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Community Awareness and Performance regarding the Safe Use of Disinfectants and Household Cleaners during the Spread of COVID-19 in Lebanon

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Abstract To reduce the spread and transmission of the SARS-CoV-2 virus, the application of disinfectants and household cleaning products became a common practice worldwide during the pandemic. However, the literature revealed that these practices were associated with limited knowledge of chemical safety and resulted in several health hazards. This pilot study aims to assess the awareness and the performance of the Lebanese community regarding the safe use of household disinfectants and cleaners during the COVID-19 spread. This cross-sectional study was performed to evaluate the extent, to which the public community in Lebanon safely handles disinfectants and household cleaning products. An Awareness-Performance questionnaire was adapted from the CDC Morbidity and Mortality Weekly Report and Arabic-translated [1]. 922 respondents (aged ≥ 18 years old) participated electronically, and their data was analyzed using SPSS descriptive analysis and the Chi-Square test for significant differences ($p < 0.05$) among the studied variables. The study population showed lower percentages of awareness than performance regarding the safe usage of

disinfectants and household cleaners. The highest percentages with significant differences ($p < 0.05$) were detected among females, university graduates, younger people, and participants who had not been previously diagnosed with the COVID-19 virus. Consequently, the study recommends additional investigations and awareness initiatives to be implemented in Lebanon.

Keywords Lebanon, COVID-19, Awareness, Performance, Disinfectants, Household Cleaners

1. Introduction

In March 2022, the World Health Organization (WHO) announced the outbreak of the COVID-19 pandemic triggered by the SARS-CoV-2 virus, exposing the world to uncommon challenges [2]. As a result, several public health measures to achieve a low transmission rate were adopted by governments worldwide. Among these

measures, considered of the most recommended practices, is the widespread use of household and personal disinfectants, since the fatty layer covering the genetic material of the SARS-CoV-2 virus is susceptible to these disinfectants [3]. Even though the utilization of cleaning products and disinfectants was viewed to be an effective practice in preventing the dissemination of the SARS-CoV-2 virus, the dearth of awareness on the safe use of hygiene products has raised a real concern in domestic settings [4], [5]. As a matter of fact, the misuse of household cleaning products may lead to indoor air pollution, allergic rhinitis, respiratory complications, asthma, bacterial resistance, or dermatitis. On the same level, when not used properly, disinfectants or hand sanitizers can lead to adverse effects. In fact, the effects of alcohol-based hand sanitizers may be acute or chronic, ranging from dermal or digestive irritations to more chronic, severe effects, such as acute lung diseases and cancer [6]. Into the bargain, accidental ingestion, dermal absorption, or mixing different household or disinfectant products can cause poisoning and may lead to death [6].

The literature revealed an existing knowledge gap in several aspects including the safe preparation of disinfectants and cleaning solutions, the need for proper protection equipment, and the proper storage of cleansers, disinfectants, and hand sanitizers [7], [8]. Other studies revealed that high-risk practices, caused by social panic during the lockdown, and intending to reduce or prohibit the transmission of the SARS-CoV-2 virus were enacted [1], [5], [8]–[11], among these practices, using home cleaning or disinfection products on exposed skin, washing food products with bleach, or purposefully inhaling or ingesting these substances [1], [5]. For instance, in the United States and Saudi Arabia, there has been a substantial rise in a number of calls for poison control centers to report chemical exposures and hazards during the COVID-19 pandemic [12], [13]. The situation is further exacerbated in middle- and low-income countries, since health services in such countries are less organized, and for this, a careful examination of community awareness and the practices related to disinfectant use within domestic settings is needed.

There is little information and data about community awareness and performance linked to household cleaning products and disinfection procedures in developing countries such as Lebanon. In effect, one study was conducted in Lebanon focused on cleaning product strategies and practices among Lebanese women [14]. Findings mainly proved there to be gaps related to the utilization of household cleaning products, specifically the mixing of different detergents, using less effective local products, using smaller quantities less than the recommended amount, and lack of ventilation of the rooms during use [14].

