Global access to handwashing: implications for COVID-19 control in low-income countries

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Abstract

Background

Low-income countries have reduced health care system capacity and are therefore at risk of substantially higher COVID-19 case fatality rates than those currently seen in high-income countries. Handwashing is a key component of guidance to reduce transmission of the SARS-CoV-2 virus, responsible for the COVID-19 pandemic. Prior systematic reviews have indicated the effectiveness of handwashing to reduce transmission of respiratory viruses. In low-income countries, reduction of transmission is of paramount importance but social distancing is challenged by high population densities and handwashing access is limited.

Objectives

To estimate global access to handwashing with soap and water to inform use of handwashing in the prevention of COVID-19 transmission.

Methods

We utilized observational surveys and spatiotemporal gaussian process regression modeling in the context of the Global Burden of Diseases, Injuries, and Risk Factors Study, to estimate access to a handwashing station with available soap and water for 1062 locations from 1990 to 2019.

Results

Despite overall improvements from 1990 (34.7\% [95\% uncertainty interval 32.5–36.7] without access) to 2019 globally, in 2019, 2.01 (1.89–2.13) billion people—26.0\% (24.4–27.6) of the global population lacked access to handwashing. More than 50\% of the population in sub-Saharan Africa were without access to handwashing in 2019, while in eight countries, more than 50 million persons lacked access.

Discussion

For populations without handwashing access, immediate improvements in access or alternative strategies are urgently needed, while disparities in handwashing access should be incorporated into COVID-19 forecasting models when applied to low-income countries.

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Introduction

In the initial months of the Coronavirus Disease 2019 (COVID-19) pandemic, the outbreak has been concentrated in middle- and high-income countries: initially China, followed by high-income east Asia, the Middle East, Europe, and North America. Even as health care systems in these relatively well-equipped regions are strained, there will soon be a need to focus on populations in low-income countries (LICs) where health care resources are limited, even before facing the demands of the pandemic. Along with social distancing, handwashing has been advised repeatedly as one of the key actions to reduce transmission of the SARS-CoV-2 virus, responsible for the COVID-19 pandemic. In a systematic review of physical interventions employed to reduce the transmission of respiratory viruses, handwashing was indicated to be effective with a meta-analytic summary estimate of a 45-55% reduction in transmission. Similarly, a systematic review of the effectiveness of personal protective measures in preventing H1N1 pandemic influenza transmission in human populations indicated a 38% reduction in transmission with handwashing, while mask use was less effective and data for cough etiquette insufficient. A review of influenza transmission in adults also concluded that handwashing was effective in reducing transmission.

While access to handwashing is near-universal in high-income countries, the same is not true for LICs. As limited access to handwashing facilities may promote the spread and magnitude of the COVID-19 pandemic in low-income countries, governments and aid agencies may prioritise rapid deployment of access or alternatives such as alcohol-containing handrub solutions to those locations without access. Further, application of COVID-19 forecasting models, especially those derived from high- and middle-income country data, to LICs may need to account for handwashing access.

In the context of the Global Burden of Diseases, Injuries, and Risk Factors Study, we estimated access to a handwashing station with available soap and water for 1062 locations from 1990 to 2019.

Methods

Access to a handwashing station with available soap and water was based on the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene definition for basic hygiene of “Availability of a handwashing facility on premises with soap and water,” where a handwashing facility was defined according to Sustainable Development Goal 6.2.1 as “a device to contain, transport or regulate the flow of water to facilitate handwashing.” This measure is a proxy of actual handwashing practice, but one with improved accuracy compared with other proxy measures such as self-reported handwashing. Country-specific Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), and Performance Monitoring and Accountability 2020 (PMA2020) surveys conducted from 2009 to 2019 were included as inputs to a mixed-effect linear regression model, followed by a spatiotemporal Gaussian process regression to model the proportion of the population with access to a handwashing station with available soap and water by year and location from 1990 to 2019. The linear regression model included as covariates the proportion of individuals with access to piped water (modeled in a similar fashion from country-specific surveys) and the Socio-demographic Index (SDI, a composite measure including income per capita, education, and fertility), with region and super-region random effects. In total 149 surveys from 88 countries were included as inputs (figure 1). All of the included data sources were from the years 2009–2019.
Results

In 2019, 2.01 (95% uncertainty interval [UI] 1.89–2.13) billion people—26.0% of the global population—were estimated to lack access to handwashing facilities. We estimated higher proportions without access in LICs, especially those in sub-Saharan Africa, south Asia and the Caribbean (figure 2). In 46 countries more than half of the population lacked access, and in eight countries (India, Nigeria, China, Ethiopia, Democratic Republic of the Congo, Bangladesh, Pakistan, Indonesia) more than 50 million persons were estimated to be without handwashing access. In India alone, some 482 million (372–601) people lacked access.

