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Measuring the frequency and determinants of COVID-19 prevention behaviours: a cross-sectional assessment of large-scale programmes in seven countries, late 2020

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ABSTRACT

Objectives This multicountry analysis aimed to assess the prevalence of key hygiene prevention behaviours and their determinants, associated with international non-governmental organisation (WaterAid) hygiene behaviour change programmes for COVID-19 prevention. The goal of this analysis is to inform future outbreak preparedness and pandemic response in low and middle-income countries.

Design Cross-sectional study.

Setting Households in seven countries where WaterAid implemented a first-phase COVID-19 response programme in 2020 (Ethiopia, Ghana, Nepal, Nigeria, Rwanda, Tanzania and Zambia).

Participants 3033 adults (1469 men and 1564 women, alternately sampled from one household to the next to maintain gender balance) in specific programme areas (211 villages) surveyed between October and November 2020.

Primary outcome measures Self-reported primary outcomes were: a composite measure of HWWS for prevention of respiratory infection/COVID-19 (total of 5 key moments); respondent increased HWWS behaviour after the COVID-19 pandemic; respondent always wears a mask in public spaces; respondent always practices physical distancing in public spaces.

Results Most respondents (80%) reported increasing their handwashing behaviour after the pandemic, but practice of HWWS at COVID-19-specific prevention moments was low. Mask wearing (58%) and physical distancing (29%) varied substantially between countries. Determinants of key behaviours were identified, including age and socioeconomic status, perceived norms, self-regulation and the motive of protecting others. Incidence rate ratios or odds ratios and 95% CIs for a range of psychosocial determinants for each of the four primary outcomes are reported.

Conclusions These findings highlight that leveraging behaviour-specific emotional drivers and norms, reducing common barriers and promoting targeted messages about specific behaviours and actions individuals can take to reduce risk are necessary to support large-scale behaviour change. Learning from the COVID-19 response to more effectively integrate novel behaviours into existing health promotion will be vital for disease prevention and outbreak resilience.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Strengths of the study include analysis of a large dataset drawn from a rapid assessment of COVID-19 response programmes across seven low- and middle-income countries.
⇒ We examined novel COVID-19-specific handwashing moments alongside routine key moments for handwashing with soap (HWWS) as well as a wide variety of behavioural predictors for three self-reported prevention behaviours (HWWS, mask wearing and physical distancing).
⇒ Another strength was the reliance on face-to-face household surveys, avoiding some of the selection biases associated with online and telephone surveys frequently used in COVID-19 contexts.
⇒ The measures and associations were consistent across countries; however, indices are a crude representation of complex psychological and social phenomena.
⇒ Other limitations include the risk of bias associated with use of self-reported measures of behaviour and the lack of a comparison group to enable causal inference.

INTRODUCTION

Before mass vaccination, COVID-19 response programmes typically focused on preventive behaviours of hand hygiene, mask use and physical distancing—all seen as a key for reducing transmission and preventing health systems from becoming overburdened. Each of these are different behaviours and facilitating them in low-resource contexts comes with unique challenges. For example, handwashing with soap (HWWS) is a pre-existing, routine behaviour. Global evidence suggests that most people understand the health

benefits of HWWS and know how to do it.[1] However, prior to the COVID-19 pandemic, the prevalence of HWWS at critical times (such as after using the toilet) in low- and middle-income countries (LMICs) was low.[2] More than a quarter of the global population lacked access to a basic handwashing facility with soap and water at home.[3] Water scarcity in many countries also made it hard to prioritise water for handwashing[4–8] and shared water, sanitation and hygiene (WASH) facilities created concerns for COVID-19 transmission.[9 10]

In contrast, mask use was an unfamiliar behaviour to most people prior to the pandemic. Affordable and equitable access to masks (both medical and fabric masks) was limited—particularly during the early stages of the pandemic, as medical-grade masks were often prioritised for staff working in healthcare settings.[11 12] Hygienic use of masks was challenging in settings where there were high levels of environmental contamination and where laundry is typically done by hand.[13] Physical distancing was also a novel behaviour in most LMICs, often running counter to religious or cultural norms, and it was difficult to enforce or regulate due to large proportions of the population living in densely populated areas and informal settlements.[14] Asking people to reduce unnecessary travel and remain at home came at a much higher socioeconomic cost to communities in LMICs due to people, on average, having larger families; smaller houses; being more reliant on daily earnings; having fewer opportunities for collaborating remotely (eg, access to phones and Wi-Fi) and due to a lack of formal social support mechanisms or financial assistance.[14–17]

Communicating about these behaviours or undertaking behaviour change interventions during the pandemic was also particularly challenging in LMICs where health and hygiene promotion programmes have historically prioritised face-to-face interactions with communities due to inequities in access to mass and digital media.[18 19] Identifying effective strategies to promote adoption of key behaviours in diverse contexts over a period of rapid change was key to improving the ongoing pandemic response and will be key for future pandemic preparedness.