Given the rapid spread of the virus, such an investigation can ensure the safe prevention of pandemics especially in the presence of a harsh economic crisis and high healthcare

shortage in Lebanon [15]. Additionally, some studies in the literature suggest the likelihood of severe epidemics occurring annually could rise by up to threefold in the future decades [16]. This paper aims to pilot an assessment of community awareness and performance concerning the safe use of household cleaners and disinfectants during COVID-19 in Lebanon. Further, this research will provide insight for health research communities to design their future studies and initiatives and spread awareness of hygienic chemicals in case of the occurrence of alike pandemic.

2. Materials and Methods

2.1. Study Design

The current cross-sectional study was carried out between February and December 2021 to assess the community awareness and performance in Lebanon regarding the safe use of disinfectants and household cleaning products during the preventive measures of SARS-CoV-2. Using Google Forms, the study tool was developed and admitted in Arabic for electronic data collection. Prior to data collection, the study tool was pre-tested by 10 experts from relevant fields (chemistry, public health, environmental health, and healthcare) to ensure the clarity of the tool content. Following this initial evaluation of the study tool, the questionnaire was shared online through several social media platforms (Facebook, Twitter, Instagram, and LinkedIn) as well as electronically with the research centers and departments of the Lebanese academic institutions. Convenience sampling was applied to forward the questionnaire to the study population (992 participants) consisting of adults aged ≥ 18 years old. The only exclusion criterion in this study was participants aged < 18 years old.

2.2. Study Tool

The structure of the questionnaire included: (1) socio-demographic data, (2) past experience with SARS-CoV-2, (3) source of information related to COVID-19 preventive measures, (4) self-reported symptoms during the handling of disinfectants and household cleaning products, (5) 11 Awareness questions (True/False) regarding the protocols of safe handling (storage; preparation; application; personal protective equipment use) (6) 11 performance questions (Agree/Disagree) regarding the handling of disinfectants and household cleaning products (household hygiene; body and hand hygiene, and label instructions). The three sections of the questionnaire (awareness, performance, and symptoms) were adapted at first place from the CDC Morbidity and Mortality Weekly Report which was published with the aim of assessing the public community's knowledge and practices towards household cleaning and disinfection for COVID-19 prevention in the

United States [1], and at second place, from the evaluation study of the public awareness and performance towards the safe use of household disinfectants-cleaners to prevent COVID-19 in the UAE (Abu Dhabi) [5].

2.3. Data Analysis

Data was examined using the Statistical Package for the Social Sciences, version 21 (SPSS). To show the sociodemographic profile of the study population, the percent frequency was arranged in a table. Descriptive analysis with % frequency was organized in figures to summarize awareness, performance, and reported symptoms among the study population. Additionally, to test for significant differences in awareness and performance for the sociodemographic variables (age, gender, educational level, and being previously diagnosed with COVID-19), a Chi-Square test was applied. All data analyses with values of $p < 0.05$ were considered statistically significant.

2.4. Ethical Considerations

The study protocol was approved by the Institutional Review Board (MU-20201211-20) at the Modern

University for Business and Science and has been performed in accordance with the ethical standards in the Declaration of Helsinki. Goals, benefits, confidentiality, and nonexistence of potential risks in data collection and analysis as well as the informative statement “participation is voluntary, and the completion of the questionnaire indicates your consent to participate in the study” were identified in the informed consent (first page of the online questionnaire).

3. Results

In total, 992 surveys were collected with a response rate of 85.7%. The respondents’ socio-demographic information, obtained by descriptive statistical analysis are displayed, in Table 1, showing that the majority of the study respondents (62.2%) live in Mount Lebanon, the province with the highest cumulative rate of infection and death cases [17]. Among the participants, the sex ratio (M:F) was 1:1.36 with a mean age of 32.6 ± 12.6 . Focusing on the educational level, around three-quarters of the participants (78.8%) were holders of a bachelor’s degree or higher. In terms of previous SARS-CoV-2 infection, 36.4% of participants claimed that they had been diagnosed with SARS-CoV-2 at least once.