While these numbers are large, there have been substantial improvements in access to handwashing in many regions of the world (table 1). In particular, there were more than 25% reductions in lack of access from 1990 to 2019 in 17 countries and territories (Paraguay, Gabon, Bhutan, Equatorial Guinea, Oman, Botswana, São Tomé and Príncipe, Tanzania, Palestine, Guatemala, Nepal, Marshall Islands, Morocco, Tokelau, Tuvalu, Congo, Saudi Arabia) (appendix table 1, appendix figure 1A-1U). These reductions parallel region-wide improvements in some cases (eg, north Africa and the Middle East, Latin America) while others are unique examples within their respective regions (eg, Bhutan, Gabon, Equatorial Guinea, Tanzania, Botswana, São Tomé and Príncipe). Overall however, little progress has been made throughout most of sub-Saharan Africa. Access is strongly related to SDI although substantial variability is present at similar SDI levels and within regions (figure 3).

Discussion

Low-income countries have reduced health care system capacity and are therefore at risk of substantially higher COVID-19 case fatality rates than those currently seen in high-income countries. In this context, suppression of transmission has heightened urgency. Inadequate access to handwashing remains prevalent in many LICs, and this is likely to facilitate COVID-19 transmission. Rural populations have disproportionately poor access to handwashing facilities; for example, across India, state-level estimates ranged from 5% without access (Mizoram) to 30% (Odisha) in urban areas, and from 12% without access (rural Delhi) to 65% (Jharkhand) in rural areas. However, access is also limited in urban slums and other informal settlements. Our estimates indicate that, in 2019, 14% of the population in urban Delhi, 58% in Addis Ababa (province) and 52% in Nairobi (province) lacked handwashing access. Should the pandemic coincide with water shortages, such as those seen in Cape Town and Chennai in 2019, access will be further restricted and will disproportionately harm those who can least afford to pay for water. In densely-populated urban areas, social distancing is also very challenging given high population densities. Further, effective within-household quarantine is likely impossible with larger families living together in a single home. Reducing COVID-19 transmission in high-density urban areas with low access to handwashing may prove especially difficult and will require urgent attention and implementation of alternative strategies to those implemented in high- and middle-income countries.

Alcohol-containing handrub solutions are an efficacious alternative to hand washing with soap and water. Guidance exists for local production of handrub solutions, and evidence from prior epidemics supports the effectiveness of local production. However, reliance on handrub solutions is less desirable compared to handwashing given requirements for sustainable production and distribution, cost
implications for low-income populations, concerns regarding flammability of reagents, and the potential for poisoning due to ingestion. Further, access to handwashing with soap and water, while requiring larger initial investments, if can offer more equitable and lasting protection in future epidemics and also protect against non-epidemic transmission of diarrhoeal disease14 and lower respiratory infections15,16 if sufficiently maintained. Indeed, in 2017 inadequate access to handwashing was estimated to be responsible for 35% of the global diarrhoeal disease burden and 9.7% of the global burden from lower respiratory infections, in total accounting for 38.4 million DALYs (95% UI 22.8–52.0), and 707 000 deaths (416 000–1 022 000). Increases in these and other common causes of death unrelated to COVID-19 are also likely to be affected as LIC health care systems are overwhelmed during the pandemic.

Immediate efforts to increase handwashing access or alternatives could help alleviate some of the baseline disease burden from diarrhoea and lower respiratory infections during the pandemic and spare valuable resources to focus on COVID-19 cases.

Progress towards improving access to handwashing has been accelerated given the recognition of its importance in two of the Millennium Development Goals, reducing childhood mortality and combating HIV/AIDS, malaria, and other diseases, and more recently as part of Sustainable Development Goal 6: to ensure availability and sustainable management of water and sanitation for all, with the indicator 6.2.1 used in this analysis8. With estimates provided here for 2019, this analysis presents the most recent and comprehensive global estimates of handwashing access to date. We estimated access for 208 national and non-sovereign locations (eg, Guam, Puerto Rico) and 697 sub-national administrative areas. The enhanced spatial resolution gained by including sub-national locations reduces the potential for spatial misalignment between survey responses and population density, thereby providing a more accurate picture of the true population with access in each country, and offers policy makers more detailed and actionable evidence.

