A Cross-sectional Study to Evaluate People's Knowledge, Attitude and Practice Towards Using Disinfectants and Sanitizers During COVID-19 Pandemic in Bangladesh

Koma Afrin Rintu[1], Kazi Milenur Rahman Prattay[1], K. M. Yasif Kayes Sikdar[2], Tanvir Rahman[1], Md. Raihan Sarkar[2] and Tanveer Hossain[1]

[1]Department of Pharmacy, University of Dhaka, Dhaka-1000, Bangladesh
[2]Department of Pharmaceutical Technology, University of Dhaka, Dhaka-1000, Bangladesh

(Received: April 20, 2022; Accepted: August 14, 2022; Published (Web): December 20, 2022)

ABSTRACT: The devastating novel coronavirus (COVID-19) pandemic worldwide has become a global health crisis. This disease is highly contagious and caused by the transmission of severe acute respiratory syndrome, coronavirus 2 (SARS-CoV-2). To prevent the transmission of SARS-CoV-2, disinfectants and sanitizers are very effective and readily available preventive agents. In this study, knowledge, attitude and practice (KAP) levels of Bangladeshi people's were assessed regarding the use of disinfectants and sanitizers during the pandemic. An online questionnaire-based survey was conducted among the respondents from July 2021 to December 2021. A total number of 428 respondents participated in this survey. Data were analysed by the Statistical Package for the Social Sciences (SPSS) V26 software and interpreted. Results revealed that most of the respondents were knowledgeable, had a positive attitude and engaged in beneficial practice. Among the respondents, a significantly higher knowledge and practice score were observed among females (54.1% and 54.4%, respectively) than their counterpart. Moreover, people living in urban areas (71.7%) had a better attitude than the rural people (28.3%). In addition, a medium positive correlation between knowledge and attitude (r = + 0.482), a weak positive association between attitude and practice (r = +0.199), and a weak positive association between knowledge and practice (r = + 0.282) were found. Overall, majority of the respondents had better KAP scores in knowledge and attitude with relatively low scores in practice which indicates some space for betterment.

Key words: COVID-19, KAP, disinfectants, sanitizers.

INTRODUCTION

The world is currently facing a breakdown in every sector due to novel coronavirus (COVID-19), which is caused by a virus called severe acute respiratory syndrome, coronavirus 2 (SARS-CoV-2).[1] As a zoonotic virus, it can easily undergo each of the following transmissions: human-to-human, animal-to-human and human-to-animal.[2,3] In the prevention of viral spread, disinfection and hand sanitization are significant ways to reduce COVID-19 transmission [4] Disinfectants are chemical agents which have the capability to inactivate or destroy viable microorganisms.[5] On the other hand, sanitizer reduces the number of microbes on surfaces or objects either by destroying them or removing them to a safe level.[6] SARS-CoV-2 displays high stability at a broad range of pH values (3-10), temperature and might persist on inanimate surfaces like plastic, metal, glass to undergo transmission for up to nine days unless disinfected.[7,8] Although SARS-CoV-2 exhibits very much transmission ability in a favourable environment, but it is susceptible to disinfection.[8] Various types of disinfectants are used against this virus.[5] Generally, alcohols show their antimicrobial activity at the optimal concentration range of 60-90% and cause denaturation of proteins, membrane damage and metabolism interference.[9]

Correspondence to: Md. Raihan Sarkar
Email: raihan.rezvi@du.ac.bd

Dhaka Univ. J. Pharm. Sci. **21**(2): 117-126, 2022 (December)
DOI: https://doi.org/10.3329/dujps.v21i2.63113

Highly electronegative chlorine oxidizes the lipids and proteins, thus damaging microbes' membrane and cell wall.[5] Moreover, aldehyde deactivates coronavirus within two minutes when used at a definite concentration (0.5-3%), and povidone-iodine at a concentration of 1% or less inactivates the virus within seconds.[5]

However, excess use or misapplication of these preparations is highly toxic to human health.[10] Adverse effects of hand sanitizer and disinfectants include skin and eye irritation, skin dryness, liver damage, respiratory conditions, etc.[10] A person in Bangladesh died due to a fire caused by sanitizer and a lit cigarette.[11] Hand sanitizers might be used in children, but all sorts of disinfectants should be kept out of their reach without adult supervision.[12] Mixing different disinfectant products together, washing food products with bleach, intentional ingestion or inhalation of disinfectants, application of household disinfectants to bare skin, etc. can cause severe adverse health effects .[13] KAP among US adults regarding disinfectant use during the COVID-19 pandemic were explored by a study.[13] A study on the pattern of disinfectant use and their irrational usage and adverse effects after the COVID-19 outbreak among the people of Iran was also conducted.[14] Hamid et al. conducted an online survey to investigate the KAP level of Kuantan population to demonstrate the exposure risk of household insecticides in Pahang.[15] Although there has been a single study that considered disinfectant usage while studying the overall KAP of Bangladeshi residents regarding COVID-19,[16] according to our best knowledge, no study was conducted on Bangladeshi people solely focused to understand their KAP associated with the use of disinfectants and sanitizers.