Table 1. Participants’ profiles (sociodemographic and past diagnosis with COVID-19) displayed in frequencies and percentages.

Variables		Frequency	Percentages
Gender	Male	295	29.7%
	Female	697	70.3%
Age	18-29	481	48.5%
	30-39	263	26.5%
	40-49	135	13.6%
	50+	113	11.4%
Province	Beirut	169	17%
	Mount Lebanon	617	62.2%
	North Lebanon	60	7.6%
	South Lebanon	52	5.2%
	Beqaa	49	4.9%
	Baalbal-Hermel	11	1.1%
	Nabatieh	18	1.8%
	Akkar	16	1.6%
Educational level	High School or Less	210	21.2%
	University Level	782	79.8%
Have you been Diagnosed with COVID-19?	No	631	63.6%
	Yes	361	36.4%

3.1. Community Awareness

In order to assess community awareness regarding the safe usage of disinfectants and household cleaning products during the prevention of SARS-CoV-2 in Lebanon in the year 2021, and through the study participants' completion of a questionnaire, researchers collected data exploring the sources of COVID-19 information and the relevant preventive measures among the study population and their awareness of the handling protocols of the cleaning products and disinfectants (storage; preparation; application; PPE use).

Descriptive analysis was applied to represent the percent frequency of the participants' responses (correct and incorrect) of awareness with respect to the safe handling of household cleaning products and disinfectants. Regarding the sources of information of participants on SARS-CoV-2, 44.9% signaled that their main source of information was the Lebanese Ministry of Public Health Lebanese (MOPH), 59.4% retrieved information from the webpages of the WHO and CDC, 36.2% of the participants relied on medical consultations, while 16.3% retrieved their information from news outlet (Newspaper, Television, and Radio) and 19% relied on social media platforms (mainly Twitter, Facebook, YouTube, WhatsApp, and Instagram). Additionally, 12.2% and 23.1% of the participants denoted that they obtained their information from family or friends, and personal experience, respectively.

Community awareness was assessed based on the correct/incorrect responses of the participants on questions inquiring about the handling protocols of the household cleaning products and disinfectants (storage; preparation; application; and PPE use), as represented in Figure 1. The highest percentages of participants (91-92%) showed good awareness of the dangerous mixing of chlorine with acids (A3: 921 out of 992 participants), and of the dangerous application of cleaning products in non-ventilated rooms (A6: 907 out of 992 participants). Additionally, high percentages of participants showed self-confidence in their hygiene awareness when it comes to never utilizing expired cleaning products (A7: 863 out of 992 participants), storing cleaners out of the children's reach (A1: 810 out of 992 participants), to handwashing after the use of household cleaning products (A8: 709 out of 992 participants), and to wear gloves during the use of some household cleaning products (A11: 801 out of 992 participants). Moreover, Participants showed lower percentages of awareness ($\leq 62\%$) when they did not recognize that Chlorine should never be mixed with other cleaning products (A4: 613 out of 992 participants), sanitizers should be stored away from children's reach (A2: 506 out of 992 participants), mask use is necessary during the long use (in hours) of some household cleaning products (A10: 485 out of 992 participants), and that water at room temperature is required for the safe dilution of Chlorine solutions (A5: 353 out of 992 participants).