In 2020, WaterAid launched COVID-19 hygiene response programmes in 26 countries. The multicountry approach was underpinned by behavioural theory and a common global strategy but was tailored to national and subnational contexts. After 6 months of initial implementation, WaterAid completed a mid-term rapid assessment (MTRA) of targeted COVID-19 behaviours across eight countries, to inform the next phase of the response, of which data from seven were analysed and discussed in this paper. Data were collected about factors that were influencing key COVID-19 prevention behaviours, including sociodemographic factors, exposure to COVID-19 prevention programmes and other behavioural determinants (eg, knowledge, norms, barriers, motives), with the aim of informing ongoing pandemic programming and future outbreak resilience. Building off this robust dataset, the objectives of the present analysis were to estimate the prevalence of key COVID-19 prevention behaviours—handwashing, mask wearing and physical distancing—across seven LMICs included in the MTRA and explore relationships with key determinants.

WaterAid COVID-19 response

WaterAid adapted their existing WASH-related national behaviour change programmes to incorporate COVID-19-specific behaviours. The first phase of the response in May–December 2020 focused on promoting key hygiene behaviours, such as HWWS, covering the mouth and nose when coughing or sneezing, wearing a mask in public places, cleaning/disinfecting frequently touched surfaces and maintaining physical distance. In this first phase, these public health behavioural messages were delivered through non-contact methods such as mass media, digital and social media. The response also included installing handwashing facilities (mostly hands-free, peddle-operated design) and soap in public locations and institutions. Later in the second phase, January–April 2021, communities were reached with face-to-face behaviour change motivational activities, including cues, depending on in-country lockdown measures. Further details of the programme delivery and intervention design in each country are found in online supplemental file 1.

METHODS

The MTRA consisted of cross-sectional face-to-face household surveys consisting of close-ended questions with precoded responses in Ethiopia, Ghana, Nepal, Nigeria, Rwanda, Tanzania and Zambia. The data were collected during October and November 2020, with data collection taking up to 2 weeks to complete in each country. Data were collected by trained field staff in each country; the MTRA survey was completed during the same 4-week period across all eight countries. Verbal informed consent was collected from each participant at the start of the survey; data collection instruments including consent statements are provided as online supplemental file 2.

Sampling

In each country, the target population was all adults living within selected geographical areas where WaterAid had implemented its first-phase COVID-19 hygiene promotion and behaviour change response. In each country, the sampling process differed slightly depending on resources, logistical constraints, population data availability and data requirements. Men and women were alternately sampled from one household to the next to ensure an even gender ratio in the sample. Details of the sampling approach are found in online supplemental file 1.

Measures

Key demographic variables including household and respondent demographics and outcome variables were

checked for missing and impossible values. All analyses were conducted by country and at the global level. We used principal component analysis (PCA) on eight household asset indicators at the country level to construct a household wealth index and divided this into country-specific relative wealth quintiles to use as a covariate in analyses.

Primary outcomes for all analyses were self-reported COVID-19 behaviours targeted by WaterAid's communications and behaviour change programmes. Specifically, these included HWWS at key moments, mask use and physical distancing. Descriptions of each outcome and determinant and items used to construct them are available in online supplemental file 3.

Multiple measures of self-reported hand hygiene were collected in the MTRA survey. Questions related to key moments where HWWS was practised referred to general behaviour without a specific recall period ('When do you wash your hands with soap and water?' with multiple responses). Exploratory PCA of self-reported hand hygiene at key moments identified three distinct, related behaviours that were used for future analyses: (1) a binary indicator of HWWS after toilet use; (2) a binary indicator of HWWS before eating and (3) a composite measure of HWWS for prevention of respiratory infection/COVID-19 (COVID-19 HWWS index), scored 0 to 3, consisting of self-reported HWWS after touching frequently touched surfaces, coming in contact with someone outside the household, or sneezing/coughing. Additionally, we created a binary variable among respondents for self-reported increase in handwashing during the pandemic compared with no change or reduced handwashing.

For mask wearing, we defined a binary indicator based on individuals reporting always wearing a face mask in public spaces versus reporting sometimes or never wearing a face mask.

For physical distancing, we defined a binary indicator for individuals reporting always practising physical distancing when in public spaces (1 or 2 m from others, depending on the country) versus sometimes or never practising physical distancing.

A range of possible determinants of self-reported behaviour were captured in the MTRA survey informed by drawing on theoretical frameworks including the risks, attitudes, norms, abilities and self-regulation model.[20 21] These corresponded to broad domains of knowledge, barriers, motives and norms. Questions related to knowledge and barriers were yes/no questions (eg, agreement with 'Water is too expensive to purchase for handwashing') while questions related to motives and norms were 5-point Likert-style questions (eg, with responses ranging from 'strongly disagree' to 'strongly agree'). To simplify analysis, we grouped all possible questions related to a specific theoretically informed determinant. If data were available on three or more questions, we used PCA to create a simple index based on responses, using a tetrachoric correlation matrix for binary variables (knowledge and barriers) and a Pearson correlation matrix for Likert-style responses (motives and norms). Validation involved verification that data presented only one principal component with an eigenvalue greater than 1, confirmation that similar patterns across countries were observed when performing the analysis at the country level and assessment of internal consistency among items included in indices using Cronbach's alpha. This was the case for all indices. Indices were rescaled to range from 0 to 3 in order to assess changes in outcomes associated with low, medium and high levels of the determinants. Indicators derived from two items (action knowledge indicators) were a simple total of the two.

