)	1.1 (1.09, 1.11)
Nepal (2006)	1.09 (1.09, 1.1)	1.09 (1.09, 1.1)	1.32 (1.3, 1.34)	1.32 (1.3, 1.34)
Pakistan (2017-2018)	1.06 (1.06, 1.07)	1.06 (1.06, 1.07)	1.04 (1.04, 1.05)	1.04 (1.04, 1.05)
Pakistan (2012-2013)	1.1 (1.1, 1.11)	1.11 (1.1, 1.11)	1.13 (1.12, 1.13)	1.13 (1.12, 1.13)
Philippines (2017)	1.24 (1.23, 1.25)	1.24 (1.23, 1.25)	1.22 (1.21, 1.23)	1.22 (1.21, 1.23)
Philippines (2013)	1.19 (1.18, 1.2)	1.18 (1.17, 1.19)	1.04 (1.04, 1.05)	1.04 (1.03, 1.04)
Philippines (2008)	0.98 (0.98, 0.98)	0.98 (0.98, 0.98)	1.41 (1.39, 1.41)	1.41 (1.39, 1.41)

	0.99)	0.99)	1.43)	1.43)
Timor-Leste (2016)	0.97 (0.97, 0.97)	0.97 (0.97, 0.97)	0.9 (0.9, 0.9)	0.9 (0.9, 0.9)
Timor-Leste (2009-2010)	1.09 (1.08, 1.1)	1.1 (1.09, 1.11)	1.12 (1.11, 1.13)	1.12 (1.12, 1.13)
Central Asia				
Kyrgyz Republic (2012)	0.74 (0.73, 0.75)	0.74 (0.73, 0.75)	0.76 (0.75, 0.77)	0.75 (0.74, 0.76)
Tajikistan (2017)	0.83 (0.82, 0.83)	0.82 (0.82, 0.83)	0.79 (0.78, 0.8)	0.79 (0.78, 0.8)
Tajikistan (2012)	1.14 (1.13, 1.15)	1.14 (1.13, 1.15)	1.04 (1.03, 1.04)	1.04 (1.03, 1.04)
Europe				
Albania (2017-2018)	0.93 (0.92, 0.94)	0.94 (0.93, 0.94)	0.31 (0.3, 0.32)	0.31 (0.3, 0.32)
Armenia (2015-2016)	0.93 (0.92, 0.93)	0.93 (0.92, 0.94)	0.93 (0.92, 0.93)	0.93 (0.92, 0.94)
Armenia (2010)	1.88 (1.83, 1.93)	1.9 (1.85, 1.95)	2.57 (2.5, 2.65)	2.54 (2.47, 2.61)
Azerbaijan (2006)	4.46 (4.27, 4.65)	4.54 (4.35, 4.73)	1.43 (1.39, 1.46)	1.42 (1.39, 1.46)
Egypt (2014)	0.93 (0.92, 0.95)	0.93 (0.92, 0.95)	0.68 (0.66, 0.71)	0.69 (0.66, 0.71)
Egypt (2008)	1.31 (1.28, 1.33)	1.31 (1.28, 1.33)	0.53 (0.51, 0.55)	0.53 (0.51, 0.55)
Jordan (2017-2018)	0.75 (0.75, 0.76)	0.76 (0.75, 0.76)	0.81 (0.8, 0.81)	0.8 (0.79, 0.8)
Jordan (2012)	0.71 (0.7, 0.72)	0.71 (0.71, 0.72)	1.47 (1.46, 1.49)	1.47 (1.45, 1.48)
Latin America				
Bolivia (2008)	1.69 (1.67, 1.71)	1.69 (1.67, 1.71)	1.31 (1.3, 1.33)	1.31 (1.3, 1.33)
Colombia (2010)	1.23 (1.22, 1.23)	1.23 (1.22, 1.24)	1.31 (1.3, 1.33)	1.31 (1.3, 1.33)
Dominican Republic (2013)	1 (1, 1)	1 (1, 1)	1.23 (1.22, 1.24)	1.23 (1.22, 1.24)
Dominican Republic (2007)	0.97 (0.97, 0.97)	0.97 (0.97, 0.97)	1.46 (1.44, 1.47)	1.45 (1.44, 1.47)