The survey was aimed to assess Bangladeshi people's KAP of using disinfectants and sanitizers during the COVID-19 outbreak.

MATERIALS AND METHODS

Study design, participants and data collection. The study was designed as an online questionnaire-based cross-sectional survey which was conducted among general people of Bangladesh from 27 July 2021 to 31 December 2021. A total number of 428 individuals participated in this study and random sampling system was implemented for determining the participant size. An online questionnaire was well-developed using “Google Form” after intensive literature review and thorough discussion and its link was shared via different electronic and social media like Email, Facebook, WhatsApp, Viber etc to reach the participants and collect data.[13-16] The survey questionnaire consisted of two sections including socio-demographic characteristics in section one and KAP regarding disinfectant and sanitizer use in section two. Data were collected only from the people who gave their informed consent to take part willingly in this survey.

Study measures. All the questions in the questionnaire regarding KAP were closed questions with prelisted probable answers of either ‘Yes’ (Y), ‘No’ (N) or, ‘May be’ (M). Any answer from the questionnaire that indicated correct knowledge, positive attitude or good practices were scored with 1 whereas answers with incorrect knowledge, negative attitude or bad practices as well as inconclusive responses (“May be”) were scored with 0. Hence, scoring matrix was question/statement specific. Total score for knowledge, attitude and practice ranged from 0 to 7, 0 to 6 and 0 to 7 respectively. A higher score in each domain of knowledge, attitude and practice indicates good knowledge, good attitude and safe practice. The scores of the participants were classified into two levels with a cut-off value, which was determined based on the median value.[7] The cut-off value was 5 or more for the 'knowledge' domain. The scores of ≥5 were considered as "adequate knowledge" and <5 were labelled as "inadequate knowledge". For the attitude domain (cut-off value 4 or more), the scores ≥4 were characterized as "positive attitude" and the score <4 was as "negative attitude". Referring to the practice questionnaire (cut-off value 4 or more), the scores ≥4 and <4 were considered as "beneficial practice" and "hazardous practice", respectively.

Statistical data analysis. The collected data were analysed by the Statistical Package for the Social Sciences (SPSS) version 26 (Chicago, Illinois, USA). The socio-demographic characteristics as well as knowledge, attitude and practice data were employed and described by the statistical descriptive data analysis. One-way analysis of variance (ANOVA) was used to compare and analyse the mean score of each component of knowledge, attitude and practice in terms of age, educational qualification and occupation. Post Hoc test was accomplished using the Least Significant Difference (LSD) process to find out the true source of differences only when the ANOVA test exhibited statistically significant results ($P < 0.05$). Moreover, association of variables like gender, marital status and residence with knowledge, attitude, and practice score were analysed using the χ^2 statistic. Statistical Pearson' coefficient correlation (r) was determined to explore the relationship between KAP.

RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents. Total 428 respondents participated in the survey 49.3% were male and 50.7% were female. Most respondents were between 15-30 years' age group (85.5%), had an educational qualification of undergraduate level (61.9%), were unmarried (73.6%) and lived in urban areas (68.9%). In terms of occupation, most of the participants (72.2%) were students (Table 1).

Knowledge regarding disinfectants use. Around 87% of participants claimed to have knowledge regarding hand sanitizer or any other disinfectants before the COVID-19 outbreak. 70.8% of participants reported knowing the ingredients used in hand sanitizer or disinfectant manufacturing and 87.4% of participants believed that they understood the instructions on labelling of the hand sanitizer or disinfectants. Moreover, approximately 79.2% of participants had an idea about the adverse effects of excessive use of these products. Most respondents (88.8%) knew that sanitizer or disinfectants must be kept out of children. But 58.4% of participants were not knowledgeable about the types of disinfectant used in the disinfectant chambers. However, 61.9% of the participants claimed that they knew the handling of disinfectant aerosol or liquid spraying safely (Table 2).

Table 1. Socio-demographic characteristics/variables of participants (n=428).

