Public Knowledge of Hand Sanitizers and Disinfectants in Saudi Arabia

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ABSTRACT

Objectives: Hand sanitizers and disinfectants have been commonly used during epidemic and pandemic situations. Despite the proven efficacy and safety of sanitizers and disinfectants, the publics' knowledge about their use is still controversial. In this survey, we aimed to investigate the knowledge of the public about the use of hand sanitizer and disinfectants in the Kingdom of Saudi Arabia. **Design and Setting:** A self-administered structured questionnaire was sent to the public via online mode. It collected demographic information and collected information about different hand sanitizers and disinfectants and their general knowledge on such products, contraindications, and storage information during the COVID-19 pandemic. Data were collected through the Survey monkey program. **Results:** A total of 402 participants responded to the questionnaire. Of them, 32.58% were from the western region, and 25.76% were from the central area, and there were statistically significant differences between different regions (p=0.000). Based on nationality, 90.88% of Saudi nationals responded to the questionnaire. In addition, 65.17% of the responders were female, with statistically significant differences (p=0.000). The most prevalent age group was between 18 and 29 years (50.25%), with statistically significant differences between all age groups (p=0.000). The average general knowledge score was 3.90emphasizing the medication administration (4.40) and frequency of usage (4.25). The average score of contraindication knowledge was 2.91. The feature most known by the public was the general side reaction that appears during use (3.21), and usage of the medication with other drugs is forbidden (3.04). The average score for the knowledge of storage was 3.45. The part most known by the patient was the storage of the sanitizer or disinfectant at room temperature (3.91) and sanitizer or disinfectant prices in general (3.58). **Conclusion:** The knowledge about storage of sanitizers and disinfectants among the public in Saudi Arabia was satisfactory; however, the knowledge about contraindications was insufficient. Therefore, we recommend increasing the general public's awareness about sanitizers and disinfectants in the Kingdom of Saudi Arabia.
Key words: Public, Knowledge, Sanitizer, Disinfectants, Saudi Arabia.

INTRODUCTION

Over the past two years, worldwide, all countries have been affected by the pandemic called COVID-19.[1,2] Various preventive measures and treatment guidelines were released from various national and international healthcare organizations.[3-5] One of the common recommendations by these organizations was to use hand sanitizer and disinfectant,[2,6,7] which are used to prevent the transmission of COVID-19. Moreover, various medical and pharmaceutical societies released some instructions dealing with sanitizer and disinfectant shortages. Despite frequent usage, the main question is about the magnitude of public knowledge of hand sanitizer and disinfectants.[6,8,9] They consisted of generic names, trade names, indications, contraindications, and storage of sanitizer and disinfectant.[8-11] The active ingredient in most of the sanitizers was alcohol (60–70%). In addition, the disinfectants contained other chemicals such as phenol-based compound, a chlorine-based compound, and quaternary ammonium salts.[8-12] Various studies have discussed the knowledge of healthcare professionals with regard to infection control, including the use of sanitizer and disinfectants.[13-21] However, most of the studies conducted in a non-public and non-COVID-19 period did not emphasize sanitizer and disinfectants usage. However, few studies have discussed the knowledge of the public with regard to the sanitizer and disinfectants during COVID-19.[22-24] However, to the best of our knowledge, there are no studies conducted about the understanding of sanitizer and disinfectants usage during the COVID-19 pandemic in Saudi Arabia or Middle Eastern countries. Therefore, in this study, we aimed to assess the public knowledge of sanitizer and disinfectants in Saudi Arabia.