As in most global-scale analyses, these estimates include several limitations. Most importantly, while we developed comprehensive global estimates, the large number of potential sources with incomplete (for presence of a station, with water and with soap) input data was a considerable limitation and is reflected in the uncertainty in national-level estimates. These national level estimates are based on recently available survey data; however, the year of the most recent survey varies by location, also contributing to uncertainty. While our spatiotemporal model estimates incorporate trends to estimate access in 2019, input data are lagged by several years. Data coverage was best throughout Africa and relatively poor in South America and south and east Asia (figure 1). Further, these estimates likely do not reflect recent disruptive events such as conflict, recent large-scale migration, or natural disasters. These events are likely to increase the number of people living without access to handwashing and also to increase the number of people living in densely populated settings where social distancing is also challenged.

In the context of the global impact of COVID-19, inadequate access to handwashing affects a large proportion of the world’s population and may undermine strategies for control of disease transmission. For those locations currently without access, alternative strategies are urgently needed. To the extent that access can be implemented in the short-term, opportunities exist to both help reduce COVID-19 transmission and to reduce in the long-term the 707 000 deaths from diarrhoeal disease and lower respiratory infections that are attributable to no handwashing access. Finally, understanding disparities in handwashing access must be considered in COVID-19 forecasting models, especially when applied to low-income countries.
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Table 1. Percentage of population without access to handwashing with soap and water globally and by GBD region, 1990 and 2019. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. UI=uncertainty interval.

| Region                          | Percentage of population without access, 1990 (95% UI) | Percentage of population without access, 2019 (95% UI) |
|---------------------------------|--------------------------------------------------------|-------------------------------------------------------|
| Global                          | 34.7 (32.5–36.7)                                        | 26.0 (24.4–27.6)                                       |
| East Asia                       | 28.1 (26.0–30.1)                                        | 8.1 (7.3–9.0)                                          |
| Southeast Asia                  | 30.4 (25.8–35.7)                                        | 16.7 (14.2–19.8)                                       |
| Oceania                         | 63.5 (56.3–69.6)                                        | 56.5 (51.5–61.2)                                       |
| Central Asia                    | 13.9 (11.5–16.7)                                        | 7.8 (6.5–9.4)                                          |
| Central Europe                  | 5.7 (4.6–7.0)                                            | 2.8 (2.3–3.4)                                          |
| Eastern Europe                  | 6.5 (4.7–8.9)                                            | 3.9 (2.7–5.5)                                          |
| High-income Asia Pacific        | 6.8 (4.7–9.9)                                            | 5.1 (3.5–7.3)                                          |
| Australasia                     | 7.1 (4.4–10.5)                                            | 5.6 (3.5–8.4)                                          |
| Western Europe                  | 4.4 (3.7–5.3)                                            | 3.5 (2.9–4.2)                                          |
| Southern Latin America          | 22.4 (16.2–30.0)                                        | 8.0 (5.6–11.5)                                         |
| High-income North America       | 3.9 (2.4–5.9)                                            | 3.1 (1.9–4.7)                                          |
| Caribbean                       | 36.3 (32.5–40.4)                                        | 34.3 (31.6–37.0)                                       |
| Andean Latin America            | 25.0 (19.3–31.2)                                        | 13.1 (9.5–16.9)                                        |
| Central Latin America           | 19.0 (15.2–23.3)                                         | 10.6 (8.9–12.7)                                        |
| Tropical Latin America          | 31.0 (20.9–42.4)                                        | 13.9 (8.6–20.7)                                        |
| North Africa and Middle East    | 33.9 (30.9–37.4)                                        | 20.3 (18.6–22.0)                                       |
| South Asia                      | 57.3 (47.7–66.3)                                        | 34.4 (28.2–40.9)                                       |
| Central sub-Saharan Africa      | 90.0 (87.1–92.3)                                         | 81.5 (78.7–84.0)                                       |
| Eastern sub-Saharan Africa      | 92.6 (91.3–93.8)                                         | 83.4 (82.1–84.7)                                       |
| Southern sub-Saharan Africa     | 64.9 (57.2–72.8)                                         | 51.0 (45.6–56.8)                                       |
| Western sub-Saharan Africa      | 91.0 (88.6–92.7)                                         | 85.4 (83.3–87.4)                                       |
Figure Captions

Figure 1. Number of input data sources by country and territory, 2019.

Figure 2. Proportion of the population with no access to a handwashing station with soap and water in 2019.

Figure 3. Relationship between no access to a handwashing station with soap and water and SDI, by GBD region, 2019. SDI=Socio-demographic Index.
Figure 1. Number of input data sources by country and territory, 2019

Number of unique sources

- 1 to <3
- 3 to <5
- 5 to <7
- 7 to <9
- 9 to <11
- 11 to <13
- 13 to 15

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SDI=Socio-demographic Index