Socio-demographic variables/ characteristics		Frequency, n (%)
Gender	Male	211 (49.3)
	Female	217 (50.7)
Age group	15-30	366 (85.5)
	31-45	38 (8.9)
	46-60	12 (2.8)
	>60	12 (2.8)
Educational qualification	Secondary	29 (6.8)
	Higher secondary	75 (17.5)
	Undergraduate level	265 (61.9)
	Postgraduate level	44 (10.3)
	PhD / MPhil	13 (3.0)
	Others	2 (0.5)
Marital status	Married	113 (26.4)
	Unmarried	315 (73.6)
Occupation	Student	309 (72.2)
	Employee (Full time)	52 (12.1)
	Unemployed	14 (3.3)
	Employee (Part time)	15 (3.5)
	Elderly person (Retired)	11 (2.6)
	Housewife	21 (4.9)
	Businessman	6 (1.4)
Current residence	Urban	295 (68.9)
	Rural	133 (31.1)

Analysis of variance (ANOVA) on various variables with the knowledge score of the participants indicated statistically significant differences ($p < 0.001$) between respondents of different ages, educational qualifications and occupation groups (Table 3) whether gender, marital status and current residence have a significant association ($p < 0.05$) with knowledge levels. The data noted a significantly higher knowledge score between females, unmarried and people living in urban areas regarding disinfectant use (Table 4).

Table 2. KAP regarding disinfectants use (n=428).

Statements	Scoring matrix	Frequency, n (%)		
		Yes	No	May be
Knowledge related				
Knowledge about hand sanitizer or any other disinfectants before the COVID-19 outbreak	Y= 1, N = 0	375 (87.6)	53 (12.4)	N/A
Knowledge about ingredients or chemicals that are used for manufacturing hand sanitizer or disinfectants	Y = 1, N = 0	303 (70.8)	125 (29.2)	N/A
Understanding the instructions written on the labeling of hand sanitizer or disinfectants	Y = 1, N = 0	374 (87.4)	54 (12.6)	N/A
Knowledge about excessive use of hand sanitizer or disinfectants that can cause harm to the skin and have an adverse effect on human health	Y = 1, N = 0	339 (79.2)	89 (20.8)	N/A
Knowledge that 'sanitizer or disinfectants must be kept out of children'	Y = 1, N = 0	380 (88.8)	48 (11.2)	N/A
Knowledge about types of disinfectants that are used in disinfectant chambers before the entry of different offices or shopping malls	Y = 1, N = 0	178 (41.6)	250 (58.4)	N/A
Knowledge about handling of disinfectant aerosol or liquid spraying safely	Y = 1, N = 0	265 (61.9)	163 (38.1)	N/A
Attitudes related				
Attitude towards effectiveness of disinfectant chambers before the entry of different offices or shopping malls to stop the spreading of COVID-19	Y = 0, N = 1	287 (67.1)	141 (32.9)	N/A
Attitude towards using hand sanitizer or any other disinfectant and washing hands with soap to control the COVID-19 pandemic	Y = 0, N = 1 M = 0	51 (11.9)	292 (68.2)	85 (19.9)
Belief that safety precaution is needed when using surface disinfectants	Y = 1, N = 0	385 (90.0)	43 (10.0)	N/A
Attitude towards use of hand sanitizer by kids	Y= 1, N= 0 M = 0	202 (47.2)	112 (26.2)	114 (26.6)
Attitude about the harmfulness of cleaning and disinfectants when inhaled or ingested	Y = 1, N= 0	388 (90.7)	40 (9.3)	N/A
Attitude about several skin disorders with excessive use of hand sanitizer and disinfectants	Y = 1, N= 0 M = 0	298 (69.6)	41 (9.6)	89 (20.8)
Practices related				
Mixing of different disinfectants such as bleaching powder, savlon, dettol, etc., or hand sanitizers together to disinfect surface or other things	Y = 0, N = 1	131 (30.6)	297 (69.4)	N/A
Sanitizing hands more frequently than before, after the COVID19 outbreak	Y = 1, N = 0	363 (84.8)	65 (15.2)	N/A
Washing of food products like fruits, vegetables with bleaching powder, alcohol solution, soap or detergent during the COVID-19 pandemic	Y = 0, N = 1	136 (31.8)	292 (68.2)	N/A
Application of household cleaning and disinfectant products such as bleaching powder to bare skin	Y = 0, N = 1	56 (13.1)	372 (86.9)	N/A
Inhaling or ingesting hand sanitizer or other disinfectants intentionally during this pandemic	Y = 0, N = 1 M = 0	25 (5.8)	395 (92.3)	8 (1.9)
Gargling regularly with mouthwash such as with povidone iodine or hot water during the COVID-19 pandemic	Y = 1, N = 0	205 (47.9)	223 (52.1)	N/A
Using of personal protecting when applying disinfectants for surface cleaning in home, office or hospitals etc.	Y = 1, N = 0	274 (64.0)	154 (36.0)	N/A

Y= Yes; N=No; M= May be; N/A= Not applicable.

Table 3. Association between age, educational qualification and occupation with KAP variables (n = 428).