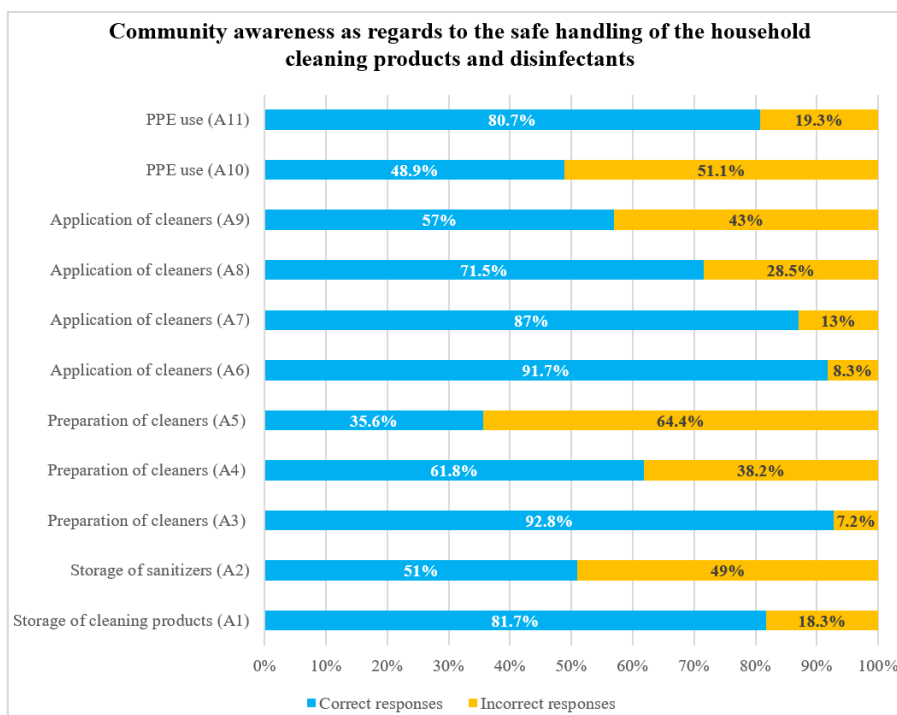


Figure 1. Percentages of the participants' responses (correct and incorrect) with respect to the awareness as regards to the safe handling of the household cleaning products and disinfectants.

3.2. Community Performance

To assess the community performance regarding the safe use of disinfectants and household cleaning products during the prevention of SARS-CoV-2 in Lebanon in the year 2021, and through the study participants' completion of the questionnaire, researchers collected data exploring the performance related to the safe use of disinfectants and household cleaning products and the symptoms experienced during their handling process.

Descriptive analysis was applied to represent the percent frequency of the participants' responses (correct and incorrect) of performance with respect to the safe use of household cleaning products and disinfectants, and to emphasize the incidence percentages related to the self-reported symptoms of Irritation-to-Poisoning among the participants during the handling of the household cleaning products and disinfectants.

The performance assessment regarding the safe use of disinfectants and household cleaning products (household hygiene; body and hand hygiene, and label instructions) among the public community is represented in Figure 2. The highest percentage of participants (97-99%) showed good performance related to household and body hygiene

when participants did not drink or gargle the mouth with chlorine (P7: 986 out of 992 participants) or other household cleaning products (P8: 963 out of 992 participants) and did not inhale vapors of the household cleaning products (e.g., bleach) (P4: 965 out of 992 participants). Additionally, high percentages of participants showed self-confidence in their hygiene performance when it comes to avoiding using the locally-filled household cleaning products with no packaging label for product identification and use instructions (P5: 881 out of 992 participants), and avoiding mixing several cleaning products to foster their cleaning process (P6: 875 out of 992 participants), to avoid using concentrated chlorine solution to guarantee that their homes are well-cleaned (P3: 868 out of 992 participants), and to avoid disinfecting fruit and vegetables with a chlorine solution (P2: 816 out of 992 participants). On the other hand, lower percentages of participants ($\leq 62\%$) utilized hand sanitizers to disinfect their child's body (P10: 618 out of 992 participants), read label instructions before product use (P11: 574 out of 992 participants), and increased the frequency of hygiene processes using household cleaning in a domestic setting (P1: 552 out of 992 participants).

