



Potential Health Impact of Excessive Disinfectant Use during COVID-19 Pandemic

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Abstract

During COVID-19 pandemic, disinfection is a commonly used practice to control and prevent spreading the infection. Overexposure to these chemicals has led to negative health consequences. This study aimed to evaluate the level of knowledge and effects of the overuse of disinfectants during the COVID-19 outbreak in Baghdad, Iraq. One hundred employees working in medical field (Ibn Al-Bitar Research Center/ Corporation of research and Industrial Development, Ministry of Industry and Minerals – Iraq) were participated in a cross-sectional questionnaire survey conducted between January and March 2022. The study found that 68% of participants were confirmed to be infected with the virus, while 32% were not. The participants showed a significant age and gender distribution. According to data, 86% of the participant committed to wearing masks, 58% committed to wearing gloves while 35% committed to wearing both gloves and masks. People pick news as their main information source over social media. Furthermore, 70% of participants used ethanol for hand sterilization, while 36% used gel hand sanitizers from different manufactures. According to health consequences that appeared with different symptoms and documented during overuse of disinfectant, the regular hand sanitizer use could cause irritation and skin damage for 33% of the participants, while 67% did not show any reaction. Employers with health symptoms suggested to be related to sterilizer overuse were found to be 33% and 35% affected in skin and breathing, respectively. To summarize, this survey provides a scientific vision on the negative side effect of the excessive use of disinfectant on health which should increase the public awareness worldwide.

1. Introduction

The usage of detergents and disinfectants in both home and healthcare settings experienced a significant increase in the initial months of 2020 as a result of the COVID-19 pandemic occurrences worldwide, to stop COVID-19 from spreading among the general public, a great number of governments began developing restrictions. Regulation from 2020 made a number of particular mentions, including frequent hand washing with hydro-alcoholic solutions and surface cleaning with products containing alcohol or chlorine [1].

A significant rise in alert requests for cleaner and disinfectant exposures is anticipated to begin in March 2020. The most frequent causes behind all of these notifications were hand sanitizer products, non-alcohol products, and bleach-based products in addition to consequences of inhalation due to increase exposure to these products. Afterward, numerous scientific papers reported these observations [2, 3]. Misuse and excessive usage of disinfectants can lead to acute responses. Acute adverse reactions and chronic health effects are two different types of harmful effects that can result from exposure to disinfectants. Chronic health effects from exposure to some disinfection chemicals over time, whether singly or in combination, may occur.

Data from US poison information centers show that compared to March 2019, The overall amount of requests concerning unintentional usage of cleansers and chemicals increased significantly in March 2020 [4]. Furthermore, in March 2020, the amount of requests to poison information centres in Canada [5]. This arises together with absent the sufficient knowledge to deal with this matter; a May 2020 questionnaire of adult Americans revealed gaps in understanding in topics such as appropriate disinfection procedure, personal protective equipment usage, and product storage.

Additionally, people described consuming or using dilute disinfection solutions, sprinkling the body with disinfectant spray, breathing disinfectant fumes, and using sodium hypochlorite on food, hands, or skin [6]. Ammonia, found in cleaning supplies, glass cleaners, and paints, reacts with sodium hypochlorite to create chloramine fumes. These fumes can cause symptoms like coughing, wheezing, nausea, watery eyes, throat, nose, eye irritation, pneumonia, and lung fluid [7].

When sodium hypochlorite and acids combine, chlorine gas is created, and chlorine gas is also created when sodium hypochlorite and boiling water are combined. Low-level chlorine gas exposure might result in symptoms like coughing, wheezing, watery and burning eyes, and runny nose [7]. Acids like hydrochloric or hypochlorous can burn eyes, throat, skin, mouth, nose also the lungs, are created when chlorine gas and water combine, in addition, high doses of chlorine gas exposure can be fatal [7].