Variables	Socio-demographic characteristics		Mean	SD	95% confidence interval		df	F- statistic	p-value
					Lower bound	Upper bound			
Knowledge	Age	15-30	5.32[a,b,c]	1.578	5.16	5.48	3	16.318	<.001
		31-45	4.37[d,e]	1.715	3.80	4.93			
		46-60	3.00[b,d]	2.683	1.20	4.80			
		>60	3.17[c,e]	1.992	1.90	4.43			
	Educational qualification	Secondary / O- level	3.23[a,b,c,d]	1.736	2.59	3.88	5	19.646	<.001
		Higher secondary/A-level	4.26[a,e,f,g]	1.784	3.84	4.68			
		Undergraduate level	5.54[b,e,h]	1.398	5.37	5.70			
		Postgraduate level	5.64[c,f,i]	1.630	5.14	6.13			
		PhD / MPhil	3.85[h,i]	2.577	2.29	5.40			
		Others	6.00[d,g]	1.414	-6.71	18.71			
	Occupation	Student	5.31[a,b,c,h]	1.499	5.14	5.48	6	5.824	<.001
		Employee (Full time)	5.10[d]	2.225	4.48	5.72			
		Employee (Temporary)	5.93[e,f,g]	1.328	5.16	6.70			
		Housewife	4.29[c,g,i]	1.554	3.58	4.99			
		Aged person (retired)	3.00[b,d,f,i]	1.949	1.69	4.31			
		Jobless (Unemployed)	4.23[a,e,h]	2.204	2.90	5.56			
		Businessman	4.50	3.536	-27.27	36.27			
Attitude	Age	15-30	4.01[a,b,c]	1.162	3.89	4.12	3	10.448	<.001
		31-45	3.24[a]	1.344	2.79	3.68			
		46-60	2.82[b]	1.722	1.66	3.97			
		>60	2.83[c]	2.038	1.54	4.13			
	Educational qualification	Secondary / O- level	3.10[a,b]	1.296	2.62	3.58	5	6.493	<.001
		Higher secondary /A-level	3.61[c,d]	1.379	3.29	3.94			
		Undergraduate level	4.02[a,c,e]	1.126	3.88	4.16			
		Postgraduate level	4.32[b,d,f]	1.073	3.99	4.64			
		PhD / MPhil	3.00[e,f]	2.041	1.77	4.23			
		Others	4.50	.707	-1.85	10.85			
	Occupation	Student	4.01[a]	1.105	3.89	4.13	6	3.382	<.001
		Housewife	3.48[e]	1.401	2.84	4.11			
		Temporary employee	3.86[c]	1.460	3.01	4.70			
		Unemployed	3.62[d]	1.325	2.81	4.42			
		Employee (Full time)	3.85[b]	1.526	3.42	4.27			
		Retired person	2.55[a,b,c,d,e]	2.018	1.19	3.90			
		Businessman	3.00	.000	3.00	3.00			
Practice	Age	15-30	4.50[a,b]	1.048	4.40	4.61	3	4.603	0.003
		31-45	4.08	1.100	3.72	4.44			
		46-60	3.91	.701	3.44	4.38			
		>60	3.75[b]	1.215	2.98	4.52			
	Educational qualification	Secondary / O- level	3.80[a,b,c]	1.064	3.40	4.20	5	3.236	0.007
		Higher secondary/A-level	4.36	1.052	4.11	4.61			
		Undergraduate level	4.50[b]	1.027	4.37	4.62			
		Postgraduate level	4.68[c]	1.137	4.34	5.03			
		PhD / MPhil	4.08	1.256	3.32	4.84			
		Others	4.50	.707	-1.85	10.85			
	Occupation	Student	4.48[a,b,c,d]	1.032	4.36	4.59	6	3.125	.005
		Employee (Full time)	4.79[d,e,f,g]	1.073	4.49	5.09			
		Employee (Part time)	4.43	1.284	3.69	5.17			
		Unemployed	3.92[e]	.760	3.46	4.38			
		Retired person	3.73[b,f]	1.009	3.05	4.41			
		Housewife	4.00[c,g]	1.000	3.54	4.46			
		Businessman	4.00	1.414	-8.71	16.71			

[a,b,c,d,e,f,g,h,i]: Any two groups, that belong to a specific criteria (i.e. age, educational qualification and occupation), with similar superscripts were found to significantly differ from each other in terms of their mean knowledge scores [determined by Post Hoc analysis- Least Square Difference (LSD) method]

Table 4. Association between gender, marital status, current residence and KAP score for each variable (n=428).