Measures of the following determinants were developed during exploratory analysis:

Action knowledge—knowledge about when to practice a specific behaviour—was operationalised as the total of two dichotomous variables, indicating whether the respondent had named the respective behaviour as a protective behaviour against COVID-19 for themselves or others. *Procedural knowledge* referred to participants' knowledge about how to perform the respective protective behaviour. For HWWS, procedural knowledge referred to knowledge about the correct key situations for HWWS. In line with the three outcomes of HWWS behaviour, we distinguished three dimensions of procedural knowledge: knowing to wash hands before eating, knowing to wash hands after toilet use and knowing to wash hands in situations specifically relevant to prevent a COVID-19 infection. For mask wearing, procedural knowledge referred to knowing the situations when to wear a mask. For physical distancing, procedural knowledge referred to knowing its definition, that is staying 1 m or 2 m (depending on the country) from others. Questions on self-regulation—factors that help the individual in managing conflicting goals and distractions when implementing or maintaining a behaviour[20]—were available for HWWS and mask use.

Barriers referred to the obstacles that participants reported regarding the respective protective behaviour. For each target behaviour, participants were asked if anything prevented them from practicing the behaviour, and then asked whether specific barriers were present. Based on exploratory analysis, three types of barriers were distinguished related to HWWS: barriers related to the availability, costs of and access to soap; barriers related to the availability, costs and quality of water and barriers related to self-regulation such as forgetting or being too busy for HWWS. For mask wearing, barriers included availability of masks (eg, costs, lack of knowledge of where to buy or how to make a mask); comfort (eg, difficulties breathing, feeling too hot under a mask); social barriers (ie, fear of being judged by others) and self-regulation (ie, forgetting). For physical distancing, barriers included: response efficacy (beliefs as to whether the recommended action step will avoid the threat that is, prevent COVID-19) and barriers related to lack of space.

Norms referred to the perceived social pressure to engage in the respective protective behaviour. Two dimensions

of norms were distinguished: descriptive norm referred to the respondents' perception of whether other people engage in the respective protective behaviour (Likert-style responses ranged from 'nobody' to 'all of them'); and injunctive norm referred to the respondents' perception of whether other people approved the respondent to engage in the respective protective behaviour (Likert-style responses ranging from 'not at all' to 'extremely').

Motives described participants' feelings and perceived benefits of executing the respective behaviour. For HWWS, the belief that HWWS protects from COVID-19, pride, attractiveness and feeling clean to others were included. For mask wearing, fear of contracting COVID-19 if somebody next to the respondent did not wear a mask, the belief that wearing a mask protects from COVID-19, pride, and respect from others were considered. For physical distancing, fear of contracting COVID-19 if not practising physical distancing, the belief that physical distancing protects from COVID-19, pride and respect were included.

Variables related to self-reported exposure to any COVID-19 communications (not limited to WaterAid communications) were converted to categorical variables for inclusion in analyses, with three levels:

1. No exposure to any COVID-19 communication.
2. Exposure to COVID-19 communications but not on the behaviour of interest.
3. Exposure to COVID-19 communications on the behaviour of interest.

Data analysis

We conducted descriptive analysis of primary behavioural outcomes globally, and at the country level. Primary outcomes were disaggregated by gender, age, disability, location and relative household wealth (online supplemental file 3).

Primary outcomes were assessed using mixed effects regression analyses with the full, multicountry dataset (including country and sampling cluster as random intercepts), with fixed slopes. Poisson regression was used for the outcome of handwashing moments for COVID-19 prevention and logistic regression was used for all other outcomes. We retained four outcomes for the regression analyses due to their relevance for COVID-19 prevention: COVID-19 HWWS index, increase in HWWS behaviour after the COVID-19 pandemic, mask wearing in public spaces and physical distancing.

Exploratory bivariable regressions were used to explore relationships between each of the potential determinants (demographics, exposure to COVID-19 communications, knowledge and norms related to the targeted behaviour, motives, barriers, household WASH access and exposure/effects of COVID-19) and self-reported behaviours. Among demographic variables, those having a significant association (at the 5% level) with at least one outcome were retained for inclusion in multivariable models—seven demographics were retained (location, gender, age, education, disability status of the respondent, disability status of any member of their household, relative household wealth quintile).

Exploratory multivariable regressions were then used to predict the self-reported behaviours through multiple determinants. Three multivariable regression models were analysed for each outcome: (1) the selected demographics, (2) behavioural factors (motives, barriers, knowledge and norms) and (3) exposure to COVID-19 communications, with models 2 and 3 adjusted for selected demographics. Country-specific workshops were held, and insights generated from these results informed subsequent interventions during the COVID-19 hygiene response, including a community-based behaviour change campaign in the second phase.

In a final stage of the analysis, all regression models were additionally adjusted for the country-specific value of the COVID-19 stringency index[22] at the midpoint of the data collection period, a composite measure of government control measures including school closures, workplace closures and travel bans.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

RESULTS

Respondent characteristics

Sampled individuals, villages and geographic location (urban/peri-urban/rural) in the seven countries included are shown in table 1. In total, 3033 individuals were surveyed across the seven countries. While all

Table 1 Demographic characteristics of respondents and their households by country

Country	Global	Ethiopia	Ghana	Nepal	Nigeria	Rwanda	Tanzania	Zambia
Individuals	3033	505	387	497	422	423	395	404
Villages/communities	211	8	39	25	48	47	11	33
Geographic area: n (%)								
Urban	1302 (42.9)	505 (100)	0 (0)	144 (29.0)	183 (43.4)	85 (20.1)	154 (39.0)	231 (57.2)
Peri-urban	712 (23.5)	0 (0)	90 (23.3)	160 (32.2)	149 (35.3)	106 (25.1)	154 (39.0)	53 (13.1)
Rural	1019 (33.6)	0 (0)	297 (76.7)	193 (38.8)	90 (21.3)	232 (54.9)	87 (22.0)	120 (29.7)