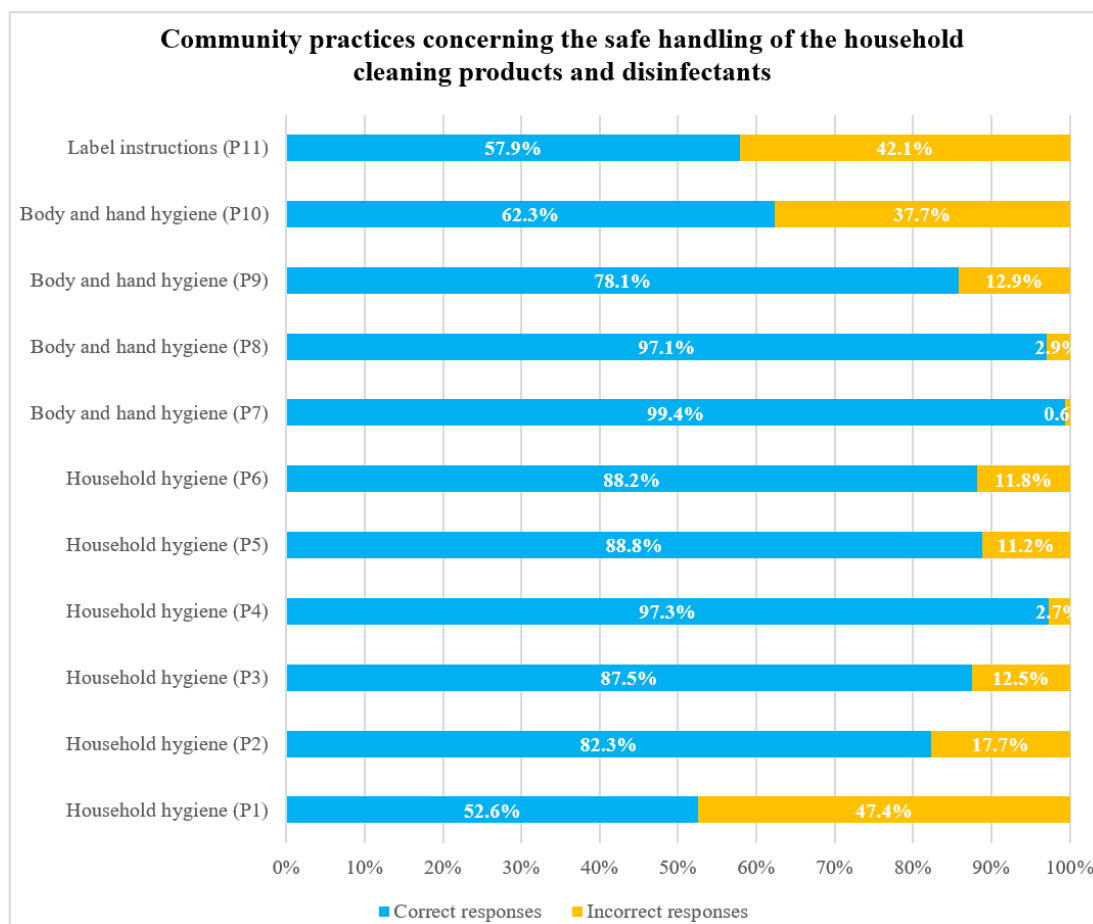


Figure 2. Percentages of the participants' responses (correct and incorrect) with respect to the practices regarding the safe handling of the household cleaning products and disinfectants.

Additionally, the incidence of the symptoms of irritation-to-poisoning has been investigated to highlight the impact of chemical misuse on community health. According to Figure 3, 49.4% of the participants had claimed at least one irritation-to-poisoning symptom while using household cleaners and disinfectants. The highest and lowest reported symptoms among the population of the study were cough (23.2%), skin irritation (6.3%), and eye irritation (5.2%), respectively. Moreover, participants reported almost comparable percentages (8-12%) of the other symptoms (Respiratory difficulties, headache/dizziness, nausea/vomiting, and nose irritation).