Guatemala (2014-2015)	1.31 (1.29, 1.33)	1.31 (1.29, 1.33)	1.2 (1.19, 1.22)	1.2 (1.19, 1.22)
Guyana (2009)	0.9 (0.9, 0.91)	0.9 (0.9, 0.91)	1.28 (1.27, 1.29)	1.28 (1.27, 1.29)
Haiti (2016-2017)	1.16 (1.15, 1.16)	1.16 (1.15, 1.16)	0.99 (0.99, 0.99)	0.99 (0.99, 0.99)
Haiti (2012)	1.76 (1.71, 1.8)	1.76 (1.71, 1.8)	1.31 (1.29, 1.34)	1.31 (1.29, 1.34)
Haiti (2005-2006)	1.03 (1.03, 1.03)	1.03 (1.02, 1.03)	1.25 (1.23, 1.26)	1.25 (1.23, 1.26)
Honduras (2011-2012)	0.98 (0.97, 0.98)	0.98 (0.97, 0.98)	1.07 (1.06, 1.07)	1.07 (1.06, 1.07)
Honduras (2005-2006)	1.08 (1.07, 1.09)	1.08 (1.07, 1.09)	1.07 (1.06, 1.08)	1.07 (1.06, 1.08)
Peru (2012)	1.46 (1.44, 1.47)	1.46 (1.45, 1.48)	1.21 (1.2, 1.22)	1.21 (1.2, 1.22)
Peru (2011)	0.92 (0.91, 0.92)	0.92 (0.91, 0.92)	1.26 (1.25, 1.27)	1.26 (1.25, 1.27)
Peru (2009)	1.59 (1.57, 1.61)	1.59 (1.57, 1.61)	1.34 (1.32, 1.35)	1.33 (1.32, 1.35)
Peru (2007-2008)	1.56 (1.54, 1.57)	1.55 (1.53, 1.57)	1.16 (1.16, 1.17)	1.17 (1.16, 1.18)
Peru (2004-2006)	1.4 (1.38, 1.41)	1.4 (1.38, 1.41)	1.38 (1.37, 1.4)	1.39 (1.37, 1.4)
West North and Central Africa				
Angola (2015-2016)	1.49 (1.48, 1.5)	1.49 (1.48, 1.5)	1.36 (1.35, 1.37)	1.36 (1.35, 1.37)
Benin (2017-2018)	1.49 (1.48, 1.5)	1.49 (1.48, 1.5)	1.36 (1.35, 1.37)	1.36 (1.35, 1.37)
Benin (2011-2012)	0.91 (0.9, 0.91)	0.9 (0.9, 0.91)	1.15 (1.14, 1.15)	1.15 (1.14, 1.15)
Burkina Faso (2010)	1.27 (1.26, 1.28)	1.27 (1.26, 1.28)	1.7 (1.68, 1.71)	1.69 (1.68, 1.71)
Burundi (2016-2017)	1.23 (1.22, 1.24)	1.23 (1.22, 1.24)	1.02 (1.01, 1.02)	1.02 (1.01, 1.02)
Burundi (2010)	1 (1, 1)	1 (1, 1)	0.93 (0.93, 0.93)	0.93 (0.93, 0.93)
Cameroon (2011)	1.02 (1.02, 1.02)	1.02 (1.02, 1.02)	1.25 (1.24, 1.26)	1.25 (1.24, 1.26)