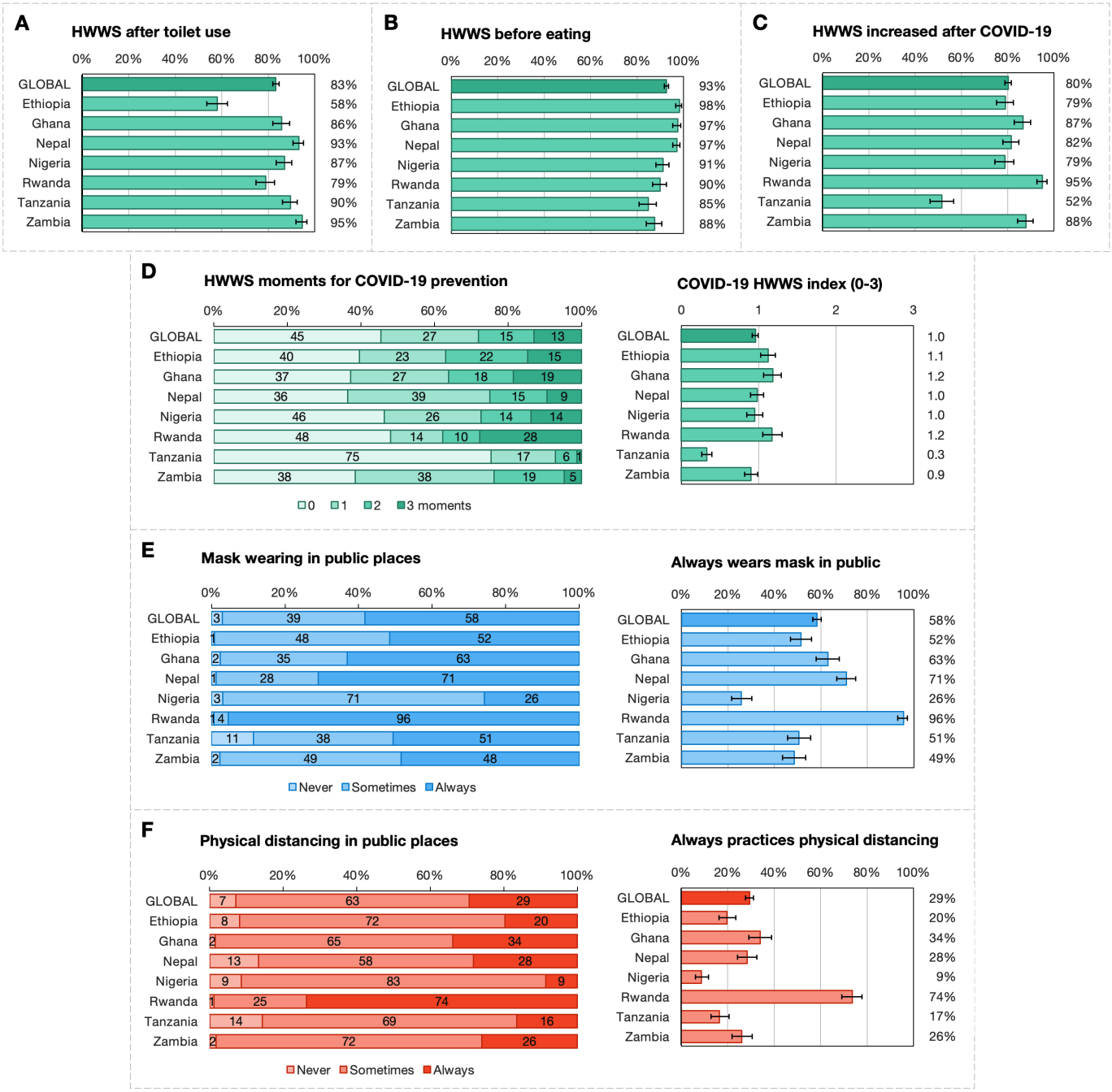

Figure 1 Global and country-level prevalence and means of self-reported COVID-19 prevention outcomes in seven countries where WaterAid worked. (A) HWWS after toilet use (%). (B) HWWS before eating (%). (C) Increase in HWWS behaviour after the COVID-19 pandemic (%). (D) COVID-19 HWWS index, distribution of key moments and mean values. (E) Mask wearing in public spaces (%). (F) Physical distancing (%). HWWS, handwashing with soap.

respondents lived in urban areas in Ethiopia and Ghana, in other countries, respondents resided in a mix of urban, peri-urban and rural areas. Details of individual and household demographics and household access to WASH facilities are in online supplemental file 3.

We removed 26 surveys where consent was unclear, and six respondents who self-identified as transgender or did not report their gender (too few observations to include in multivariable analyses).

Prevalence of COVID-19 preventive behaviours

Figure 1 presents mean values and SD for self-reported HWWS, as well as mask wearing in public spaces, and physical distancing.

