



ORIGINAL ARTICLE

Handwashing knowledge, attitudes, and practices in Ghana

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Key words

Handwashing Knowledge • Attitudes • Practices • Ghana • Handwashing facilities.

Summary

Introduction. Handwashing has been recognized as a convenient, effective, and cost-effective means of preventing communicable diseases. However, many people overlook the importance of handwashing when engaging in activities that require handwashing due to various factors. The objectives of this study were to assess the level of handwashing knowledge, attitudes, and practices and determine their relationships and how they are affected by sex, educational background, and age.

Methods. A cross-sectional survey was conducted among 636 respondents who received and completed an online questionnaire that was disseminated to the contacts of the researchers via WhatsApp, Email, LinkedIn, and Facebook. Respondents were presented with several statements to assess their handwashing knowledge, attitudes, and practices.

Results. Overall, 82.2% of respondents had good knowledge, 91%

had a positive attitude, and 48.4% adhered to good handwashing practices. Having a high school level of education ($OR = 0.193$, $p = 0.034$), ($OR = 0.145$, $p = 0.000$) and ($OR = 0.448$, $p = 0.049$) decreased the likelihood of having good knowledge, positive attitudes, and good practices than in persons with tertiary level education. Predictors of good handwashing practices were knowledge ($OR = 1.059$, $p = 0.37$) and attitude ($OR = 1.095$, $p = 0.000$). These results suggest that having a higher level of education could increase a person's knowledge and attitude, which in turn enhances the likelihood that the person would adhere to most handwashing and hand hygiene practices.

Conclusions. Enhancing people's handwashing practices requires positive attitudes and good knowledge about handwashing. These need to be complemented by enhanced access to handwashing facilities and innovative measures to enforce and encourage compliance.

Introduction

The World Health Organization (WHO) declared the novel coronavirus disease (COVID-19) outbreak as a public health emergency of international concern on 30 January 2020. By 4th May 2020, a total of 3,407,747 cases with 238,198 deaths had been confirmed in 215 countries, areas, or territories [1]. The WHO then issued some precautionary measures to the public to protect themselves and others from the spread of COVID-19. The measures include regular and thorough hand cleaning with an alcohol-based hand rub or washing them with soap and water and covering the mouth and nose with bent elbow or tissue when coughing or sneezing.

Elaborating on the appropriate hand hygiene protocol, UNICEF (Ghana) published on its website an article titled "Everything you need to know about washing your hands to protect against coronavirus [2]. The article highlighted, among others, (a) how to wash the hands properly, (b) when hands should be washed, (c) how to help children wash their hands, (d) types of water required for washing hands, (e) whether and how washed hands should be dried, (f) whether washing hands is more effective than using hand sanitizer, and (g) what to do in the absence of soap.

Ghana had its first two confirmed cases of COVID-19 on 12th March 2020 and by 5th May 2020, the cases had increased to 2,719 with 294 recoveries and 18 deaths. In the statement announcing the two cases on 12th March, the Minister for Health entreated all Ghanaians to observe the precautionary measures, which include regular and thorough washing of hands with soap under running water and the use of alcohol-based hand sanitizers [3]. By 14th March, Ghana had recorded a total of six cases and on 15th March, the President of Ghana gave his first national address on the pandemic [4]. Among others, the President banned all public gatherings and instructed establishments such as offices, supermarkets, shopping malls, restaurants, nightclubs, hotels, and drinking spots to observe enhanced hygiene procedures by providing hand sanitizers, running water, and soap for washing of hands. Furthermore, he asked the Ministry of Transport to work with private and public transport operators to ensure enhanced hygienic conditions in all vehicles and terminals, by providing hand sanitizers, running water, and soap to wash hands. The Ministry of Local Government and Rural Development was also tasked to coordinate with the Metropolitan, Municipal, and District Assemblies to enhance hygiene conditions in markets across the country.