Disinfectants can be used excessively or more frequently than is recommended, which can result in overexposure, acute adverse responses, as well as chronic health effects. Cleaning products and disinfection products are frequently used together. Other sensitizers contain components that can increase allergies and asthma. Long exposure to specific active ingredients may lead to negative health effects. Improperly mixed items, such as chloramines and chloroform, can also contribute to health issues like asthma and rhinitis [8, 9]. Indoor pollutants like cigarette smoke, mold, dust, allergens, and airborne particles and aromatic organic Substances from painting, carpeting, and equipment may cause asthma attacks and other breathing related conditions [10].

The process of disinfection requires the use of a chemical agent to inanimate surfaces in order to effectively eliminate all pathogenic germs. The prevention of COVID-19 infection in households and public areas is a common practice today. High doses of disinfectant solutions are sprayed in metropolitan public spaces in many parts of the world to fight the pandemic. Additionally, a wide variety of disinfection products are used on hands, faces, and other body parts to preserve people's health [11].

Disinfectants use various active ingredients, including bleach, sodium chlorite, peroxides, phenols, quaternary ammonium compounds, and many other substances, to kill or inactivate various microorganisms. Three main classes are effective against pathogenic microorganisms: Hypochlorite bleach, peroxides, and quaternary ammonia (QAM) [8]. Chemical disinfectants, including alcohol, chlorine, formaldehyde, glutaraldehyde and many other substances, are commonly used in healthcare and domestic settings. Disinfectants that have received EPA approval are utilized for disinfection all around the world [11].

There are many chemical disinfectants that are very effective at preventing coronavirus [11, 12]. Quats, hypochlorous acid, citric acid, hydrogen peroxide, isopropanol, sodium octanoic acid, peroxyacetic acid, hypochlorite, triethylene glycol, phenolic, ethanol, glycolic acid, L-lactic acid, ammonium carbonate (the product contains ingredients that have been certified by the usage of the Environmental Protection Agency

(EPA) to combat COVID-19 [12]. The aim of this study investigates and find out the damages resulting from potential adverse medical consequences of extensive disinfectant usage during the COVID-19 a pandemic.

2. Experimental Procedure

2.1. Participants

This investigation attempted to determine the knowledge and influence of employers working in medical field, particularly, Ibn Al-Bitar Research Centre/ Corporation of research and Industrial Development, Ministry of Industry and Minerals – Iraq, following verbal consent obtained from each participant. All participants were informed of the study's objectives, assured of the confidentiality of their responses, and were made aware that their participation was voluntary. Data was collected from 100 participants who represent the research community exclusively and comprehensively. By adopting the questionnaire, which included 12 items, the personal interviews were conducted while distributing the questionnaire and the explanation and clarification of its items.

2.2. Statistical Analysis

Statistical Analysis System (SAS) (2018) was utilized to determine the influence of variance components on research percentage. In this study, the chi-square test was utilized to compare percentages (0.05 and 0.01 likelihood) statistically significant [13].

3. Results and Discussion

The current study shown in the pie chart of Figure (1) found that 68% of respondents confirmed being infected with the Coronavirus, while 32% were not. The chi-square value of 4.00 indicates a significant statistical correlation between coronavirus infection and the participant studied. This indicates a significant difference in individuals' responses about their Coronavirus infection. In general, there is a significant difference between those infected with the Coronavirus and those not, indicating a link between these two variables in the studied participant.

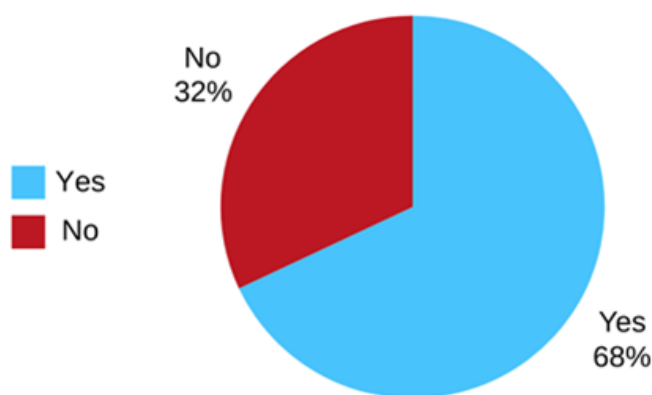


Figure (1): Number and percentage of the questionnaire respondents studied according to: Have you been infected with Corona virus?