More than 80% of participants globally reported that their HWWS practice had increased since the start of the pandemic (figure 1C). This increase was similar across most countries, except in Rwanda (95%) and Tanzania (52%). Across all countries, more than 80% and more

than 90% of participants reported HWWS after toilet use and before eating, respectively (figure 1, panels A and B). In contrast, regarding the COVID-19 HWWS index, out of the three possible moments, the mean number of moments at which participants reported washing hands with soap was one moment (figure 1D, right). This finding was similar across countries except for Tanzania with a mean of 0.3 moments. figure 1D also presents a more detailed picture of self-reported handwashing behaviour for COVID-19 prevention on the left. Across all datasets, 45% of respondents did not report HWWS at any of the key COVID-19-related junctures. Even fewer respondents practised any COVID-19 protective HWWS in Tanzania (75% reported no key moments) (At the time of the survey the government of Tanzania did not recognise COVID-19; therefore, the campaign was framed slightly differently as prevention behaviours for communicable diseases). Twenty-eight per cent of respondents practised HWWS at two or more key moments for COVID-19. Consistent HWWS in all three situations was reported by few participants across countries ranging from 1% of Tanzanian respondents to 28% of Rwandan respondents.

Prevalence of always wearing a face mask varied considerably by country (figure 1E, right), with nearly all respondents in Rwanda (96%) and few (26%) in Nigeria always wearing a mask. Globally, only 3% of respondents reported never wearing a face mask (figure 1E, left); 58% of participants reported always wearing a face mask in public places while 39% reported to sometimes wear a face mask.

While in public, 29% of respondents globally reported to always practice physical distancing (figure 1F, right). Physical distancing was most practiced in Rwanda, with 74% reporting that they always maintain a distance in public.

Relationships with demographic characteristics

Table 2 displays multivariable regression analyses of COVID-19 prevention outcomes against selected respondent and household demographics. For the COVID-19 HWWS index, relationships between demographic variables and self-reported behaviour are displayed as incidence rate ratios with corresponding 95% CIs. For other outcomes, results are displayed as ORs with corresponding 95% CIs. Gender, age, education, household member with disability and wealth were significantly associated with HWWS moments for COVID-19 prevention. Gender and household wealth were significantly associated with odds of increasing handwashing behaviour after the pandemic.

Respondents over 50 years old (OR: 1.47) and respondents with at least primary (OR: 1.72) or secondary (OR: 1.80) education were more likely to wear a mask in public (table 2). Odds of practising physical distancing were higher among women (OR: 1.27) and increased with age.

Relationships with behavioural determinants

We conducted multivariable regression analyses in order to quantify how the behavioural factors discussed (knowledge, norms, motives and barriers) related to the behavioural outcomes of interest (table 3). Procedural knowledge was consistently positively associated with HWWS, and individuals who believed that the behaviour protected others from COVID-19 (action knowledge) tended to report having increased their handwashing behaviour. Fear of COVID-19 was moderately positively associated with an increase in HWWS since the beginning of the pandemic.

Normative considerations were associated with mask wearing and physical distancing outcomes: individuals who perceived others to practice the behaviour more frequently (descriptive norm) and who perceived others to approve of practising the behaviour (injunctive norm) were more likely to report mask wearing and physical distancing.

The effect sizes for descriptive norms were consistently greater than those of injunctive norms for these behaviours. Self-regulation in particular was a significant barrier for HWWS and mask wearing. Respect from the community was positively associated with physical distancing.

Relationships with COVID-19 communications

Multivariable regression analyses were used to explore relationships between exposure to COVID-19 communications and key behaviours, after adjusting for the selected demographics. Exposure to any communications and exposure to messages specific to each key behaviour were compared with a baseline of no communications heard.

Respondents who recalled hearing messages specific to handwashing practiced 30% more HWWS moments for COVID-19 prevention and had over three times greater odds of HWWS after toilet use and having increased handwashing behaviour after the pandemic, compared with those who heard no COVID-19 communications (table 4). The respondent having heard any COVID-19 communications and specific messages on the key behaviour were both associated with significantly higher odds of wearing a mask (ORs: both 2.18). In contrast, recalling general COVID-19 communication was not associated with any of the handwashing outcomes or physical distancing.

The country-level value of the COVID-19 stringency index at the time of data collection was not associated with any primary outcome and adjustment for stringency index did not alter findings (not shown); results are presented for models without this variable.

DISCUSSION

In line with other analyses of COVID-19 behaviours in LMICs,[23–25] we found that 80% of respondents in the seven studied countries in our analysis reported increasing their handwashing practice in response to the pandemic and over half reported always wearing a mask in public, whereas only 29% practised physical distancing, a more demanding behaviour that had low levels of adoption throughout the pandemic.[25] The substantial between-country variability in mask wearing and physical

Table 2 Multivariable regression analyses of COVID-19 prevention outcomes on selected respondent and household demographics in seven countries where WaterAid worked