As a result of the President's directives, many

organizations started providing hand hygiene facilities at work and in public places. There was even an apparent shortage of alcohol-based sanitizers on the market. For that reason, on 16th March 2020, the President met with leaders of Ghana's pharmaceutical industries to discuss the local production of materials, including sanitizers, and liquid soaps as part of the COVID-19 response in Ghana. Accordingly, the Food and Drugs Authority fast-tracked the registration of hand sanitizers, and by 10th April 2020, it had approved 327 hand sanitizers for the COVID-19 fight [5]. There was heightened production, purchase, and display of handwashing facilities such as Veronica buckets and hand cleaning products at public spaces, workplaces, and similar locations.

Handwashing has been a convenient, effective, and cost-effective means of preventing communicable diseases in developing countries. Many infections start when hands are contaminated with disease causing-organisms, and this can happen after using the toilet, coughing or blowing the nose, handling garbage, and touching other contaminated surfaces [6]. Most diseases such as diarrhea and pneumonia, which are transmitted mainly by contaminated hands can be prevented by handwashing with soap [7]. However, many people overlook the importance of handwashing when engaging in activities that require the washing of hands. For example, less than 40% of zoo visitors are reported to wash their hands upon exiting animal contact areas [8]. A study in 54 countries in 2015 found that, on average, 38.7% of households practiced handwashing with soap [9].

Factors such as hygiene education, adequate organizational factors including the availability of handwashing materials, and strong examples from influential persons, could effectively increase adherence to hand hygiene practices and reduce the incidence of infections [10, 11]. In an observational study, it was reported that people who lived in urban districts, with high educational levels and sufficient knowledge on infectious diseases have a high handwashing compliance rate [12]. In addition, women are more likely to wash their hands than men after controlling for washroom characteristics and clustering effects associated with social norms [13]. Several studies have examined attitudes and perceptions toward hand hygiene and found, for example, that most healthcare workers held positive attitudes and perceptions [14-16].

In contrast, few studies have focused on people's knowledge, attitudes, perceptions, and practices toward hand hygiene during a pandemic. A few studies were undertaken to identify the factors that most effectively motivated people to adopt certain protective measures, including hand hygiene during the H1N1 epidemic

and SARS pandemic, mainly in Hong Kong, China, Singapore, and South Korea [17-20]. A post-Ebola virus disease epidemic study in Nigeria showed that a higher proportion of respondents had a good knowledge of the risk factors of the disease but had a poor practice of hand hygiene for infection control [21].

This current study assessed the handwashing knowledge, attitudes, and practices of the public (i.e., people 15 years or older living in Ghana) during the COVID-19 pandemic. The objectives were to determine if handwashing knowledge, attitude, and practices differ by sex, educational background, and age, and assess the level of handwashing knowledge, attitudes and practices, and the relationships among them. This study provides insights into the level of knowledge and attitudes Ghanaians have about hand hygiene, especially handwashing, and identifies the knowledge gaps as well as issues that must be addressed to always enhance hand hygiene practices including during pandemics and epidemics.

Methodology

A quantitative method was employed. The study was conducted between July and October 2020 when the Ghana Health Service was urging everyone to adhere to the COVID-19 preventive protocols. Handwashing knowledge was assessed by providing a set of questions and statements with corresponding options for the study participants to choose correct answers (Tab. II). Handwashing attitudes were assessed by providing statements for the respondents to indicate whether they agreed with them or not (Tab. III). Handwashing practices were assessed by providing a list of the prescribed hand hygiene practices (as publicized at the onset of the COVID-19 pandemic) to the participants to indicate whether they adhere to the practices or not (Tab. IV).

Because of the restrictions on movements due to the COVID-19 pandemic, the data was collected using an online link to the questionnaire linked to the KoBo Toolbox. The online survey link was shared with the contacts of the researchers via WhatsApp, Email, and LinkedIn. The researchers appealed to all the contacts who had received the online link to also share with their contacts. The study was approved by the Council for Scientific and Industrial Research Institutional Review Board with approval no: RPN 004/CSIR-IRB/2020. An introductory statement was included in the survey that informed participants about the purpose of the survey, assured them of the confidentiality of the data, and gave them the option to opt out if they felt uncomfortable.

Tab. I. Regional distribution of respondents.