The participant shows a significant gender distribution as illustrated in the pie chart of Figure (2), with females comprising 55% of the participant and males at 45%. The gender distribution showed a statistically significant difference, as indicated by a high chi-square value of 4.00 with $P < 0.05$ as the significance threshold.

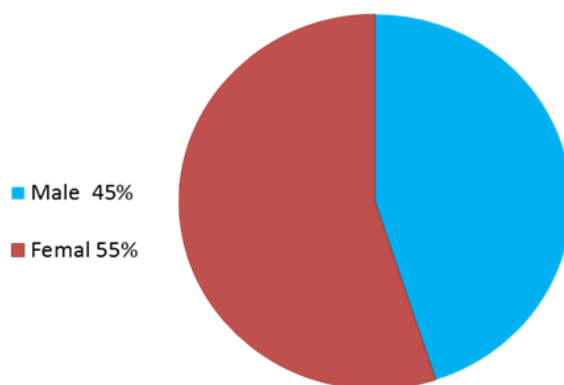


Figure (2): The number and percentage of the questionnaire respondents studied according to gender.

The study revealed a slight decrease in male patient numbers during the March–May 2020 closure period, possibly due to women taking on greater responsibility for managing disinfection in various settings, especially domestic ones [14].

The pie chart of Figure (3) shows that 81% of the population have made preventative prediction, with 19% don't making these procedures, and the p value suggests that there is a significant difference ($P \leq 0.01$) between preventative prediction and educational beliefs.

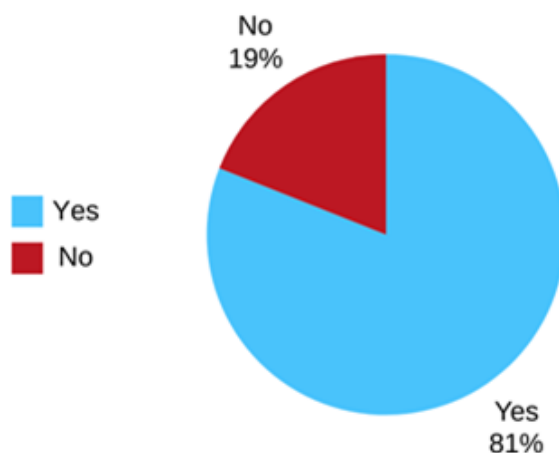


Figure (3): Number and percentage of the survey participant studied according to whether you took preventative prediction.

During the pandemic, there have been more accidental exposures to these substances as a result of abuse or incorrect usage. According to data from the U.S. Centers of Disease Control and Prevention, throughout a pandemic (January 2020–March 2020, for example), the requests for poisoning departments concerns contact with cleaners and disinfectants increased by 16.4% and 20.4%, respectively in comparison with the identical period of time in the years prior to the pandemic (e.g. 2019 and 2018). Humans may come into contact with disinfectants during or beyond their recommended usage, even though these elevated exposures are linked to chemical disinfectant abuse or incorrect use [15].

The study reveals a significant increase in the age distribution of individuals over 40 years (71%), 31–40 years (24%) and 13–30 years (5%) as depicted in the pie chart of Figure (4), with a chi-square value of 69.97. This indicates a strong statistical correlation between Number of infected people and age distribution.