	COVID-19 HWWS index (0–3)		HWWS increased		Always wears a mask		Always physically distances	
	IRR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Demographics								
Geographic location								
Urban	Ref		Ref		Ref		Ref	
Peri-urban	0.97	(0.73 to 1.28)	0.75	(0.42 to 1.31)	0.86	(0.50 to 1.47)	0.51*	(0.29 to 0.88)
Rural	0.93	(0.72 to 1.22)	0.86	(0.50 to 1.49)	1.12	(0.66 to 1.88)	0.82	(0.48 to 1.40)
Respondent gender								
Male	Ref		Ref		Ref		Ref	
Female	0.88*	(0.81 to 0.95)	1.25*	(1.00 to 1.56)	1.12	(0.92 to 1.37)	1.27*	(1.02 to 1.58)
Respondent age								
18–25	Ref		Ref		Ref		Ref	
26–50	1.22*	(1.08 to 1.39)	1.33	(0.97 to 1.82)	0.99	(0.75 to 1.31)	1.46*	(1.06 to 2.02)
> 50	1.34*	(1.15 to 1.56)	1.32	(0.89 to 1.96)	1.47*	(1.03 to 2.09)	1.83*	(1.22 to 2.73)
Respondent education								
No education completed	Ref		Ref		Ref		Ref	
Primary school completed	1.15*	(1.03 to 1.29)	1.68*	(1.25 to 2.26)	1.72*	(1.31 to 2.26)	1.29	(0.96 to 1.71)
Secondary school or higher completed	1.23*	(1.08 to 1.39)	1.36	(0.98 to 1.90)	1.80*	(1.32 to 2.47)	1.22	(0.86 to 1.74)
Respondent has disability	1.00	(0.90 to 1.11)	0.73*	(0.56 to 0.96)	1.19	(0.92 to 1.52)	1.16	(0.88 to 1.52)
Member of household has disability	0.87*	(0.78 to 0.96)	1.02	(0.78 to 1.35)	0.83	(0.65 to 1.06)	0.99	(0.76 to 1.29)
Household relative wealth quintile								
Lowest	Ref		Ref		Ref		Ref	
Second	1.13	(0.98 to 1.31)	1.83*	(1.29 to 2.59)	1.29	(0.94 to 1.77)	0.92	(0.64 to 1.33)
Middle	1.24*	(1.07 to 1.43)	1.66*	(1.17 to 2.36)	1.25	(0.90 to 1.72)	1.19	(0.83 to 1.70)
Fourth	1.28*	(1.09 to 1.51)	1.75*	(1.19 to 2.58)	1.39	(0.97 to 1.99)	0.95	(0.63 to 1.44)
Highest	1.50*	(1.27 to 1.78)	2.28*	(1.46 to 3.58)	2.41*	(1.60 to 3.62)	1.23	(0.79 to 1.93)

Mixed effects Poisson regression models used for COVID-19 HWWS index (0–3), with random intercepts for country and village—coefficients (ratio of HWWS moments mentioned) and 95% CIs displayed. Mixed effects logistic regression models used for other outcomes, with random intercepts for country and village—ORs and 95% CIs displayed.
*Effect significant at the 5% level.
HWWS, handwashing with soap; IRR, incidence rate ratio.

distancing behaviours—echoed in other estimates of self-reported mask wearing in LMICs[26–33] ranging from 28% in the Philippines[31] to over 90% in Mozambique[26]—may have reflected differing national pandemic responses, with higher adherence where behaviours were mandatory or already in common practice.[12 34] Over the study period (October–November 2020), most countries relaxed restrictions to a small degree, with a mean stringency index of 54.4 at the start and 48.4 at the end for the studied countries.[22] We note that countries with the highest mean stringency index (Rwanda; 72.7) had the highest self-reported behaviours, and vice versa for the lowest (Tanzania; 14.8), although the stringency index at a single fixed point did not explain variation in outcomes in our analysis. While handwashing had reportedly increased, a notable finding was the very limited practice of HWWS at key moments associated with COVID-19 prevention compared with established key moments (after toilet use and before eating). Although other analyses of hygiene behaviours during the COVID-19 pandemic often lack detail on key handwashing moments,[34] one study in Indonesia also observed a lower frequency of HWWS at similar COVID-19 prevention moments.[35]

Table 3 Multivariable regression analyses of COVID-19 prevention outcomes on all behavioural factors (knowledge, barriers, norms and motives), adjusted for key demographics variables, in seven countries where WaterAid worked

	COVID-19 HWWS index (0–3)		HWWS increased		Always wears a mask		Always physically distances	
	IRR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Behavioural factors†								
Knowledge								
Action knowledge for specific behaviour	1.02	(0.89 to 1.18)	1.66*	(1.17 to 2.36)	1.27	(0.90 to 1.79)	0.95	(0.67 to 1.35)
Procedural knowledge for HWWS								
Moments for prevention of respiratory infection (0–3)	2.04*	(1.94 to 2.14)	1.10	(0.93 to 1.31)				
After toilet use			0.90	(0.62 to 1.30)				
Before eating			2.71*	(1.74 to 4.23)				
Procedural knowledge for mask wearing								
Situations where necessary (0–3)					1.03	(0.92 to 1.15)		
Procedural knowledge for physical distancing								
Definition of physical distancing							1.42	(0.92 to 2.19)
Barriers								
HWWS								
Soap (0–3)	0.95	(0.89 to 1.01)	1.00	(0.84 to 1.18)				
Water (0–3)	0.98	(0.91 to 1.06)	0.76*	(0.61 to 0.94)				
Self-regulation (0–3)	0.90*	(0.84 to 0.97)	0.88	(0.73 to 1.06)				
Mask wearing								
Availability (0–3)					0.69*	(0.59 to 0.82)		
Comfort (0–3)					0.90	(0.80 to 1.01)		
Pride (0–3)					1.11	(0.69 to 1.80)		
Self-regulation					0.52*	(0.40 to 0.68)		
Physical distancing								
Response efficacy							0.88	(0.56 to 1.38)
Space (0–3)							0.74*	(0.66 to 0.84)
Norms								
Descriptive norm specific to behavioural outcome (0–3)	0.99	(0.93 to 1.07)	1.17	(0.97 to 1.41)	1.90*	(1.55 to 2.33)	1.78*	(1.47 to 2.14)
Injunctive norm specific to behavioural outcome (0–3)	1.02	(0.94 to 1.11)	1.06	(0.84 to 1.33)	1.74*	(1.38 to 2.19)	1.42*	(1.11 to 1.83)
Motives								
General fear of COVID-19	1.07	(0.97 to 1.17)	1.33*	(1.06 to 1.67)	1.15	(0.94 to 1.41)	0.92	(0.74 to 1.14)
Motives specific to behavioural outcome								