Region	No.	Region	No.	Region	No.	Region	No.
Ahafo	4	Central	27	Northern	11	Upper West	4
Ashanti	39	Eastern	24	Oti	28	Volta	125
Bono	2	Greater Accra	305	Savannah	6	Western	7
Bono East	6	North East	1	Upper East	5	Western North	1

Tab. II. Statements and responses on handwashing knowledge.

Handwashing knowledge statements	Authors' Marking scheme	% of respondents who gave correct responses	% of respondents who gave wrong responses
MATERIALS USED FOR HANDWASHING			
Water is a material used for handwashing	Yes	94.0	6.0
Soap is a material used for handwashing	yes	93.9	6.1
Antiseptics are materials used for handwashing	No	84.9	15.1
An alcohol-based sanitizer is a material used for handwashing	No	51.1	48.9
Level of knowledge on materials used for handwashing	Good knowledge = 82.2%; Fair knowledge = 17.0%; Poor knowledge = 0.8%		
BENEFITS OF HANDWASHING			
Handwashing is a part of personal hygiene	Yes	96.9	3.1
Handwashing prevents diseases	Yes	93.9	6.1
Prevents mosquito bites	No	96.7	3.3
Handwashing Protects children against ill-health	Yes	75.9	24.1
Handwashing Limits spread of infections	Yes	93.4	6.6
Level of knowledge on benefits of handwashing	Good knowledge = 90.4%; Fair knowledge = 8.0%; Poor knowledge = 1.6%		
DISEASES PREVENTABLE BY HANDWASHING			
Cholera is preventable by handwashing	Yes	93.1	6.9
Malaria is preventable by handwashing	No	97.0	3.0
Hypertension (a No is correct)	No	97.2	2.8
COVID-19 is preventable by handwashing	Yes	98.4	1.6
Common cold, Catarrh is preventable by handwashing	Yes	40.1	59.9
Typhoid is preventable by handwashing	Yes	52.8	47.2
Diarrhea is preventable by handwashing	Yes	77.4	22.6
Level of knowledge on diseases preventable by handwashing	Good knowledge = 87.3%; Fair knowledge = 11.6%; Poor knowledge = 1.1%		
KNOWLEDGE ABOUT HANDWASHING DAY			
15 th October is Global Handwashing Day	Yes	24.3	75.7
Level of knowledge on Global Handwashing Day	Good knowledge = 14.8%; Fair knowledge = 47.0%; Poor knowledge = 38.2%		
The Overall level of Knowledge about handwashing	Good knowledge = 84.1%; Fair knowledge = 14.5%; Poor Knowledge = 1.4%		

DATA ANALYSIS

A total of 679 respondents completed the survey, of which 645 were from Ghana and 34 were from other countries. However, of the respondents in Ghana, nine (9) did not complete the questionnaire; hence those cases were discarded in addition to the cases by respondents outside Ghana. The analysis presented here is thus based on 636 respondents who were residents in Ghana at the time of the survey.

ASSESSMENT OF KNOWLEDGE ABOUT HANDWASHING

The questions were categorized into (1) materials used for handwashing, (2) benefits of handwashing, (3) diseases preventable by handwashing, and (4) knowledge about the Global Handwashing Day. A correct response attracted 1 point, while a wrong response attracted 0 points. The total correct points were calculated in terms

of absolute numbers and percentages. A criterion was developed to determine the level of knowledge: a score of 70-100% = Good knowledge; a score of 50-69% = Fair knowledge; and a score of 0-49% = Poor knowledge.

ASSESSMENT OF ATTITUDE ABOUT HANDWASHING

An agreed response implied a negative attitude while a disagreed response indicated a positive attitude. An agreed response attracted -1, while a disagreed response attracted +1 point. The total point for attitude was calculated by adding the positive and negative points. A negative total implies a negative attitude, and a positive total suggests positive attitude.

ASSESSMENT OF HANDWASHING PRACTICE

Any handwashing practice adhered to attracted 1

Tab. III. Respondents' attitudes to handwashing.