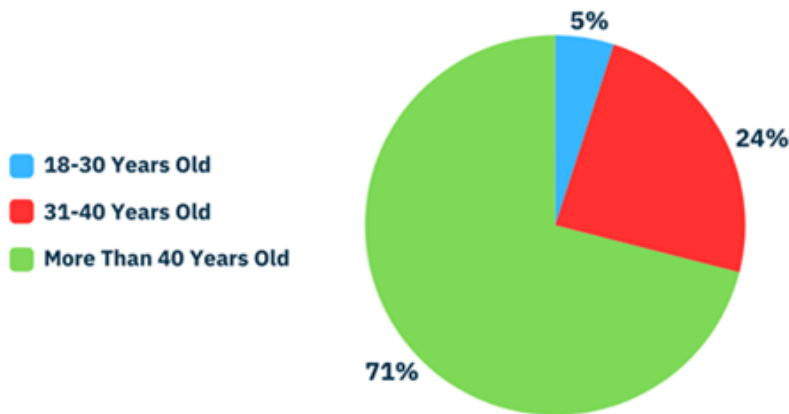


Figure (4): Number and percentage of the questionnaire participant studied according to age.

Research indicates that during lockdown, children aged 1-5 years have significantly higher exposure to disinfectants, despite not showing a statistically significant increase in their exposure compared to other age groups [16]. The lockdown significantly reduced exposures of 11-19-year-olds, leading to increased home-based activities and a preference for sedentary activities, according to a study calculating the percentage difference [16].

The study found that 86% of the participants committed to wearing masks while 14% were not as shown in Figure (5). The chi-square value of 51.840 indicates a strong and significant correlation between mask adherence and the participant studied. This indicates a significant difference in individuals' behaviour regarding mask use, emphasizing the importance of taking preventive measures in the face of the Coronavirus. Therefore, adherence to masks is crucial.

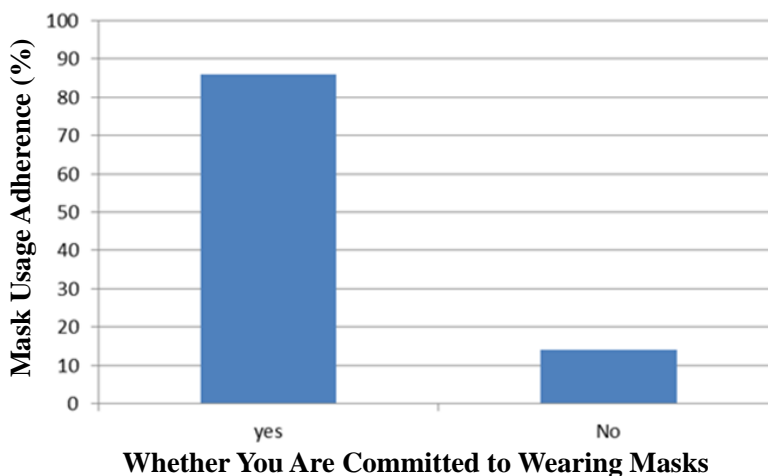


Figure (5): Number and percentage of the questionnaire participant studied according to whether you are committed to wearing masks.

According to research, SARS-CoV-2 may remain active for hours or even days on a number of surfaces, such as wood and latex gloves [17]. While the study found that 58% of the participant committed to wearing gloves, while 42% did not. The chi-square value was 2.56, indicating no significant correlation between gloves and the participant. The symbol NS signifies that the statistical examination did not show a significant difference. Therefore, the use of gloves did not have a significant statistical effect on the participant, as indicated by the chi-square value and symbol NS as demonstrated in Figure (6).