MATERIALS AND METHODS

A quantitative, cross-sectional electronic survey was performed in Saudi Arabia through a self-administered questionnaire distributed to the general public over four months. All Saudi citizens were included in this study. Incomplete responses and responses received from outside Saudi Arabia were excluded from the study. An online self-developed questionnaire validated by an expert reviewer was distributed to the public in Saudi Arabia. The survey consisted of two parts. Part one collected demographic information (location, gender, age, qualification, occupational status, and monthly income). The second part included questions on general knowledge, contraindications, and storage information of sanitizer or disinfectants during COVID-19. Moreover, resources of knowledge about hand sanitizer or disinfectants. A 5-point Likert response scale system was used to obtain responses. The survey was distributed based on convenient sampling methods and a calculated number of sample of public responders. The survey was distributed through various social media applications such as WhatsApp and Telegram, as well as via direct face-to-face contact. A reminder message was sent once every 1-2 weeks. Based on the previous literature with unlimited population size, the sample was calculated with the population percentage of 50%, the confidence level of 95%, z score of 1.96, the margin of error of 5%, and drop-out rate of 5%. As a result, the calculated sample size was 399, with the power of study of 80%.[25-27] The response rate required for the estimated sample size was 60–70%.[27,28] Expert reviewers and pilot testing validated the survey. Various reliability tests such as McDonald's ω, Cronbach's α, Guttman's λ2, and Guttman's λ6 were conducted. The data were collected through the Survey Monkey system and analyzed with Statistical Package of Social Sciences (SPSS), Jeffery's Amazing Statistics Program (JASP), and Microsoft Excel (version 16). We performed descriptive and frequency analysis, the goodness of fit analysis, correlation analysis, and inferential analysis between independent variables. The STROBE (Strengthening the reporting of observational studies in epidemiology statement: guidelines for reporting observational studies) guided the reporting of this study.[29-31]

RESULTS

A total of 402 participants responded to this online questionnaire. Only participants who completed all the sections in the questionnaire were included. The questionnaire's reliability scores were as follows: McDonald's ω was 0.916, Cronbach's α was 0.914, Guttman's λ2 was 0.919, Guttman's λ6 was 0.951, and Greatest Lower Bound was 0.964. Out of 402 responders, 32.58% were from the western region, and 25.76% were from the central region, with statistically significant differences between different regions ($p<0.001$). Of the total responders, 90.88% were Saudi nationals. Females (65.17%) responded more than males, with statistically significant differences ($p<0.001$). Based on the age, there were five sub-categories of the responders. The most prevalent age group was between 18 and 29 years (50.25%), with statistically significant differences between all age groups ($p<0.001$). Table 1 shows socio-demographic data in detail. Regarding the responders' education level, 65.67% had a bachelor's degree, 34.91% were employed, 34.16% were students, and 26.18% were non-employees, with statistically significant differences between all educational levels ($p<0.001$). Based on the profession, only 36.82% of the responders were healthcare practitioners, and 78.38% of these practitioners were pharmacists, with statistically significant differences between disciplines ($p<0.001$) (Table 2).

Responders were asked to choose a level of general knowledge of sanitizers or disinfectants during COVID-19. These elements of learning are commonly used for patient education. The average score of knowledge was 3.90. The most known part by the responders was how to use the medication (4.40) and frequency of usage (4.25). The part with the least knowledge was the generic name of the drug (3.52) and medication dosage form (3.56), with statistically significant differences between responses ($p<0.001$) (Table 3). Responders were also asked to choose the level of knowledge among knowledge of contraindications of sanitizers or disinfectants. The average score of knowledge was 2.91. These elements of learning are commonly used for patient education. The feature most known by the responders was the general side reaction that appears during use (3.21), and usage of the medication with other drugs is forbidden (3.04). On the contrary, the part least known to the responders was the deal with sanitizer or disinfectant poisoning (2.75) and the effect of the hand sanitizer or disinfectant during breastfeeding (2.78), with statistically significant differences between the responses ($p<0.001$) (Table 4).

Table 1: The socio-demographic data of responders to the questionnaire.

locations	Response Count	Response Percent	*p*-value
Central area	102	25.76%	0.000
North area	54	13.64%	
South area	76	19.19%	
East area	35	8.84%	
West area	129	32.58%	
Answered question	**396**		
Skipped question	**6**		
Nationality	**Response Count**	**Response Percent**	
Saudi	339	90.88%	0.000
Non-Saudi	34	9.12%	
Answered question	**373**		
Skipped question	**29**		
Gender	**Response Count**	**Response Percent**	
Male	140	80.45%	0.000
Female	262	19.55%	
Answered question	**402**		
Skipped question	**0**		
Age	**Response Count**	**Response Percent**	
<18	35	8.71%	0.000
18 - 29	202	50.25%	
30 - 44	110	27.36%	
45 - 60	41	10.20%	
> 60	14	3.48%	
Answered question	**402**		
Skipped question	**0**		