Statements	Disagree (positive attitude) %	Agree (negative attitude) %
You will NOT wash your hands after using the toilet if you feel your hands are clean	82.5	17.5
You will NOT wash your hands after using the toilet if you are in a hurry and have no time to wash your hands	83.8	16.2
You will NOT wash your hands after using the toilet if you feel handwashing is cumbersome	85.1	14.9
You will NOT wash your hands after using the toilet if there is not enough water	76.9	23.1
You will NOT wash your hands after using the toilet if there is no soap	75.2	24.8
You will NOT wash your hands after using the toilet if the water is too cold	87.1	12.9
You will NOT wash your hands after using the toilet if handwashing is not your habit	78.5	21.5
You will NOT wash your hands after using the toilet if there is no paper or cloth napkin or hand dryer	87.4	12.6
You will NOT wash your hands after using the toilet if you feel the water is not clean	49.1	50.9
Do you think handwashing is important?	97.5	2.5
Would you feel guilty if you did not wash your hands before eating?	94.0	6.0
The overall level of attitude	91.0	9.0

Tab. IV. Respondents' handwashing and hand hygiene practices.

Practice	% of respondents practicing
Using hand sanitizer	65.4
Using hand wipes	64.0
Keeping hand sanitizer in your bag/pocket when out of home	74.8
Washing your hands after blowing your nose	74.4
Washing your hands after visiting a public place, e.g. markets, church, or mosque	66.5
Washing your hands after touching surfaces outside of the home, e.g. money, Automated Teller Machine	78.9
Washing your hands before eating	50.6
Washing your hands when you return home from work/town	61.5
Washing your hands after using the toilet	50.8
Washing your hands when your hands are visibly dirty	50.3
Washing your hands after shaking hands	72.3
Washing your hands before entering your office or workplace	81.0
Washing your hands before entering a supermarket	84.7
The overall level of practice	Good practice = 48.4% Fair practice = 19.8% Poor practice = 31.8%

point while a practice not followed attracted 0 points. The points were summed up and the equivalent percentages calculated. A criterion was developed as follows to determine the level of practice: a score of 70-100% = Good practice; a score of 50-69% = Fair practice; and a score of 0-49% = Poor practice.

Initial data analysis included descriptive statistics and cross-tabulations (chi-square tests) where the influence of sex, age, and educational background on respondents' responses was examined. The cross-tabulation analysis on knowledge scores yielded some results where the expected cell counts were less than 5; hence the knowledge scale was dichotomized into 'good knowledge' and 'fair knowledge'. Also, correlations and crosstabulations were performed to assess the relation of handwashing knowledge and attitude with handwashing practices. Furthermore, in cases where chi-square tests were significant, logistic or multinomial regression was

used to determine the relationships. Finally, odds ratios (OR), p-values, and confidence intervals were reported for each level of the variables.

Results

The respondents were made up of 52.3% male and 43.7% female, with 58.5% being youthful (15-35 years) and 41.5% being older (36-80 years). About 77.3% had tertiary level of education while 15.7% and 6.9% had high school and basic school level education, respectively. The regional distribution of the respondents is shown in Table I as per the 16 regions of Ghana. The regional distribution of respondents appeared to have been influenced by the networks of the researchers. Table II shows the proportion of respondents who gave correct or wrong responses. A total of 82.2% of

Tab. V. Cross tabulations of educational level against handwashing knowledge, attitude and practices.

Cross tabulations of educational level against handwashing knowledge, attitude and practices				
	Basic School	High School	Tertiary level	Total
Good knowledge	4.7%	10.1%	69.3%	84.1%
Fair Knowledge	2.2%	5.7%	8.0%	15.9%
Positive attitude	6.3%	11.5%	73.4%	91.2%
Negative attitude	0.6%	4.3%	3.9%	8.8%
Good practice	3.6%	3.8%	41.0%	48.4%
Fair practice	1.1%	6.9%	11.8%	19.8%
Poor practice	2.2%	5.0%	24.5%	31.8%
Cross tabulations of handwashing practices against knowledge and attitude				
	Good practice	Fair practice	Poor practice	Total
Good knowledge	42.8%	14.6%	26.7%	84.1%
Fair Knowledge	5.7%	5.2%	5.0%	15.9%
Positive attitude	46.3%	17.2%	27.7%	91.2%
Negative attitude	2.2%	2.7%	3.9%	8.8%