3.3. Comparative Analysis among Socio-demographics, Awareness, and Performance

In order to check for significant differences in awareness and performance related to household cleaners and disinfectants, with respect to gender, age, educational level, and previous diagnosis of COVID-19, the Chi-square test

($P < 0.05$) was applied. The comparative analysis amidst the socio-demographic characteristics and the community awareness concerning the safe handling of household cleaning products and disinfectants is exhibited in Table 2. Except for the awareness questions (A3, A6, and A11), females and well-educated participants (specifically holders of a university level degree) showed higher significant percentages ($P < 0.05$) of awareness questions (A1-2, A4-5, and A7-10) than males and less-educated participants (high school level or less), respectively. Additionally, participants who were not previously diagnosed with COVID-19 showed higher significant percentages ($P < 0.05$) of awareness questions (A1, A4-5, and A7-10) than participants who were non-diagnosed with COVID-19. Looking at the age intervals of the study population, participants with the youngest age interval (18-29 years old) showed the highest significant percentages ($P < 0.05$) of awareness questions (A1-2, A4-5, and A8-10) when compared to the elder participants (aged 30-39, 40-49, 50 and above).

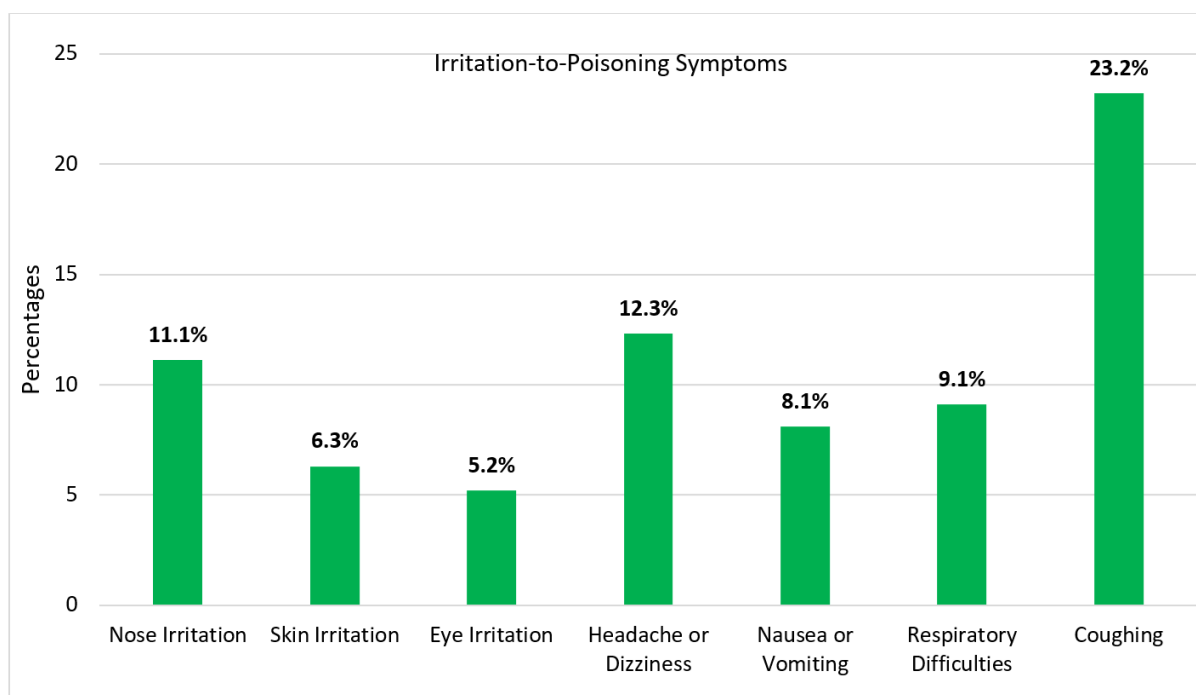


Figure 3. Bar Graph representing the occurrence percentages of the Irritation-to-Poisoning symptoms among the participants during the handling of the household cleaning products and disinfectants.