Next, we analyzed the level of knowledge of storage information of sanitizers and disinfectants. These elements of learning are commonly used for patient education. The average score of knowledge was 3.45. The part most known by the patient was to store the sanitizer or disinfectant at room temperature (3.91) and sanitizer or disinfectant prices in general (3.58). The part with the least knowledge was the insurance coverage of your hand sanitizer (2.79) and insurance coverage of your disinfectant (2.79), with statistically significant differences between responses ($p<0.001$) (Table 5). Participants were also asked about their sources of information about hand sanitizers or disinfectants. For example, some responders depended on the internet to get information (243 (64.46%)) and healthcare practitioners (174 (46.15%)). Followed by The Drug Bulletin (154 (40.85%)) Relatives and friends 115=6 (30.77%)) (Table 6).

Factors influencing the Public general knowledge of public about hand sanitizers and disinfectants

Factors that affected the general knowledge, contraindications, and storage of sanitizer or disinfectant during COVID-19. Using independent samples Kruskal–Wallis test and the Bonferroni correction for multiple

Table 2: **Social and professional information of responders.**

Responder Qualifications	**Response Count**	**Response Percent**	***p*-value**
Doctorate	8	1.99%	0.000
Master's degree	37	9.20%	
Bachelor's degree	264	65.67%	
Diploma	32	7.96%	
High school	48	11.94%	
Intermediate School	10	2.49%	
Primary School	2	0.50%	
Not educated	1	0.25%	
Answered question	**402**		
Skipped question	**0**		
Occupational status	**Response Count**	**Response Percent**	
Employee	140	34.91%	0.000
Non-employee	105	26.18%	
Student	137	34.16%	
Retried	19	4.74%	
Answered question	401		
Skipped question	1		
Are you a health care practitioner (Medical Doctor- Dentist- Pharmacist- Nurse- Others?	**Response Count**	**Response Percent**	
Yes	148	36.82%	0.000
No	254	63.18%	
Answered question	**402**		
Skipped question	**0**		
If you are a health care practitioner, you are a	**Response Count**	**Response Percent**	
Physician	11	7.43%	0.000
Dentist	9	6.08%	
Pharmacist	116	78.38%	
Nurse	4	2.70%	
Other (please specify)	8	5.41%	
Answered question	148		
Skipped question	**254**		

Table 3: **The General knowledge of sanitizer or disinfectant during used covid-19.**

	Complete information		**Incomplete information**		**Weak information**		**I do not have information**		**I do not need this information**		**Total**		***p*-value**
The generic name	99	25.06%	121	30.63%	88	22.28%	59	14.94%	28	7.09%	395	3.52	0.000
The trade name	127	31.83%	137	34.34%	71	17.79%	41	10.28%	23	5.76%	399	3.76	0.000
The strength	136	34.09%	134	33.58%	72	18.05%	43	10.78%	14	3.51%	399	3.84	0.000
Dosage Form	117	29.47%	112	28.21%	77	19.40%	60	15.11%	31	7.81%	397	3.56	0.000
Indications	212	53.13%	103	25.81%	44	11.03%	28	7.02%	12	3.01%	399	4.19	0.000
How to use	259	64.91%	75	18.80%	40	10.03%	17	4.26%	8	2.01%	399	4.40	0.000
Frequncy of times usage	220	55.84%	100	25.38%	38	9.64%	26	6.60%	10	2.54%	394	4.25	0.000
Time to stop hand sanitizer or disinfectant	117	29.70%	133	33.76%	66	16.75%	60	15.23%	18	4.57%	394	3.69	0.000
Answered													
Skipped													

Table 4: The knowledge of Sanitizer or disinfectant contraindications information.