Variables	Socio-demographic characteristics		Not adequate, n (%)	Adequate, n (%)	Pearson χ^2 - statistic	df	P- value
Knowledge	Gender	Male	70 (57.9)	141 (45.9)	4.936	1	0.026
		Female	51 (42.1)	166 (54.1)			
		Total	121 (100)	307 (100)			
	Marital status	Married	42 (34.7)	70 (22.8)	6.372	1	0.012
		Unmarried	79 (65.3)	237 (77.2)			
		Total	111 (100)	307 (100)			
	Current residence	Urban	71 (58.7)	224 (73)	8.271	1	0.004
		Rural	50 (41.3)	83 (27)			
		Total	121 (100)	307 (100)			
			Negative attitude n (%)	**Positive attitude n (%)**			
Attitude	Gender	Male	58 (50.9)	153 (48.7)	0.155	1	0.694
		Female	56(49.1)	161 (51.3)			
		Total	114 (100)	314 (100)			
	Marital status	Married	35 (30.7)	77 (24.5)	1.653	1	0.199
		Unmarried	79 (69.3)	237 (75.5)			
		Total	114 (100)	314 (100)			
	Current residence	Urban	70 (61.4)	225 (71.7)	4.105	1	0.043
		Rural	44 (38.6)	89 (28.3)			
		Total	114 (100)	314 (100)			
			Hazardous practice, n (%)	**Beneficiary practice, n (%)**			
Practice	Gender	Male	55 (64)	156 (45.6)	9.247	1	0.002
		Female	31 (36)	186 (54.4)			
		Total	86 (100)	342 (100)			
	Marital status	Married	24 (27.9)	88 (25.7)	0.168	1	0.682
		Unmarried	62 (72.1)	254 (74.3)			
		Total	86 (100)	314 (100)			
	Current residence	Urban	59 (68.6)	236 (69.0)	0.005	1	0.943
		Rural	27 (31.4)	106 (31.0)			
		Total	86 (100)	342 (100)			

ANOVA test indicated significant differences in attitude score among respondents from different age groups ($p < 0.001$), educational qualifications ($p < 0.001$) and occupations ($p < 0.01$) (Table 3). A significant association ($p < 0.05$) between current residence and levels of attitude was found. The result indicated that people living in urban areas had a higher attitude score than the others (Table 4).

Practice on disinfectants use. A significant number of respondents (69.4%) claimed that they never mixed different disinfectants. 84.8% of respondents reported that they sanitize their hands more frequently than before. Additionally, 68.2% of respondents stated that they never washed food products with disinfectants during the COVID-19 outbreak and 86.9% of respondents ensured that they never applied household cleaning and disinfectant products such as bleaching powder to bare skin. Almost all respondents (92.3%) reported that they never inhaled or ingested hand sanitizer or other disinfectants during this pandemic intentionally. Only 47.9% of participants mentioned that they gargled

regularly with a mouthwash such as with povidone-iodine or hot water during the COVID-19 pandemic and 64.0% of respondents also practiced keeping personal protection while using disinfectants (Table 2).

ANOVA test demonstrated significant differences in practice level among respondents from different age groups, educational qualifications and occupations ($p< 0.01$) (Table 3). The gender group has a significant association ($p< 0.05$) with practice levels whereas female respondents were found to have a better practice score than the male (Table 4).

Relationship between KAP's domain. A moderately positive correlation ($r = + 0.482$) was found between knowledge and attitudes, but the correlation was very weakly positive ($r = + 0.199$) in-between attitude and practice. However, a weakly positive correlation was found between practice and knowledge ($r = +0.282$) (Table 5).

Table 5. Association among attitude, knowledge and practice regarding disinfectants use among the participants (n=428).

	Pearson correlation, r
Knowledge vs attitude	$+0.482^{**}$
Attitude vs practice	$+0.199^{**}$
Knowledge vs practice	$+0.282^{**}$

** means significant at 0.01 level; r value: 0-0.19 = very weak association, 0.8-1 = very strong relationship, 0.40-0.59 = moderate association, 0.2-0.39 = weak association and 0.6-0.79 = robust association.[17]

Knowledge regarding disinfectants use. The survey identified the knowledge levels regarding disinfectants and sanitizers use during this COVID-19 outbreak. The results revealed that most respondents knew hand sanitizer or any other disinfectants before this pandemic. Having knowledge about active ingredients of cleaning products is necessary because different types of ingredients may display some side effects such as ammonia can cause skin and eye irritation; excessive exposure to phenol can cause liver damage and diarrhoea; toxic chlorine gas from bleach can cause bowel cancer, etc.[18] It is recommended to follow the instructions written on the disinfectant products' labelling to ensure safe and effective use.[19] Most of the respondents reported that they had knowledge about the ingredients of the disinfectants and understood the labelling instructions. Knowledge gaps were found regarding disinfectant types used in disinfectant chambers before entering different offices or shopping malls. The excessive use of disinfectants could cause adverse effects on the skin, central nervous system, eye, respiratory system etc.[10] Disinfectant and hand sanitizer products should be stored in a safe place away from children.[12] According to the study, most of the respondents were knowledgeable about the adverse effects of disinfectants and ensured that they stored these products out of reach of children, which was consistent with another study.[13] Safe handling of spray cleaning and disinfectant products is necessary because these products have been associated with adverse respiratory effects.[10] More than half of the respondents of the current study had knowledge regarding the handling of disinfectant aerosol or liquid spraying safely.