Chad (2014-2015)	1.11 (1.1, 1.12)	1.11 (1.1, 1.12)	1.31 (1.3, 1.33)	1.31 (1.3, 1.33)
Comoros (2012)	1.28 (1.27, 1.29)	1.28 (1.27, 1.29)	1.41 (1.4, 1.43)	1.41 (1.4, 1.43)
Congo (2011-2012)	0.97 (0.97, 0.98)	0.98 (0.97, 0.98)	0.97 (0.96, 0.97)	0.97 (0.96, 0.97)
Congo (2005)	0.89 (0.88, 0.9)	0.89 (0.88, 0.9)	0.81 (0.8, 0.82)	0.81 (0.8, 0.82)
Congo Democratic Republic (2013-2014)	0.88 (0.87, 0.88)	0.87 (0.87, 0.88)	1.06 (1.05, 1.06)	1.06 (1.05, 1.06)
Congo Democratic Republic (2007)	1.19 (1.18, 1.2)	1.19 (1.18, 1.21)	1.35 (1.33, 1.36)	1.34 (1.32, 1.36)
Cote d'Ivoire (2011-2012)	0.97 (0.97, 0.97)	0.97 (0.97, 0.97)	1.2 (1.19, 1.21)	1.2 (1.19, 1.21)
Eswatini (2006-2007)	1.2 (1.19, 1.21)	1.2 (1.19, 1.21)	1.09 (1.08, 1.1)	1.09 (1.08, 1.09)
Ethiopia (2016)	0.98 (0.98, 0.99)	0.99 (0.98, 0.99)	1.06 (1.05, 1.07)	1.07 (1.06, 1.07)
Ethiopia (2011)	1.65 (1.61, 1.69)	1.62 (1.59, 1.66)	1.73 (1.69, 1.77)	1.7 (1.66, 1.75)
Gabon (2012)	0.99 (0.99, 0.99)	0.99 (0.99, 0.99)	1.2 (1.19, 1.21)	1.2 (1.19, 1.21)
Gambia (2013)	1.12 (1.11, 1.12)	1.12 (1.11, 1.12)	1.33 (1.32, 1.34)	1.33 (1.32, 1.34)
Ghana (2014)	1.25 (1.23, 1.26)	1.25 (1.23, 1.26)	1.14 (1.13, 1.15)	1.14 (1.13, 1.15)
Ghana (2008)	0.97 (0.97, 0.98)	0.98 (0.97, 0.98)	0.77 (0.76, 0.78)	0.77 (0.76, 0.77)
Guinea (2012)	0.8 (0.79, 0.81)	0.8 (0.79, 0.81)	1.17 (1.16, 1.19)	1.17 (1.16, 1.19)
Kenya (2014)	1.27 (1.25, 1.29)	1.27 (1.25, 1.29)	1.29 (1.27, 1.31)	1.29 (1.27, 1.31)
Kenya (2008-2009)	1.35 (1.33, 1.36)	1.34 (1.33, 1.36)	1.24 (1.23, 1.25)	1.24 (1.23, 1.25)
Lesotho (2014)	1.11 (1.11, 1.12)	1.11 (1.11, 1.12)	1.16 (1.15, 1.16)	1.16 (1.15, 1.16)
Liberia (2013)	1.29 (1.27, 1.3)	1.29 (1.27, 1.31)	1.26 (1.25, 1.28)	1.26 (1.25, 1.28)
Liberia (2007)	1.17 (1.16, 1.19)	1.17 (1.16, 1.19)	1.22 (1.2, 1.24)	1.22 (1.2, 1.24)

Madagascar (2008-2009)	1.29 (1.28, 1.31)	1.29 (1.28, 1.31)	1.14 (1.13, 1.15)	1.14 (1.13, 1.15)
Malawi (2015-2016)	1 (1, 1)	1 (1, 1)	1.04 (1.03, 1.04)	1.04 (1.03, 1.04)
Malawi (2010)	0.92 (0.91, 0.92)	0.92 (0.91, 0.92)	0.87 (0.86, 0.88)	0.87 (0.86, 0.88)
Mali (2012-2013)	1.03 (1.03, 1.03)	1.03 (1.03, 1.03)	1.06 (1.06, 1.07)	1.06 (1.06, 1.06)
Mali (2006)	1.07 (1.07, 1.07)	1.07 (1.07, 1.07)	1.13 (1.12, 1.13)	1.13 (1.12, 1.13)
Mozambique (2011)	0.71 (0.71, 0.72)	0.72 (0.71, 0.72)	0.88 (0.88, 0.89)	0.88 (0.87, 0.89)
Namibia (2013)	1.21 (1.2, 1.21)	1.21 (1.2, 1.21)	1.04 (1.04, 1.05)	1.04 (1.04, 1.05)
Namibia (2006-2007)	1.01 (1.01, 1.01)	1.01 (1.01, 1.01)	0.99 (0.99, 1)	1 (0.99, 1)
Niger (2012)	1.37 (1.35, 1.38)	1.37 (1.35, 1.39)	1.58 (1.56, 1.61)	1.59 (1.56, 1.62)
Niger (2006)	1.26 (1.25, 1.28)	1.26 (1.25, 1.28)	1.16 (1.15, 1.17)	1.16 (1.15, 1.17)
Nigeria (2013)	0.94 (0.93, 0.94)	0.94 (0.93, 0.94)	0.91 (0.91, 0.92)	0.91 (0.91, 0.92)
Nigeria (2008)	1.15 (1.14, 1.16)	1.15 (1.14, 1.16)	1.34 (1.33, 1.36)	1.34 (1.33, 1.36)
Rwanda (2014-2015)	1.3 (1.29, 1.31)	1.3 (1.29, 1.31)	1.06 (1.05, 1.06)	1.06 (1.05, 1.06)
Rwanda (2010)	1.38 (1.38, 1.39)	1.38 (1.37, 1.39)	1.04 (1.04, 1.04)	1.04 (1.04, 1.04)
Sao Tome and Principe (2008-2009)	1.05 (1.05, 1.06)	1.06 (1.05, 1.06)	1.43 (1.41, 1.44)	1.43 (1.41, 1.44)
Senegal (2017)	1.19 (1.18, 1.2)	1.18 (1.17, 1.19)	1.17 (1.16, 1.18)	1.17 (1.16, 1.18)
Senegal (2016)	0.85 (0.83, 0.86)	0.84 (0.82, 0.85)	1.16 (1.14, 1.18)	1.16 (1.14, 1.18)
Senegal (2015)	1.05 (1.05, 1.06)	1.05 (1.05, 1.06)	1.08 (1.07, 1.08)	1.08 (1.07, 1.08)
Senegal (2014)	1.22 (1.21, 1.24)	1.22 (1.21, 1.24)	1.02 (1.02, 1.02)	1.02 (1.02, 1.02)
Senegal (2012-2013)	1.23 (1.22, 1.23)	1.23 (1.22, 1.23)	1.26 (1.25, 1.26)	1.26 (1.25, 1.26)