	Complete information		Incomplete information		Weak information		I do not have information		I do not need this information		Total		*p*-value
Use your medications with diseases are forbidden	79	16.56%	135	28.30%	80	16.77%	83	17.40%	100	20.96%	477	3.02	0.000
Usage the medication with other drugs are forbidden	85	17.93%	131	27.64%	76	16.03%	83	17.51%	99	20.89%	474	3.04	0.000
General side reaction that appear during use	85	18.44%	141	30.59%	96	20.82%	65	14.10%	74	16.05%	461	3.21	0.000
The effect of your medications during pregnancy	69	13.83%	127	25.45%	64	12.83%	105	21.04%	134	26.85%	499	2.78	0.000
The effect of your hand sanitizer or disinfectant during breast feeding	57	11.22%	129	25.39%	64	12.60%	113	22.24%	145	28.54%	508	2.69	0.000
The effect of your sanitizer or disinfectant on children	76	16.03%	132	27.85%	88	18.57%	80	16.88%	98	20.68%	474	3.02	0.000
The effect of your sanitizer or disinfectant on Elderly	78	15.63%	120	24.05%	74	14.83%	108	21.64%	119	23.85%	499	2.86	0.000
How to deal with sanitizer or disinfectant poisoning	71	13.81%	110	21.40%	81	15.76%	122	23.74%	130	25.29%	514	2.75	0.000
First aid when poisoning	71	14.29%	128	25.75%	79	15.90%	106	21.33%	113	22.74%	497	2.88	0.000
Answered													
Skipped													

Table 5: The knowledge of Sanitizer or disinfectant storage information while using them.

	Complete information		Incomplete information		Weak information		I do not have information		I do not need this information		Total		*p*-value
Store the sanitizer or disinfectant at room temperature	39.95%	157	28.75%	113	16.54%	65	12.21%	48	2.54%	10	393	3.91	0.000
storage in a refrigerator	17.14%	66	27.79%	107	17.66%	68	31.95%	123	5.45%	21	385	3.19	0.000
storage the Sanitizer or disinfectant exhibition of light	26.34%	103	26.60%	104	17.39%	68	26.34%	103	3.32%	13	391	3.46	0.000
How to deal with expired Sanitizer or disinfectant	26.09%	102	21.99%	86	17.90%	70	29.41%	115	4.60%	18	391	3.36	0.000
Sanitizer or disinfectant prices in general	25.32%	100	33.42%	132	19.75%	78	17.47%	69	4.05%	16	395	3.58	0.000
Insurance coverage of your hand sanitizer	12.37%	48	25.00%	97	18.56%	72	35.31%	137	8.76%	34	388	2.97	0.000
Insurance coverage of your disinfectant	13.59%	53	24.87%	97	16.67%	65	34.87%	136	10.00%	39	390	2.97	0.000
Answered													
Skipped													

Table 6: Sources of information about hand sanitizer or disinfectant.

Answer Choices	Responses	
Health practitioners	174	46.15%
Drug Bulletin	154	40.85%
Relatives and friends	116	30.77%
Internet	243	64.46%
The drug information center at the hospital	66	17.51%
Awareness lectures in a hospital	50	13.26%
Awareness lectures primary healthcare center	53	14.06%
Healthcare care awareness events at the market	58	15.38%
Medical doctor	40	10.61%
Other (please specify)	6	1.59%
Answered	**377**	
Skipped	**25**	

tests, we adjusted significant values. The various factors that might affect the general knowledge of sanitizer or disinfectants during COVID-19 include location, nationality, gender, age, qualifications, occupational status, and whether the responders are healthcare practitioners (medical doctor, dentist, pharmacist, nurse, and others). Most of the factors did not affect the knowledge of storage, with a non-statistically significant difference (p>0.05). Five locations affected the general understanding of sanitizer or disinfectants. The southern region showed the highest scores (4.6301), and the western region showed the lowest score (3.8603), with a statistically significant difference between different locations (p=0.002). Four various worksites affected the general understanding of sanitizer or disinfectants. The lowest score (3.7917) was obtained for students when compared with non-working responders (4.5668), with a statistically significant difference between all groups (p=0.000). Five different age groups affected the general knowledge of sanitizer and disinfectants. The lowest score (3.9488) was obtained for those in the age group of 18–29 years, followed by those in the age group of <18 years (4.8235), with a statistically significant difference (p=0.001). Eight groups of educational levels affected the general knowledge of sanitizer and disinfectants with the lowest score (3.9279) obtained for those with Bachelor's degrees followed by those who studied up to high school (4.6520), with a statistically significant difference between all levels (p=0.001). Non-healthcare professionals showed the highest score (4.5755) than healthcare professionals, with a statistically significant difference between them (p=0.000).