Based on this study, most of the respondents were knowledgeable about disinfectant use during this pandemic situation. Current study shows that higher number of participants were knowledgeable in both urban and rural area separately which means regardless the ratio of respondents from urban and rural area, number of knowledgeable participants is greater than the non-knowledgeable ones. However, the difference in ratio of respondents with adequate and non-adequate knowledge in urban and rural area indicates that magnitude of difference between knowledgeable and non-knowledgeable respondents would be less if similar number of respondents were taken from urban and rural area. As a large portion of respondents were from urban areas, which might be the reason for the high magnitude of positive outcome. According to UNESCO's GRALE 4 (fourth Global Report on Adult Learning and Education), the literacy rate is higher in urban areas for both males and females in Bangladesh.[20] It can be postulated that literate people are more knowledgeable regarding disinfectants used. The study revealed that the female respondents got a higher knowledge score than their counter part males. The finding is consistent with

another study that demonstrated that females showed more interest in acquiring health-related knowledge because of their motherly nature.[21] Higher knowledge score was demonstrated by Kuantan females regarding the usage of household insecticides compared to males.[15] The study also suggested that unmarried people were more knowledgeable regarding disinfectants use than married people.

Attitudes toward disinfectants use. The current study revealed the attitudes of general people towards disinfectants use. Most of the respondents believed that disinfectant chambers effectively stopped the spreading of COVID-19, which indicates a bad attitude. According to WHO, the disinfectant booth can effectively disinfect the surface but not the human body due to its harmful effect on the human body.[22] It can be assumed that lacking their knowledge may influence their attitude towards the disinfectants chamber. Most of the respondents of this study thought that disinfection was not the only way to control this pandemic which indicates a good attitude. WHO advises simple precautions against COVID-19 outbreak including maintaining physical distancing, wearing a mask, avoiding close contacts and crowds, cleaning hands regularly, maintaining proper room ventilation, and coughing into a tissue or bent elbow.[23] Safety measures need to be taken when using disinfectants and excessive use of hand sanitizers or disinfectants can cause several skin disorders.[10] Almost all of the respondents in this study believed that safety precautions are needed during surface disinfection and thought the excessive use of disinfectants as a health hazard. Less than half of the respondents mentioned that kids could use hand sanitizer, supported by the literature, which stated that children could use hand sanitizer with at least 60% alcohol provided that they are supervised well by the guardian in case they are ≤5 years old since poisoning can occur in children due to swallowing a small amount of hand sanitizer.[24] Accidental or intentional ingestion and inhalation can cause harmful effects, such as renal problems, gastrointestinal diseases, acute cardiopulmonary arrest due to bleach ingestion, or inhalation. [13,25] Almost all the respondents thought ingestion and inhalation were harmful. In this study, people living in urban areas got higher attitude scores, and the literacy rate is higher in urban areas.[20] It can be assumed that literacy rates influence the attitude levels and literate people possess a good level of attitudes.

Practice on disinfectants use. The results pictured that more than half of the respondents avoided mixing disinfectant products. Mixing cleaning products leads to corrosive compounds, such as mixing bleach and ammonia produces chloramines that irritate the nose and eye throat and damage the lung and chest pain.[26] According to WHO, food products such as fruits, vegetables should be washed thoroughly with clean water.[27] The study presented that only a few respondents were engaged in high-risk practices like deliberately inhaling, applying sanitizer/disinfectant products to the skin directly, cleaning fruit and vegetables with disinfectants, or ingesting hand sanitizer, or others consistent with the other study conducted by CDC among U.S. adults.[28] Less than half of the respondents reported that they regularly gargled with mouthwash or hot water during this pandemic. This practice is supported by a study published in the Journal of Infectious Diseases, which suggests that gargling with mouthwash may help avert the spread of the SARS-CoV-2 virus.[29] Almost all respondents of this study mentioned that they sanitized their hands more frequently than before, similar to a previous study describing that hand sanitizing frequency increased during this COVID-19 outbreak.[30] The use of personal protective equipment (PPE) during surface disinfection is a good practice was neglected by many people.[18] Practice scores of the respondents were associated with the age group, but there were no association between occupation, educational qualification and the practice score. The findings revealed that females were more engaged in good practice than males.