respondents had good knowledge of the materials that are used for handwashing. However, about 51% said alcohol-based sanitizers are among materials used for handwashing, probably because they were unclear about the difference between handwashing and hand sanitizing, which does not involve the use of water. Also, 90.4% of respondents had good knowledge about the benefits of handwashing but 24.1% did not know that handwashing could protect children against ill-health. Furthermore, 87.3% had good knowledge about diseases that could be prevented by handwashing but 59.9% and 47.2% of respondents did not know that common cold and typhoid, respectively were preventable by handwashing. Only 387 out of 636 respondents were aware of the existence of the Global Handwashing Day (GHWD) and just 24% of the 387 knew the date on which the GHWD is commemorated. Overall, 90.4% of respondents had good handwashing knowledge, 8% had fair knowledge, and 1.6% had poor knowledge.

On handwashing attitudes, overall, 91% of respondents had a positive attitude towards handwashing, with 75-98% showing a positive attitude for each statement except the statement “You will not wash your hands after using the toilet if you feel the water is not clean” where 50.9% portrayed a negative attitude (Tab. III). Also, 21-25% of the participants showed a negative attitude by agreeing that they would not wash their hands after using the toilet (a) if there is not enough water (23.1%), (b) if there is no soap (24.8%), and (c) if handwashing is not their habit (21.5%).

In terms of handwashing practices, Table IV shows that overall, less than 50% of respondents undertake most of the prescribed handwashing practices. About 32% of respondents exhibited poor handwashing practices as they did not adhere to most of the prescribed practices. The practices that most respondents adhered to were ‘washing their hands before entering an office or workplace’ (81.0%), ‘washing their hands before entering a supermarket’ (84.7%), and ‘washing hands after touching surfaces outside of the home’ (78.9%).

Cross-tabulation of the level of handwashing knowledge

with sex, age, and level of education yielded a significant Pearson chi-square statistic only for the level of education (Tab. V). Also, a Chi-square test was performed for handwashing practices against knowledge and attitude and the results were statistically significant (Tab. V). Hence logistic regression analysis was performed to assess how educational background influences handwashing knowledge, attitude, and practices as well as how handwashing knowledge and attitude influence practices (Tab. VI).

The logistic model (Tab. VI) showed that having a basic level of education (OR = .136, $p = .024$) and high school level of education (OR = 0.193, $p = 0.034$.) decreased the likelihood of having good knowledge about handwashing by 0.136 and 0.193 times, respectively than in persons with tertiary level education. The results suggest a statistical association between level of education and level of knowledge about handwashing, however, basic and high school levels of education is not significant in predicting fair level knowledge. Results also showed that having a high school level of education (OR = 0.145, $p = 0.000$) decreased the odds of showing a positive attitude towards handwashing by 0.145 times than in people with tertiary level education. This suggests a statistical association between level of education and having a positive rather than negative handwashing attitude, however, this is not statistically significant in persons having a basic level of education. Similarly, persons having a high school level of education (OR = 0.448, $p = 0.049$) were 0.448 times less likely to exhibit good handwashing practices than in persons with a tertiary level of education after controlling for the other factors in the model. Furthermore, a person with a high school level of education (OR = 2.860, $p = 0.000$) is 2.860 times more likely to exhibit fair handwashing practices compared to poor handwashing practices than in persons with a tertiary level of education after controlling for the other factors in the model. These results suggest that having a higher level of education could enhance one’s handwashing attitude and practices compared to a lower level of education.

Tab. VI. Logistic regression for the influence of educational background on handwashing knowledge, attitude, and practices, and the influence of handwashing knowledge and attitude on handwashing practices.

		Sig. (p-value)	Odds ratio	95% C.I. for EXP(B)	
				Lower	Upper
Influence of educational background on handwashing knowledge, attitude and practices. (Reference categories: Poor knowledge, Negative attitude, Poor practice, Tertiary education)					
Good knowledge	Basic School	0.024	0.136*	0.024	0.773
	High School	0.034	0.193*	0.042	0.884
Fair Knowledge	Basic School	0.467	0.511	0.083	3.126
	High School	0.934	0.936	0.196	4.463
Positive attitude	Basic School	0.269	0.536	0.178	1.618
	High School	0.000	0.145*	0.080	0.264
Good practice	Basic School	0.959	0.982	0.491	1.964
	High School	0.049	0.448*	0.255	0.789
Fair practice	Basic School	0.935	1.040	0.403	2.684
	High School	0.000	2.860*	1.680	4.869
Influence of handwashing knowledge and attitude on level of handwashing practices (Reference categories: Poor practice)					
Good Practice	Knowledge score	0.037	1.059*	1.004	1.119
	Attitude score	0.000	1.095*	1.043	1.149
Fair Practice	Knowledge score	0.570	0.983	0.928	1.042
	Attitude score	0.004	0.931*	0.886	0.977