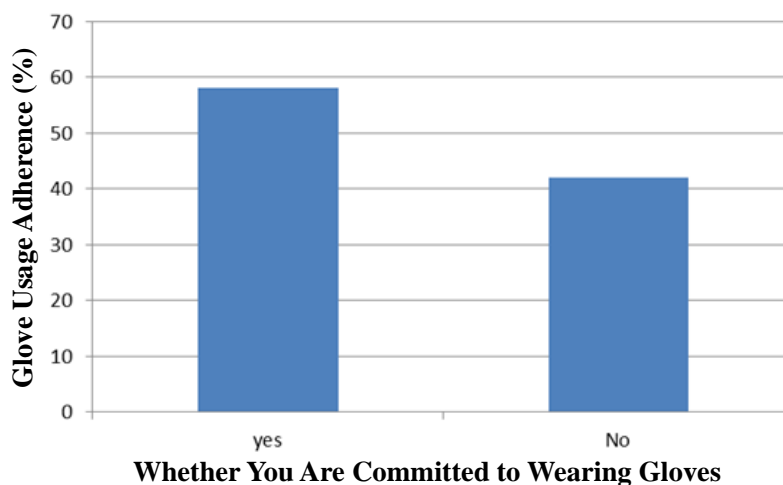


Figure (6): The number and percentage of the questionnaire participant studied according to whether you are committed to wearing gloves.

Guidelines for preventing and controlling infections are provided by WHO, and they include the use of facemasks, eye protection, and avoiding contact with mucosal membranes. Hand washing is the strongest defence against the spread of diseases, and both the public and healthcare professionals should abide by these health guidelines [18].

Based on the study, in addition to functional awareness, the media should concentrate on raising scientific and general knowledge, as most people obtain information from news. The study found that 24 individuals benefited from in-person workshop, 23 from online workshop, 67 from news, 22 from training courses, 42 from community culture (friend and relatives), and 5 from posters. The chi-square test resulted in a high statistical significance ($P \leq 0.01$), indicating a correlation between sources of awareness and knowledge about the subject studied. The percentages of individuals who benefited from news bulletins, training courses, community culture, and posters were all high as seen in Figure (7).

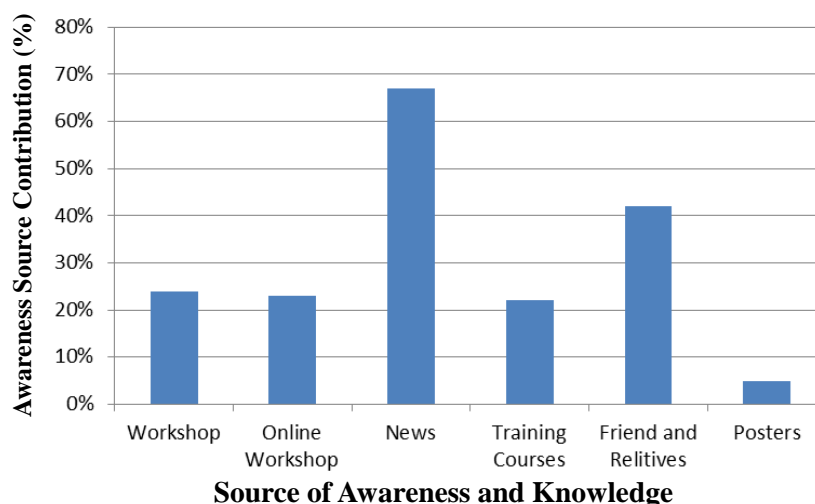


Figure (7): Number and percentage of the questionnaire participant studied according to the source of awareness and knowledge.

A study indicates that mass media, including radio and TV, has a bigger influence on people's knowledge and mindset than social media apps [19]. A Pakistan study found that the majority of participants rely on social media for information [20]. Mass media significantly enhances people's awareness, but this awareness is not fundamental or scientific. Taghrir *et al.* found that the students that study medicine have a high level of knowledge and performance, possibly due to their profession [21].

According to the questionnaire presented in Figure (8), most of studied participants have an academic achievement, which correlated with the knowledge and performance. Research showed that People's overall achievement was higher than their overall awareness, there was a strong relationship between performance and awareness [22].