Current study shows that any two aspects of KAP regarding disinfectants and sanitizers use were significantly positively correlated among Bangladeshi population which means improvement in one domain will result in the betterment of other two

domains. Similar sort of positive correlations were found while investigating KAP level regarding household insecticides usage in Pahang.[15]

CONCLUSION

In this study, people's knowledge, attitude and practice (KAP) towards using disinfectants and sanitizers during the COVID-19 pandemic were studied. One of the major limitations of these study was that being an online based study, it mostly included participants who were habituated and had access to relevant social media and that caused majority of our study participants to be urban young adults which might not be an absolute representative sample of Bangladeshi population. However, the information from this study can be used as baseline data by the authority to take proper steps in ensuring safer and effective use of disinfectants and sanitizers. The participants had adequate KAP towards the use of disinfectants. Most of the participants were found knowledgeable, had a significant positive attitude and had better practice regarding disinfectant and sanitizer use. But relatively low scores in KAP evaluation were found for a considerable number of participants, which indicated some space for betterment. In addition, inappropriate and/or excessive use of disinfectants could cause serious health hazards. So, more efforts as well as awareness programs are needed on COVID-19 to spread awareness, improve attitude regarding disinfectant use and ensure safe disinfection practices.

ACKNOWLEDGEMENT

The authors are truly grateful to the respondents for participating in this survey study.

Conflict of interest

The authors declare that there is no conflict of interest.

Ethical approval

No ethical approval was required to conduct the study.

REFERENCES

1. Rothan, H.A. and Byrareddy, S.N. 2020. The epidemiology and pathogenesis of coronavirus disease (COVID-19) outbreak. *J. Autoimmun.* **109**, 102433.
2. Li, C., Ji, F., Wang, L., Wang, L., Hao, J., Dai, M., Liu, Y., Pan, X., Fu, J., Li, L., Yang, G., Yang, J., Yan, X. and Gu, B. 2020. Asymptomatic and human-to-human transmission of SARS-CoV-2 in a 2-family cluster, Xuzhou, China. *Emerg. Infect. Dis.* **26**, 1626-1628.
3. Di Gennaro, F., Pizzol, D., Marotta, C., Antunes, M., Racalbuto, V., Veronese, N. and Smith, L. 2020. Coronavirus diseases (COVID-19) current status and future perspectives: a narrative review. *Int. J. Environ. Res.* **17**, 2690.
4. Dhama, K., Patel, S.K., Kumar, R., Masand, R., Rana, J., Yatoo, M.I., Tiwari, R., Sharun, K., Mohapatra, R.K., Natesan, S. and Dhawan, M. 2021. The role of disinfectants and sanitizers during COVID-19 pandemic: advantages and deleterious effects on humans and the environment. *Environ. Sci. Pollut. Res.* **15**, 34211-34228.
5. Al-Sayah, M.H. 2020. Chemical disinfectants of COVID-19: an overview. *J. Water Health* **18**, 843-848.
6. O'Neill, M. 2021. Sanitize vs. Disinfect: What's the Difference? *Health* Retrieved from: https://www.health.com/condition/infectious-diseases/coronavirus/sanitize-vs-disinfect [accessed 20 October 2021].
7. Sarfaraz, S., Shabbir. J., Mudasser, M.A., Khurshid, Z., Al-Quraini, A.A.A., Abbasi, M.S., Ratnayake, J. and Zafar, M.S. 2020. Knowledge and attitude of dental practitioners related to disinfection during the COVID-19 Pandemic. *Healthcare (Basel)* **8**, 232.
8. Chin, A.W., Chu, J.T., Perera, M.R., Hui, K.P., Yen, H.L., Chan, M.C., Peiris, M. and Poon, L.L. 2020. Stability of SARS-CoV-2 in different environmental conditions. *Lancet Microbe* **1**, e10.
9. McDonnell, G. and Russell, A.D. 1999. Antiseptics and disinfectants: activity, action and resistance. *Clin. Microbiol. Rev.* **12**, 147-179.
10. Makati Medical Center. 2020. Harmful side effects of hand sanitizers and other disinfectants. Retrieved from: https://www.makatimed.net.ph/news-and-exhibits/news/harmful-side-effects-of-hand-sanitizers-and-other-disinfectants [accessed 21 October 2021].
11. Dhakatribune. 2020. Cigarette meets hand sanitizer: Burnt physician loses battle for life. Retrieved from: https://archive.dhakatribune.com/bangladesh/2020/07/28/cigarette-meets-hand-sanitizer-burnt-physician-dies-in-dhaka [accessed 28 July, 2020].
12. Cho, H.J., Lee, S.Y., Park, D., Ryu, S.H., Yoon, J., Jung, S., Lee, E., Yang, S.I. and Hong, S.J. 2019. Early-life exposure to humidifier disinfectant determines the prognosis of lung function in children. *BMC Pulm. Med.* **19**, 1-10.
13. Gharpure, R., Hunter, C.M., Schnall, A.H., Barrett, C.E., Kirby, A.E., Kunz, J. Berling, K., Mercante, J.W., Murphy, J.L. and Garcia-Williams, A.G. 2020. Knowledge and practices regarding safe household cleaning and disinfection for COVID-19 prevention-United States, May 2020. *Am. J. Transplant.* **20**, 2946-2950.