* Significant Odds ratio at $p < .05$

In terms of the influence of knowledge and attitude on handwashing practices, firstly, correlations analysis showed that handwashing knowledge ($r = 0.154$, $p < 0.001$) and handwashing attitude ($r = 0.197$, $p < 0.001$) had significant positive associations with handwashing practices. In contrast, the knowledge score ($r = 0.394$, $p < 0.001$) had a positive association with the attitude score. These suggest that people would adhere to most handwashing practices if they had a positive attitude toward handwashing and have good knowledge about handwashing. Secondly, the logistic regression model showed that increasing the knowledge score (OR = 1.059, $p = 0.37$) by 1 unit increased the likelihood of having good handwashing practices compared to poor practices by 1.059 times after controlling for the other factors in the model. This result showed a statistical association between a person's handwashing knowledge score and the level of handwashing practices exhibited; however, the association is not significant in terms of predicting a fair level of handwashing practice. Results also showed that if a person increases his/her handwashing attitude score (OR = 1.095, $p = 0.000$) by 1 unit the odds of exhibiting good practices compared to poor practices would be expected to increase by 1.095 units while holding all other variables in the model constant. Similarly, the odds for exhibiting fair handwashing practices compared to poor practices would be expected to decrease by 0.931 units if a person's attitude score (OR = .931, $p = 0.004$) increased by a unit. These suggest that the more positive one's attitude is towards handwashing, the greater the likelihood that the person would adhere to most handwashing and hand hygiene practices.

Discussion

This study assessed whether handwashing knowledge, attitude and practices differ by sex, educational background and age or not and determined the level of handwashing knowledge, attitude and practices and their relationships. Although 82.2% of respondents had good knowledge of the materials used for handwashing, about half of the respondents indicated that alcohol-based sanitisers were among materials used for handwashing. This indicates that some people did not know the distinction between handwashing, which entails washing hands with non-antimicrobial or antimicrobial soap and water, and other means of ensuring hand hygiene. It is important for hygiene educators and promoters to emphasise the difference and note which hand hygiene methods should be promoted under specific conditions. For example, in poor communities where access to hand sanitizers may be a challenge, it is critical to promote handwashing with water and soap that may be easily accessible. Although sanitizers are used to maintain hand hygiene, it is important to emphasize that it is not the same as handwashing. Similarly, antiseptics are not used for handwashing, but antiseptic agents may be contained in antimicrobial soaps that are used for handwashing [22]. In this case, it is important for public health educators to distinguish between antiseptic handwash, which entails washing hands with water and soap or other detergents containing an antiseptic agent, and an antiseptic hand rub which involves applying a waterless antiseptic agent to all surfaces of the hands to reduce the number of microorganisms present [22]. Handwashing provides several benefits that could contribute to changing people's attitudes and behaviors towards handwashing. Most respondents in this study had good knowledge about the benefits of handwashing,