Continued

Table 3 Continued

	COVID-19 HWWS index (0–3)		HWWS increased		Always wears a mask		Always physically distances	
	IRR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Belief that behaviour protects others from COVID-19 (0–3)	1.01	(0.90 to 1.13)	1.48*	(1.09 to 2.01)	1.24	(0.93 to 1.66)	1.04	(0.73 to 1.49)
Pride in practising behaviour (0–3)	0.99	(0.87 to 1.13)	1.27	(0.91 to 1.77)	1.15	(0.90 to 1.46)	1.11	(0.81 to 1.51)
Belief that behaviour makes respondent attractive to others (0–3)	1.07	(0.95 to 1.20)	1.22	(0.90 to 1.67)				
Belief that behaviour makes respondent clean to others (0–3)	1.00	(0.88 to 1.14)	0.64*	(0.46 to 0.89)				
Fear of contracting COVID-19 if behaviour is not practised (0–3)					1.15	(0.89 to 1.49)	1.33	(0.97 to 1.83)
Respect from community for practicing behaviour (0–3)					1.02	(0.82 to 1.26)	1.38*	(1.06 to 1.80)

Mixed effects Poisson regression models used for COVID-19 HWWS index (0–3), with random intercepts for country and village—coefficients (ratio of HWWS moments mentioned) and 95% CIs displayed. Mixed effects logistic regression models used for other outcomes, with random intercepts for country and village—ORs and 95% CIs displayed.
*Effect significant at the 5% level.
†Also adjusted for key demographic and household variables (geographic location, respondent gender, age, education level and disability, household member with disability and relative household wealth quintile.
HWWS, handwashing with soap; IRR, incidence rate ratio.

Regression analyses provided evidence on the demographic characteristics of those who have adopted prevention behaviours and those who might be a focus of future response. Respondent education and relative household wealth were positively associated with multiple behaviours, and residents of peri-urban areas were less likely to practice physical distancing than those in urban areas, perhaps reflecting the spatial and economic limitations to mitigation behaviours in crowded informal settlements and low-resource communities.[14 31] Additionally, respondents over 50 years old were more likely to practice HWWS for COVID-19 prevention, mask wearing and physical distancing than those under 50. This is corroborated by other research indicating increased reporting of COVID-19 prevention behaviours among older age groups in other LMICs.[25 26 34 36 37] Young people may have a perceived lower vulnerability to COVID-19, but critically can still transmit pathogens to high risk groups.[38] Other research has indicated that younger people may also be more affected by social norms and could be effectively motivated by prosocial motives of keeping families and communities safe.[38] In LMICs, which largely have younger populations compared with high-income countries,[39] differences in behavioural practice by age and wealth highlight the opportunity to develop targeted and age-appropriate messages for younger populations and more vulnerable segments of the population[12 39] that use evidence of motives and drivers of prevention behaviours.

We explored the various factors that might influence uptake of COVID-19 prevention behaviours. As expected from the associations with wealth and location, we found that mask availability and adequate space were significant barriers to mask wearing and physical distancing behaviours, respectively. Barriers related to self-regulation were significant predictors of HWWS and mask wearing. Future interventions promoting these behaviours might, therefore, seek to use visual cues or 'nudges'[40 41] to provide a reminder to practice behaviours and increase availability of masks to facilitate behaviours.

Fear of contracting COVID-19 and knowledge of protective behaviours predicted HWWS but no other behaviours, reflecting mixed evidence of the influence of these constructs on prevention behaviours.[27 33 42–44] In contrast, norms significantly predicted multiple behaviours, with descriptive norms as consistently stronger predictors than injunctive norms. Uptake of prevention behaviours can be induced by observing similar behaviour in the community or, conversely, discouraged if few are seen to comply.[44 45] Descriptive norms were strong predictors of prevention behaviours in other settings,[32 35] and an analysis of predictors of COVID-19 behaviours in 28 countries using machine learning identified injunctive norms as the strongest predictors of behavioural adoption, with descriptive norms ranking highly.[44] Public commitments have been widely used to promote HWWS by increasing descriptive norms[46 47] and should be explored further to promote HWWS in the context of COVID-19. The motive of protecting vulnerable groups was also highly

Table 4 Multivariable regression analyses of COVID-19 prevention outcomes on exposure to general COVID-19 communications, adjusted for key demographics variables, in seven countries where WaterAid worked