The relationship between the public's general knowledge about sanitizer or disinfectant during COVID-19 and factors affecting it was studied. According to the results of multiple regression analysis, there was a medium relationship (R=0.397 with p=0.000) between the general knowledge of the public about sanitizer and disinfectants and factors affecting it. Six out of seven factors showed non-significant differences (p>0.05). However, a single factor (i.e., responder being a healthcare professional or not) explained a 40.1% positive relationship with the knowledge of sanitizer or disinfectant, with a statistically significant difference between them (p=0.000); the Bootstrap model confirmed this result. Furthermore, the relationship was verified by the non-existence of multi-collinearity with the current position factor with variance inflation factor (VIF) of 1.123, which is less than 3 or 5 as an acceptable number of VIF.[32-34] (Table 7).

Factors influencing the Public knowledge of public about contraindications of hand sanitizer and disinfectants

Various factors affected the knowledge of the public about contraindications of sanitizers and disinfectants during COVID-19. According to our results, most of the factors did not affect the knowledge of storage, with a non-statistically significant difference (p>0.05). However, one factor that affected the knowledge of contraindications was the healthcare practitioner as the profession. Responders with non-healthcare professions showed the highest score (2.7999) than those of healthcare professions (2.4204), with statistically significant differences (p=0.000). Next, the relationship between public knowledge about contraindications of sanitizers and disinfectants during COVID-19 and factors affecting it was analyzed. Based on the multiple regression analysis, there was a weak relationship (R=0.246 with p=0.002) between the public's knowledge about sanitizers and disinfectants' contraindications. Four out of seven factors showed non-significant differences (p>0.05). However, age explained 11.1%, and educational level explained 12.4% of the negative relationship. Moreover, healthcare professionals or otherwise responders described 21.5% of the positive relationship with knowledge about contraindications of sanitizers and disinfectants with a statistically significant difference (p=0.042, 0.029, and 0.000) in age educational level and healthcare professional respectively). The non-existence of multi-collinearity verified the relationship with the current position factor with VIF of 1.113, 1.211, and 1.123, respectively, which is less than 3 or 5 as an acceptable number of VIF.[32-34] (Table 8).

Factors influencing the Public knowledge of storage of hand sanitizer and disinfectants

Various factors affected the knowledge of storage of sanitizers or disinfectants during COVID-19, which includes location, nationality, gender, age, qualification, occupational status, and whether the responders were healthcare professionals. According to the results, most of the factors did not affect the knowledge of storage, and the differences were non-statistically significant (p>0.05). However, a single factor affected the knowledge of storage, which is if the responder was a healthcare professional or not. The responder with healthcare professionals showed a higher score (3.5609) than that of non-healthcare professionals, with a statistically significant difference (p=0.000). The relationship between the knowledge of storage of sanitizers and disinfectants during COVID-19 was analyzed by multiple regression analysis. According to the results, there was a weak relationship (R=0.219 with p=0.015) between the knowledge of storage of sanitizers and disinfectants and factors affecting it. Six out of seven factors did not show any significant difference (p>0.05). However, a single factor (i.e., the responder being the healthcare professional or not) explained 19.3% of the negative relationship with the knowledge of the public about the storage of sanitizers and disinfectants, with a statistically significant difference (p=0.001). The non-existence of multi-collinearity verified the relationship with the current position factor with a VIF of 1.124, which is less than 3 or 5 as an acceptable number of VIF[32-34] (Table 9).

DISCUSSION

Hand sanitizers and disinfectants are playing an active role in controlling the pandemic.[2,6,7] In general, they prevent diseases transmission.[2,6,7] Sanitizers and disinfectants contain various types of chemicals such as alcohol, phenols, and quaternary ammonium chloride.[8-11] These chemicals can be used daily on soft and hard surfaces.[2,6,7] Each class of disinfectant has a unique indication, adverse effect, contraindication, and storage condition.[8-11] Public and patients must know these elements to prevent themselves from drug-related problems and infection.