14. Dindarloo, K., Aghamolaei, T., Ghanbarnejad, A., Turki, H., Hoseinvandtabar, S., Pasalari, H. and Ghaffari, H. R. 2020. Pattern of disinfectants use and their adverse effects on the consumers after COVID-19 outbreak. *J. Environ. Health Sci. Eng.* **18**, 1301-1310.
15. Abd Hamid, A.A., Isa, M.L.M., Pien, L.S., Hassan, N.F.N., Muhammad, H. and Abd Hamid, H. 2021. Exposure risk of household insecticide: identification of the knowledge, attitude and practice levels among Kuantan population, Pahang. *Mal. J. Med. Health Sci.* **17**, 23-32.
16. Saha, M., Saha, G. and Islam, M. 2022. Knowledge, attitude and practice of Bangladeshi residents during COVID-19 pandemic. *PLOS Glob. Public Health* **2**, e0000407.
17. Swinscow, T.D. 2021. In: Statistics in Square one (Campbell, M.J., Eds.), Wiley Blackwell, Oxford, Chapter 11, pp. 165-182.
18. Whitacre, S.H. 2002. Chem 101: What you need to know about active ingredients. *CleanLink*. Retrieved from: https://www.cleanlink.com/hs/article/Chem-101-What-you-need-to-know-about-active-ingredients--372 [accessed 22 October 2021].
19. CDC. 2021. COVID-19 and Your Health. Retrieved from: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/disinfecting-your-home.html [accessed 22 October 2021].
20. The Business Standard. 2019. 58 percent urban, 40 percent rural males above 60 are literate: UNESCO. Retrieved from: https://www.tbsnews.net/bangladesh/58-percent-urban-40-percent-rural-males-above-60-are-literate-unesco [accessed 23 October 2021].
21. Yang, Y.C., Boen, C., Gerken, K., Li, T., Schorpp, K. and Harris, K.M. 2016. Social relationships and physiological determinants of longevity across the human life span. *Proc. Natl. Acad. Sci. U.S.A.* **113**, 578-583.
22. Rabby, M.I., Hossain, F., Akter, F., Mahbub, T. and Huda, S.N. 2020. Disinfection booth: blessing or curse for spreading of COVID-19 in Bangladesh. *Can. J. Public Health* **111**, 660-662.
23. WHO. 2021. Coronavirus disease (COVID-19): Similarities and differences between COVID-19 and Influenza. Retrieved from: https://www.who.int/emergencies/ diseases/novel-coronavirus-2019/question-and-answers-hub/coronavirus-disease-covid-19-similarities-and-differences-with-influenza [accessed 23 October 2021].
24. Healthy Children. 2021. Hand Sanitizers: Keep Children Safe from Poisoning Risk. Retrieved from: -https://www. healthychildren.org/English/health-issues/conditions/ COVID-19/Pages/Keep-Hand-Sanitizer-Out-of-Childrens-Reach.aspx [accessed 24 October 2021].
25. Peck, B., Workeneh, B., Kadikoy, H., Patel, S.J. and Abdellatif, A. 2011. Spectrum of sodium hypochlorite toxicity in man also a concern for nephrologists. *Nephrol. Dial. Transplant.* **4**, 231-235.
26. Hansen, B. 2020. Mixing Cleaners-Just Don't! *Toxicology Education Foundation*. Retrieved from: https://toxed-foundation.org/mixing-cleaners-just-dont/; 2021 [accessed 24 October 2021].
27. WHO. 2020. Coronavirus disease (COVID-19): Food safety and nutrition. Retrieved from:https://www. who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19-food-safety-and-nutrition [accessed 23 October 2021].
28. Food-safety. 2020. CDC: Washing Food with Bleach Among Unsafe Disinfection Methods on the Rise During Pandemic. Retrieved from: https://www.food-safety.com/articles/6637-cdc-washing-food-with-bleach-among-unsafe-disinfection-methods-on-the-rise-during-pandemic [accessed 24 October 2021].
29. The Times of India. 2020. A mouthwash to defeat COVID-19? Scientists say a mouthwash could lower infection spread. Retrieved from: https://timesofindia.indiatimes. com/life-style/health-fitness/health-news/a-mouthwash-to-defeat-covid-19-scientists-say-a-mouthwash-could-lower-infection-spread/photostory/77482946.cms [accessed 24 October 2021].
30. Mahmood, A., Eqan, M., Pervez, S., Alghamdi, H.A., Tabinda, A.B., Yasar, A., Brindhadevi, K. and Pugazhendhi, A. 2020. COVID-19 and frequent use of hand sanitizers; human health and environmental hazards by exposure pathways. *Sci. Total Environ.* **742**, 140561.