	COVID-19 HWWS index (0–3)		HWWS increased		Always wears mask		Always physically distances	
	IRR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Triggers†								
Exposure to any COVID-19 communications								
No COVID-19 communications heard	Ref		Ref		Ref		Ref	
COVID-19 communications heard but no messages specific to behavioural outcome	1.04	(0.74 to 1.47)	1.78	(0.95 to 3.35)	2.18*	(1.20 to 3.96)	1.32	(0.64 to 2.71)
Messages heard specific to behavioural outcome	1.32*	(1.07 to 1.64)	3.46*	(2.25 to 5.34)	2.18*	(1.33 to 3.56)	1.76	(0.91 to 3.41)

Mixed effects Poisson regression models used for COVID-19 HWWS index (0–3), with random intercepts for country and village—coefficients (ratio of HWWS moments mentioned) and 95% CIs displayed. Mixed effects logistic regression models used for other outcomes, with random intercepts for country and village – ORs and 95% CIs displayed.
*Effect significant at the 5% level.
†Also adjusted for key demographic and household variables (geographic location, respondent gender, age, education level and disability, household member with disability and relative household wealth quintile.
HWWS, handwashing with soap.

predictive.[44] These findings point to a focus on increasing perception of others' behaviour and targeting behaviour-specific emotional drivers, instead of increasing knowledge, to sustain COVID-19 prevention measures. They also underscore the need for public health interventions centred on communal behaviour and social responsibility in the face of future outbreaks.

We explored the potential influence of COVID-19 communications on self-reported behaviours and found positive associations between exposure to COVID-19 communications and each of the key behaviours. Exposure to specific messages linking the promoted behaviour directly to COVID-19 prevention or transmission was generally associated with greater effects on self-reported preventive behaviours than those of general COVID-19 communications (not specific to the behaviour). For HWWS, only exposure to specific messages was significantly associated with the outcomes. There is evidence that both specific and non-specific messages can impact behaviour. For example, a COVID-19 intervention in India delivered COVID-19 prevention messages to 25 million recipients and was found to increase adherence to prevention behaviours. This study found that the effects on COVID-19 behaviours that were not directly targeted in the messages increased in the same magnitude to those mentioned.[48] However, messaging may not be sufficient to lead to sustained behavioural change. In a cluster-randomised trial of mask wearing in Bangladesh, a combination of mask distribution, role-modelling and light informal social sanctions was critical to affect behaviour.[49] Efforts to establish social norms around novel behaviours, alongside targeted messages on HWWS moments for COVID-19 prevention, will help stabilise prevention behaviour even as the context in which individuals practice behaviours is rapidly shifting.[45]

Non-pharmaceutical interventions such as HWWS, mask wearing and physical distancing are likely to be an important future defence against infectious diseases, which have significant outbreak and/or pandemic potential (eg, influenza). Effectively integrating novel behaviours into existing health promotion will be vital for disease prevention and outbreak resilience. For example, hand hygiene plays a critical role in preventing diarrhoeal diseases, trachoma and respiratory infections[50–52] as well the emergence and spread of other infectious disease outbreaks.[53] However, the typical focus on hand hygiene among caregivers to interrupt faecal-oral transmission of diarrhoeal pathogens will need to be adapted to foster practice of the key moments critical for preventing respiratory viruses we identified as priorities.[53] Innovative research in LMICs during past epidemics, such as testing methods to engage remote populations with novel behaviours during the Ebola crisis, has shaped the current global COVID-19 response,[54] and continued learning will enable adaptation of present and future responses.

A strength of the study was the reliance on face-to-face household surveys, which are not subject to the same selection biases as the online and telephone surveys frequently used to assess self-reported behaviour in COVID-19 contexts. We were also able to explore various handwashing moments in the context of a large-scale response programme and across multiple countries. However, there are limitations with using self-reported measures of behaviour, which can often be over-reported due to social desirability bias, and reporting of routine behaviours can be particularly affected by recall bias.[55]

For example, in a study in Kenya, the 88% prevalence of self-reported mask wearing was reduced to only 10% when observed in practice.[56] Including proxy measures of behaviour may strengthen data collection of this nature in the future. Reporting of behaviour also does not guarantee correct practice. For example, we could not observe if respondents were wearing masks correctly or keeping appropriate distance. The lack of a comparison group or baseline period in the study communities means we cannot make causal links between the intervention and the target behaviours. We used simple ways to aggregate data and indices are a crude representation of the complex psychological and social phenomenon they represent. However, the measures and associations were consistent across countries. We were limited in the number of determinants that could be reflected in the data, and we did not have more granular data on stringency in national control measures and contextual factors related to individual compliance with measures to adequately explain between-country variation. Unfortunately, we were also unable to explore hygiene behaviours among individuals outside of the gender binary due to the limited response rate. Future research should focus on gender-non-conforming individuals and explore how pandemic responses include and address their needs.

CONCLUSION

In this multicountry analysis of areas where WaterAid implemented its first-phase COVID-19 response in 2020, we sought to understand prevalence and drivers of self-reported COVID-19 prevention behaviours to improve pandemic learning. We observed high levels of established handwashing moments and mask wearing but lower practice of handwashing at novel COVID-19 prevention moments and physical distancing, with between-country variation. Our analyses call for a renewed focus on younger and poorer subsections of the population. Pursuing increasing descriptive norms and motives of protecting others and respect, reducing common barriers, with targeted messaging for novel handwashing moments, may help improve and sustain behaviours for reducing the ongoing burden of COVID-19. How well we are able to promote novel behaviours alongside established ones in a variety of contexts may also determine how well we can respond to future emergent pandemic threats.

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