Table 7: Multiple regression of Factors with the General knowledge of sanitizer or disinfectant during used covid-19.[a]

						Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Collinearity Statistics	
Model		R	R Square	F	Sig.	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.397[b]	.157	9.439	.000[b]	2.430	0.575		4.229	0.000	1.300	3.561		
	Locations					0.035	0.046	0.039	0.765	0.445	−0.056	0.127	0.901	1.110
	Sector of work					−0.016	0.084	−0.011	−0.194	0.846	−0.181	0.148	0.816	1.226
	Age (years)					0.031	0.081	0.019	0.375	0.708	−0.130	0.191	0.899	1.113
	Nationality					−0.195	0.247	−0.039	−0.792	0.429	−0.680	0.290	0.970	1.031
	Gender					−0.146	0.160	−0.048	−0.915	0.361	−0.461	0.168	0.850	1.176
	Educational level					0.004	0.079	0.003	0.047	0.963	−0.152	0.160	0.829	1.207
	Are you from a health care professional					1.201	0.155	0.401	7.749	0.000	0.896	1.506	0.891	1.123

a. Dependent Variable: **General knowledge of Sanitizer or disinfectant during used covid-19** [a], Predictors: (Constant), Location, Site of work, Age, Nationality, Gender, Educational level, Are you from the health care professional (Medical Doctor- Dentist- Pharmacist- Nurse- Others),

Bootstrap for Coefficients

			Bootstrap[a]				
						95% Confidence Interval	
Model		B	Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
1	(Constant)	2.430	0.030	0.535	0.001	1.398	3.513
	Locations	0.035	0.000	0.046	0.442	−0.052	0.129
	Sector of work	−0.016	−0.005	0.096	0.873	−0.213	0.168
	Age (years)	0.031	−0.001	0.087	0.742	−0.150	0.194
	Nationality	−0.195	−0.018	0.216	0.352	−0.618	0.238
	Gender	−0.146	0.001	0.155	0.340	−0.468	0.156
	Practice area	0.004	−0.002	0.076	0.963	−0.148	0.161
	Are you from a health care professional	1.201	0.009	0.151	0.001	0.890	1.503

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Therefore, in this study, we aimed to assess the knowledge of the public about sanitizers and disinfectants. In this cross-sectional study, we applied a self-administered electronic survey, which was validated with high reliability. The responders belonged to various regions, gender, age, qualifications, and jobs, which has also been reported by previous studies.[22-24] The various demographic data is beneficial as most coverage of the society and population types. The average general knowledge of the public about sanitizers and disinfectants was found to be acceptable, which is better than that reported in previous studies.[22-24] However, some vital information, such as the medication's generic name and its dosage form, is rare, which many people may not be interested in memorizing. Some of them may remember only the trade name. In this study, the average knowledge of the public about contraindications of sanitizers and disinfectants was found to be inadequate, which agrees with the results of previous studies.[22,24] This result emphasizes that the public has information about adverse drug reactions and drug-drug interactions. However, the knowledge was weeks with the public about poisoning and related management of sanitizers and disinfectants and medications during breastfeeding and pregnancy. This information is highly required, especially during a pandemic. In this study, the average knowledge of the public about the storage of sanitizers and disinfectants war fair, which emphasizes the storage temperature requirement and medications prices similar to the previous study.[24] This result might be related to the daily practice habits of the public, which is essential information.

On the contrary, the healthcare insurance coverage of sanitizer and disinfectants was rarely known by the public. The majority of the people did not ask about health insurance coverage or the cost of the products. The majority of the public obtained information about sanitizers and disinfectants from the internet and non-specified healthcare practitioner. They rarely asked pharmacists or physicians about it. Most people believe that it is easy for them to search about it on the internet, which can be quick and free of charge. However, the communications with the healthcare professionals might take some time or be more expensive to visit them. Besides, the internet may not provide accurate information most of the time, which might cause drug-related problems.