	1.25)	1.24)	1.28)	1.28)
Senegal (2010-2011)	1.03 (1.03, 1.03)	1.03 (1.03, 1.04)	0.91 (0.91, 0.92)	0.92 (0.91, 0.92)
Sierra Leone (2013)	1.43 (1.41, 1.45)	1.43 (1.41, 1.45)	1.41 (1.39, 1.43)	1.41 (1.39, 1.42)
Sierra Leone (2008)	0.96 (0.96, 0.97)	0.96 (0.96, 0.97)	0.91 (0.9, 0.91)	0.91 (0.9, 0.91)
South Africa (2016)	1.24 (1.23, 1.25)	1.24 (1.23, 1.25)	1.02 (1.02, 1.02)	1.02 (1.02, 1.02)
Tanzania (2015-2016)	1.11 (1.1, 1.12)	1.11 (1.11, 1.12)	1.21 (1.19, 1.22)	1.21 (1.2, 1.22)
Tanzania (2010)	1.24 (1.22, 1.26)	1.24 (1.23, 1.26)	1.22 (1.2, 1.23)	1.22 (1.2, 1.23)
Togo (2013-2014)	0.95 (0.95, 0.95)	0.95 (0.95, 0.95)	0.87 (0.87, 0.88)	0.87 (0.87, 0.88)
Uganda (2016)	1.2 (1.19, 1.21)	1.2 (1.19, 1.21)	0.95 (0.94, 0.95)	0.95 (0.94, 0.95)
Uganda (2011)	1.17 (1.16, 1.18)	1.17 (1.16, 1.18)	1.84 (1.81, 1.87)	1.84 (1.81, 1.87)
Uganda (2006)	1 (1, 1)	1 (1, 1)	1.09 (1.09, 1.1)	1.09 (1.09, 1.1)
Zambia (2013-2014)	1.22 (1.21, 1.23)	1.22 (1.2, 1.23)	1.08 (1.08, 1.09)	1.08 (1.08, 1.09)
Zambia (2007)	1.08 (1.07, 1.08)	1.09 (1.08, 1.09)	1.06 (1.05, 1.07)	1.06 (1.06, 1.07)
Zimbabwe (2015)	0.9 (0.9, 0.91)	0.9 (0.9, 0.91)	0.97 (0.97, 0.98)	0.97 (0.97, 0.98)
Zimbabwe (2010-2011)	0.75 (0.74, 0.76)	0.75 (0.74, 0.76)	0.88 (0.87, 0.89)	0.88 (0.87, 0.89)
Zimbabwe (2005-2006)	1.17 (1.16, 1.18)	1.17 (1.16, 1.18)	1.07 (1.07, 1.08)	1.07 (1.06, 1.08)

Figures

Figure 1

Box plot for (A) prevalence of antibiotic use by wealth index, (B) prevalence of diarrhea by mother education, (C) prevalence of diarrhea at different age groups of several DHS survey regions.

Figure 2

Global mapping of acute watery diarrhea prevalence in different DHS survey regions (A) South East Asia, (B) Central Asia, (C) Europe, (D) Latin America, and (E) North and Central Asia Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

Figure 3

Global mapping of antibiotic treatment prevalence for acute watery diarrhea in different DHS survey regions (A) South East Asia, (B) Central Asia, (C) Europe, (D) Latin America, and (E) North and Central Asia Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

Figure 4

Linear trend analysis of antibiotic use for AWD among (A) South East and Central Asia, (B) Europe, (C) Latin America, and (D) West North and Central Africa

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