There is a statistically significant ($P \leq 0.01$) correlation between the examined questionnaire sample and academic success, as indicated by the Chi-square value of 81.920. This indicates that the sample's population distribution deviates considerably from the pattern of distribution that would be predicted if the sample were drawn at random.

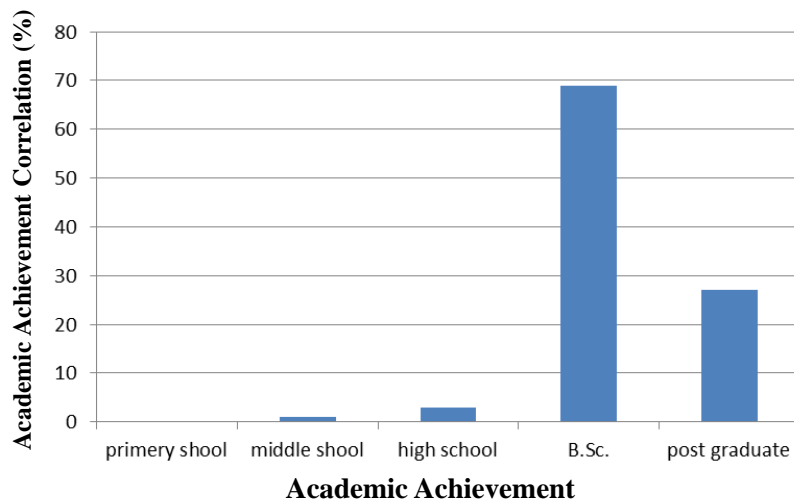


Figure (8): Number and percentage of the questionnaire participant studied according to academic achievement.

This study shows that 70% of people used ethanol in their hand sterilization while 36% of people used hand sanitizers gel in their hand sterilization moreover 28% used Bleaching spray and 34% used Dettol in their hand sterilization shows in Table (1).

Table (1): The number and percentage of the studied questionnaire participant according to the type of sterilization used personally or at the home level.

The type of sterilization used personally or at the home level	Number	Percentage (%)
Ethanol 70%	71	71.00
Hand sanitizers gel	36	36.00
Bleaching spray	28	28.00
Dettol	34	34.00
Another types	10	10.00
(Chi-Square χ^2)	---	57.028 **
significant significance $P \leq 0.01$		

The study aligns with Yasseen *et al.*'s findings, indicating a significant rise in poison control center calls due to increased contact with chlorine gas (21%), hand sanitizers (25%), and bleach (42%) [4].

The participant consists of 19 individuals who use and mix multiple types of food, while 81 do not. The total participant size is 100%. The results of the chi-square test indicate a substantial difference with a high statistical significance ($P \leq 0.01$). Between those who use and mix multiple types and those who do not. This difference is not due to chance but is considered statistically significant as tabulated in Table (2).

Table (2): The number and percentage of the questionnaire participant studied according to if use and mix more than one type of disinfectant.

Do you mix more than one type of disinfectant?	Number	Percentage (%)
Yes	19	19.00
No	81	81.00
SUM	100	100%
(Chi-Square $-\chi^2$)	---	38.440 **
**highly significant significance $P \leq 0.01$		

According to research 41.4% of those surveyed reported they had medical conditions involving one or more organs. As a result of using more detergent and disinfectants during the COVID-19 epidemic. These problems included dry skin, obsession, itching, irritation, coughing, hand redness, headaches, eye itching, and burning in the throat and lungs [23]. A study comparing disinfectant use in 2019 and 2020 revealed a higher number of surface disinfectant and hand sanitizer poisoning cases in 2020 compared to 2019 as shown in Table (2) [24].

The study shows that 33 individuals suffer from skin health problems or symptoms related to sterilizers, with a percentage of 33.00%, while 67 individuals do not. The findings of the chi-square analysis show a statistically significant relationship between the presence of health problems or symptoms and individuals' belief that they are related to sterilizers, with a value of 11.56, indicating a strong association between the two.