however about one-third did not know that handwashing could protect children against ill-health. Good knowledge about this handwashing benefit is very critical because of the vulnerability and susceptibility of children to microbial infections. According to the WHO diarrhoeal disease, which is a symptom of infections caused by a host of bacterial, viral, and parasitic organisms, most of which are spread by feces-contaminated water, is the second leading cause of death in children under five years old, killing around 525,000 children each year [23]. Therefore, the importance of handwashing for the prevention of infectious disease especially, in children, has been established and is advocated for [24-27]. It is estimated that about one-third of infections are preventable by practicing correct handwashing [28]. Regarding the specific diseases preventable by handwashing, the overall knowledge level is good in 87.3% of respondents. This is not different from a study by Suen et al. [29], who found that majority of their respondents could differentiate between the diseases that could or could not be transmitted through poor hand hygiene. Notwithstanding the overall good knowledge, the findings showed that about 60% of respondents did not know that the common cold could be prevented by handwashing, while 47% did not know the power of handwashing in preventing typhoid infection. These findings suggest that more education is needed on the various health benefits of handwashing, especially for endemic infectious diseases. In Ghana, typhoid fever was ranked among the top twenty causes of outpatient morbidity and accounted for 1.2%, 1.7%, and 1.3% of hospital admissions in 2017, 2016, and 2015, respectively. The transmission of typhoid fever occurs through the fecal-oral route; hence hygienic procedures such as handwashing are important for preventing and controlling the infection [30]. A study in Jakarta, Indonesia, where typhoid is endemic, found that households that do not use soap for handwashing are at a significantly higher risk of contracting typhoid [31]. Handwashing with soap could prevent respiratory infections by 16-21%, reduce pneumonia by 25%, and protect about 1 of 5 young children with respiratory infections [32-34]. The low-level knowledge with respect to specific illnesses calls for the need for more education on the various health benefits of handwashing as well as common diseases it could help prevent. Overall, the majority (91.2%) of the respondents had a positive attitude towards handwashing, with over 70% showing a positive attitude for each statement except for three. The highest proportion of respondents (97.5%) showed a positive attitude towards the statement 'handwashing is important aligning with a study where 89.8% agreed to this statement [35]. For the statement "You will not wash your hands after using the toilet if you feel the water is not clean", about half of the respondents portrayed a negative attitude which calls to question the kind of water that can be used for handwashing. This is critical, especially in communities where water may be prone to contamination. However, it is critical to emphasize that water for handwashing

does not have to be as clean as drinking water because research has found that washing hands with soap and even very contaminated water from the municipal water supply still delivered health benefits including diarrhea reduction [36]. Also, about 21-25% of the respondents showed a negative attitude by agreeing that they would not wash their hands after using the toilet (a) if there is not enough water (23.1%); (b) if there is no soap (24.8%), and (c) if handwashing is not their habit (21.5%). Although handwashing with soap is substantially more effective at removing dirt and germs from hands, the use of water alone does help reduce the risk of diarrhea [37]. Thus, it is preferable to wash hands with only water to not wash at all because of the absence of soap. In hygiene education, where there is no water, it is important to emphasize other hand hygiene practices such as the use of hand sanitizers. The findings bring to the fore the importance of ensuring the provision, availability, and access to handwashing materials or hand hygiene materials. Handwashing is a repetitive action that may lead to the formation of a habit, and habits can influence behaviour [38]. However, about 78.5% of respondents were of the view that even if they had not developed the habit of handwashing, they would wash their hands after using the toilet. This positive attitude could be the result of their understanding of the benefits of handwashing. Handwashing practices are the actual activities that will lead to disease prevention. Hence, it was quite unsatisfactory that overall, less than 50% of respondents undertook most of the COVID-19 prescribed handwashing and hygiene practices while one-third of respondents exhibited poor hand washing practices. Similar findings were reported by Fielmua et al. [39] and UNICEF [33], where only 20% of the Ghanaians population were found to wash their hands with soap while awareness about the importance of the practice remains low, with a handwashing growth rate of 8% over the period 2014-2017 [33]. Similar findings were reported by Rabbi and Dey [40], where 90% of their respondents had knowledge about the importance of handwashing before eating, but only 21% did so. The practices that most respondents adhered to were 'washing hands before entering an office' (81.0%), 'washing hands before entering a supermarket' (84.7%), and 'washing hands after touching surfaces outside of the home' (78.9%). These results could be attributed to the COVID-19-related directives by the Ghana government, where handwashing and hand hygiene facilities were supposed to be provided at public spaces, including offices, supermarkets, churches, and bus stations. These facilities were not only provided, but there were also persons stationed near the facilities to enforce compliance by people visiting these public spaces. The provision of these facilities in shops and other public spaces has also been reported in a study conducted in Northern Ghana [39]. However, contrary to our findings, they found that adherence to COVID-19 safety protocols at shopping centres was very poor, with about 91.3% of the customers not practicing handwashing before entering the shops although handwashing facilities

were provided. They also report that non-adherence to COVID-19 protocols was higher in shops where there was no pressure to conform to the protocols.