Various factors affected the general knowledge of the public about sanitizers and disinfectants. This result might be related to educational sessions provided to the public during the COVID-19 pandemic. Based on the occupational status, students showed the lowest level of knowledge, which was similar to a previous study.[22] This result is expected because they needed more educational sessions on the use of sanitizers and disinfectants. In contrast, the findings showed the non-working

Table 8: Multiple regression of Factors with the knowledge of Sanitizer or disinfectant contraindications.[a]

	Model	R	R Square	F	Sig.	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
						B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.246b	.060	3.228	.002b	2.960	0.400		7.406	0.000	2.174	3.746		
	Locations					−0.013	0.032	−0.021	−0.389	0.698	−0.076	0.051	0.904	1.107
	Sector of work					0.044	0.058	0.043	0.754	0.451	−0.071	0.159	0.815	1.227
	Age (years)					−0.115	0.057	−0.111	−2.038	0.042	−0.227	−0.004	0.899	1.113
	Nationality					−0.073	0.171	−0.022	−0.426	0.670	−0.410	0.264	0.971	1.030
	Gender					−0.177	0.112	−0.089	−1.586	0.114	−0.397	0.043	0.847	1.181
	Educational level					−0.121	0.055	−0.124	−2.189	0.029	−0.229	−0.012	0.826	1.211
	Are you from a health care professional					0.425	0.108	0.215	3.936	0.000	0.213	0.637	0.891	1.123

a. Dependent Variable: **the knowledge of Sanitizer or disinfectant contraindications [a],** Predictors: (Constant), Location, Site of work, Age, Nationality, Gender, Educational level, Are you from the health care professional (Medical Doctor- Dentist- Pharmacist- Nurse- Others),

Bootstrap for Coefficients

	Model	B	Bootstrap[a]				
						95% Confidence Interval	
			Bias	Std. Error	Sig. (2-tailed)	Lower	Upper
1	(Constant)	2.960	0.011	0.397	0.001	2.196	3.755
	Locations	−0.013	−0.002	0.036	0.734	−0.086	0.057
	Sector of work	0.044	0.000	0.064	0.483	−0.078	0.180
	Age (years)	−0.115	−0.002	0.062	0.072	−0.238	0.009
	Nationality	−0.073	−0.001	0.189	0.690	−0.454	0.299
	Gender	−0.177	0.002	0.107	0.100	−0.382	0.040
	Practice area	−0.121	−0.001	0.050	0.021	−0.220	−0.017
	Are you from a health care professional	0.425	0.000	0.108	0.001	0.219	0.633

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

had higher knowledge than students. They might be graduates and had a good time reading about sanitizers and disinfectants. Moreover, non-working mainly in older people with gained higher degrees and experiences. Age affected the knowledge of sanitizers and disinfectants, emphasizing that those in the age group of less than 18 years had a higher score of knowledge than those in the age group of 18–29 years, which agrees with the results of a previous study.[23] However, our results did not agree with some other studies, which might be related to the sample size of participants in the age group less than 18 years, which did not reflect the actual situation. Furthermore, participants who went to high school had higher knowledge than those with a bachelor's degree. Another factor that affected sanitizers and disinfectants' knowledge was whether the responders were healthcare professionals or otherwise. According to the results, non-healthcare professionals had higher knowledge than those healthcare professionals, which might be because they were busy working during COVID-19, and there was no time to read much about them. However, the busy schedule was not an excuse to increase the knowledge of sanitizer and disinfectants. Additional analysis showed a positive relationship between knowledge and healthcare professionals, which might depend almost 40% on the factors with increased knowledge.

The majority of factors did not affect the knowledge of contraindications of sanitizers and disinfectants. However, non-healthcare providers had higher knowledge of contraindications than healthcare professionals. That might be related to the fact that non-healthcare professionals were more serious about gaining more knowledge about contraindications. In addition, regression analysis showed that age affected the knowledge of sanitizers and disinfectants. The younger generation revealed more knowledge than that of older age. Moreover, the level of education negatively affected the knowledge. These results might be because those with lower degrees were more serious about getting information about sanitizer and disinfectants than those with higher academic qualifications.