This study shows that the hand sanitizer that used on a regular basis could cause irritation and skin damage for 33% of the questionnaire participant while 67% did not showed any reaction shows in Table (3), this study is compatible with Himabindu et al. (2020) and Mahmood et al. (2020). Base on the research, using hygiene products can cause the skin barrier's protein to denature, alter intercellular lipid composition, reduce corneocyte adhesion, and alter the corneum's ability to bind water [25]. The study suggests that there are two categories of sanitizer-related skin responses [26, 27]. The study found that 35 individuals suffer from health problems or respiratory symptoms related to disinfectants, with a 35% percentage believing they are related, while 65 do not. The chi-square test revealed a significant degree of statistical significance when $P \leq 0.01$. Indicating a strong relationship with the presence of health problems or symptoms and individuals' belief that they are related to disinfectants. This indicates a significant relationship between health issues and the belief in disinfectants as listed in Table (4).

Table (3): The number and percentage of the questionnaire participant studied according to: Do you have any signs or health concerns you think are connected to using sterilizers?

Do you have any signs or health concerns you think is connected to using sterilizers?	Number	Percentage (%)
Yes	33	33.00
No	67	67.00
SUM	100	100%
(Chi-Square $-\chi^2$)	---	11.56 **
significant significance $P \leq 0.01$		

Research indicates that employees, particularly those working in hospitals, who were subjected to detergents or disinfection chemicals, had a higher incidence of asthmatic and respiratory symptoms similar to asthma. Who conduct a lot of cleaning and disinfecting tasks, potentially exposing them to respiratory and skin symptoms [28]. Furthermore, another study showed that QACs, or polychlorinated compounds, are connected with a higher incidence of COPD or work-related illnesses including asthmatic. Excessive use of disinfectants like bleach can cause respiratory damage and asthma. QACs in human blood can cause health biomarkers to change, including

increased inflammatory cytokines, reduced mitochondrial activity, and dose-dependent disturbance of cholesterol homeostasis [15].

Table (4): The number and percentage of the questionnaire participants studied according to: Do you notice any health issues or symptoms that you suppose are connected to using sterilizers? Difficulty breathing?

Do you notice any health issues or symptoms that you suppose are connected to using sterilizers? Difficulty breathing?	Number	Percentage (%)
Yes	35	35.00
No	65	65.00
SUM	100	100%
(Chi-Square χ^2)	---	9.00 **
**significant significance $P \leq 0.01$		

4. Conclusions

The current research gives additional knowledge into the ways in which disinfectants interact with their environments and possible effects on human safety and health through high exposure to humans. According to the wide ability of Coronaviruses to survive for hours or days on glass, metal, and plastic surfaces, A significant rise in usage of chemicals to break the chain infection. Additionally, these chemicals may accumulate on crops and contaminate the food chain, which might have a negative effect on aquatic environments. This leads to toxic impact on environments and can cause respiratory and skin issues upon repeated exposure. Therefore, despite it has become essential to apply disinfectants more often to combat COVID-19. However, excessive and ongoing use of these chemicals may have negative short- and long-term impacts on the health of people and animals. To counter this, it is necessary to look for safer and more environmentally friendly alternatives. Furthermore, prolonged usage of sanitizer might lead to resistance to their antibacterial properties complicated the life of people who already interact with medical personnel. Thus, it is crucial to educate the public about the risks associated with excessive use of detergents and disinfectants.

Conflict of Interest: The authors declare that there are no conflicts of interest associated with this research project. We have no financial or personal relationships that could potentially bias our work or influence the interpretation of the results.

Editorial Transparency: Hashim M. Zehraw is the Editor of the Iraqi Journal of Industrial Research. Despite this role, the peer review process and the final decision were conducted independently, ensuring that his editorial role did not influence the outcome in any way.

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