Gender and age of respondents had no significant influence on the level of handwashing knowledge, attitude and practices. However, the educational level of respondents was found to significantly influence the level of handwashing knowledge, such that the higher the educational level the better the knowledge in issues related to handwashing. Similar findings were reported by Suen et al. [29], in which having a tertiary education level improved handwashing knowledge. On the contrary, they found that gender and age influence handwashing knowledge, whereas being female and middle-aged significantly enhanced handwashing knowledge. Our findings also differ from Fielmua et al. [39], who found that youth and children had a poor attitude towards the COVID-19 protocol practices including, handwashing, compared to adults. In Ghana, before the COVID-19 pandemic, messages on handwashing were rarely shared with the public; hence most people who knew might have read about it themselves or were taught during their formal education. In Ghana, where the illiteracy rate among persons 15 years and older is 21% World Bank [41], it will be useful to integrate handwashing messages in non-formal educational programs as well as during church and funeral programs, festivals and other social gatherings. It is also critical to incorporate handwashing lessons in all educational curricula starting from preschool through basic to tertiary levels.

The positive correlations found among handwashing knowledge, attitude, and practices suggest that people would adhere to most handwashing practices if they had a positive attitude towards handwashing and had good knowledge about handwashing procedures and benefits. This was confirmed in the logistics regression analyses where there were statistical associations between a person's handwashing knowledge score, positive attitude, and handwashing practices. Thus, a higher handwashing knowledge score and a positive attitude towards handwashing are likely to increase a person's adherence to the prescribed handwashing practices. Fielmua et al. [39] also found that attitude is critical to handwashing behavior and the fight against the COVID-19. These findings are in line with Garba and Uche [42], who found that level of knowledge and attitude toward proper handwashing practices were significantly associated with the adherence to the practice.

One major limitation of the study is that all the data are based on self-reports by the respondents, which the authors could not verify because the study was online based. In addition, regional influence on the results was not assessed because of their uneven representation, which reflects the sampling technique employed.

Conclusions

This study assessed the handwashing knowledge, attitudes, and practices of people living in Ghana during

the COVID-19 pandemic. Handwashing knowledge was found to be generally good among the respondents; however, in terms of the distinction between handwashing and hand sanitizing materials as well as the specific diseases that are preventable by handwashing, a lot more public education is required. It is also important to create more awareness about Global Handwashing Day and sensitize people on the importance and significance of the Day. Furthermore, handwashing knowledge, attitude, and practices were found to be statically associated with the educational background of respondents; hence it is important to take advantage of this and incorporate handwashing education in formal educational curricular as well as non-formal educational programs to address the needs of people who may not be literates.

Most respondents generally had a positive attitude to handwashing and were of the view that handwashing is important, especially after visiting the toilet. However, it is important for public health and hygiene educators to clearly explain what types of water could be used, whether soap should necessarily be used, and what to do when there is inadequate or no water and/or soap. Despite the general good knowledge and positive attitudes to handwashing, most respondents exhibited poor adherence to the prescribed handwashing and hand hygiene practices except in a situation where measures had been put in place to enforce compliance.

This study has revealed that enhancing people's handwashing practices requires positive attitudes towards handwashing as well as good knowledge about the appropriate materials used for handwashing and the health benefits of handwashing. These need to be complemented by enhanced access to handwashing facilities and innovative measures to enforce and encourage compliance with most hand hygiene practices, especially during pandemics such as COVID-19 and epidemics such as cholera and other endemic infectious diseases.

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Ethical approval

The study was approved by the Council for Scientific and Industrial Research Institutional Review Board with approval no: RPN 004/CSIR-IRB/2020.

Conflict of interest statement

The authors declare no potential conflicts of interest.

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Authors' contributions

RO and FZ designed the study. RO, SBT, FZ, WA participated in the data collection and analysis. RO drafted the manuscript. All authors read, revised, and approved the manuscript.

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