Various factors affected the knowledge of storage of sanitizer and disinfectants. However, a single aspect affected the knowledge significantly. Healthcare providers had higher knowledge than non-healthcare professionals. Moreover, there was a 19.3% reduction in knowledge, which might be related to work experience, and had lower knowledge of sanitizer and disinfectant. They did not or rarely read about sanitizer and disinfectant during the practice because of busy duties. We obtained conflicting results with regard to the type of knowledge of healthcare professionals. They had good general

Table 9: Multiple regression of Factors with The knowledge of Sanitizer or disinfectant storage.[a]

	Model	R	R Square	F	Sig.	Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	95.0% Confidence Interval for B Upper Bound	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	.219b	.048	2.521	.015b	3.664	0.377		9.725	0.000	2.923	4.405		
	Locations					−0.048	0.030	−0.087	−1.579	0.115	−0.107	0.012	0.901	1.109
	Sector of work					−0.024	0.055	−0.025	−0.433	0.665	−0.131	0.084	0.815	1.228
	Age (years)					0.060	0.053	0.062	1.125	0.261	−0.045	0.165	0.898	1.114
	Nationality					0.107	0.163	0.035	0.657	0.511	−0.214	0.428	0.969	1.032
	Gender					−0.040	0.105	−0.021	−0.379	0.705	−0.246	0.167	0.848	1.179
	Educational level					0.085	0.052	0.094	1.633	0.103	−0.017	0.187	0.825	1.211
	Are you from a health care professional					−0.354	0.101	−0.193	−3.487	0.001	−0.553	−0.154	0.890	1.124

a. Dependent Variable: the **The knowledge of Sanitizer or disinfectant storage** [a], Predictors: (Constant), Location, Site of work, Age, Nationality, Gender, Educational level, Are you from the health care professional (Medical Doctor- Dentist- Pharmacist- Nurse- Others),

Bootstrap for Coefficients

	Model	B	Bootstrap[a] Bias	Bootstrap[a] Std. Error	Bootstrap[a] Sig. (2-tailed)	95% Confidence Interval Lower	95% Confidence Interval Upper
1	(Constant)	3.664	−0.024	0.342	0.001	2.935	4.319
	Locations	−0.048	0.000	0.032	0.142	−0.113	0.014
	Sector of work	−0.024	0.002	0.063	0.688	−0.149	0.100
	Age (years)	0.060	0.003	0.056	0.281	−0.051	0.174
	Nationality	0.107	0.008	0.164	0.530	−0.215	0.426
	Gender	−0.040	0.004	0.100	0.668	−0.244	0.157
	Practice area	0.085	−0.004	0.047	0.080	−0.017	0.176
	Are you from a health care professional	−0.354	0.003	0.102	0.003	−0.549	−0.153

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

knowledge and knowledge about storage. However, their knowledge about contraindications was poor. Moreover, responders with higher qualifications had poor knowledge. Therefore, all healthcare providers should increase their knowledge about sanitizers and disinfectants.[35]

Limitation

This study had an acceptable sample size, a high-reliability survey, and expert validation. However, it had some limitations. For example, the number of responders was different for different geographic locations, ages, occupations, and healthcare professionals. In addition, there were only a few studies to compare with them. Therefore, we recommend further studies with equal demographic information to overcome the drawbacks of this study.

CONCLUSION

The essential knowledge about sanitizers and disinfectants during the COVID-19 pandemic is acceptable in Saudi Arabia. However, the knowledge of the public about contraindications is inadequate. Most factors such as location, nationality, gender, and occupational status did not affect the understanding of sanitizers and disinfectants. However, healthcare professionals' age and membership might positively or negatively affect the knowledge of sanitizer and disinfectants. Therefore, we recommend providing educational sessions to the public about sanitizers and disinfectants to improve patient safety effectively.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Consent for Publications

Informed consent was obtained from all the participants

Ethical Approval

This research is exempted from research and ethical committee or an institutional review board (IRB) approval.
https://www.hhs.gov/ohrp/regulations-and-policy/decision-charts-2018/index.html

ABBREVIATIONS

COVID-19: Coronavirus; MOH: Ministry of Health; KSA: Kingdom of Saudi Arabia; SPSS: Statistical package of social sciences; JASP: Jeffery's Amazing Statistics Program; STROBE: Strengthening the reporting of observational studies epidemiology.

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