Table 2. Relative percentages, and Chi-square tests of the participants’ awareness of household cleaners and disinfectants; responses distributed according to gender, age, educational level, and previous diagnosis of COVID-19.

Variable	Gender		Age				Educational Level		Have you been Diagnosed with COVID-19?	
	Male	Female	18-29	30-39	40-49	50+	High School or Less	University level	No	Yes
A1	64.1	89.1	85.2	82.1	77	70.8	68.6	85.2	90.5	66.2
	P < 0.001		P= 0.002				P < 0.001		P < 0.001	
A2	44.1	53.9	53.6	51.7	50.4	38.9	39	54.2	52.8	47.9
	P= 0.004		P= 0.045				P < 0.001		P > 0.05	
A3	94.2	92.2	92.1	92.8	91.9	97.3	91	93.4	93.8	91.1
	P > 0.05		P > 0.05				P > 0.05		P > 0.05	
A4	39	71.4	69.4	63.1	60	28.3	32.4	69.7	67.7	51.5
	P < 0.001		P < 0.001				P < 0.001		P < 0.001	
A5	15.6	44	41	33.5	34.8	18.6	16.7	40.7	41	26
	P < 0.001		P < 0.001				P < 0.001		P < 0.001	
A6	93.6	91	90.2	91.6	95.6	93.8	94.3	91	90	93.4
	P > 0.05		P > 0.05				P > 0.05		P > 0.05	
A7	82	89.1	89.6	84	83.7	86.7	81.9	88.4	91.4	79.2
	P= 0.003		P > 0.05				P= 0.013		P < 0.001	
A8	48.5	81.2	81.1	68.8	64.4	45.1	48.6	77.6	80	56.5
	P < 0.001		P < 0.001				P < 0.001		P < 0.001	
A9	29.2	68.7	65.1	59.7	50.2	23.9	26.2	56.2	64.3	44
	P < 0.001		P < 0.001				P < 0.001		P < 0.001	
A10	30.5	56.7	58	47.5	41.5	22.1	20	56.6	55	38.2
	P < 0.001		P < 0.001				P < 0.001		P < 0.001	
A11	78.6	81.6	79.8	79.8	80.7	86.7	83.8	79.9	80.5	81.2
	P > 0.05		P > 0.05				P > 0.05		P > 0.05	

*Values in bold show significant p-values less than 0.05.

The comparative analysis amidst the socio-demographic characteristics and the community performance regarding the safe use of household cleaning products and disinfectants is outlined in Table 3. In contrast to the performance question (P10), females and well-educated participants showed higher significant percentages ($P < 0.05$) of performance questions (P3, P5-6, and P11) than males and less-educated participants, respectively. On the other hand, participants showed no significant differences ($P > 0.05$) when comparing the variables of gender and educational level to the rest of the performance questions (P1-2, P4, and P7-9). Contrary to the performance questions (P2 and P9), participants who were not previously diagnosed with COVID-19 showed higher

significant percentages ($P < 0.05$) of performance questions (P1, P3, P5-6, and P11) than participants who were previously diagnosed with COVID-19. Moreover, there were no significant differences ($P > 0.05$) for the rest questions of performance (P4, P7-8, and P10) among the two groups of studies. Additionally, the age groups of the study showed no significant differences ($P > 0.05$) in performance questions (P1, P3-8, and P11). The highest significant percentages ($P < 0.05$) were recorded among participants with the youngest age intervals (18-29 years old) in performance question (P2) and elder age intervals (40-49 years old; 50 years old and above) in performance questions (P9 and P10), respectively.

Table 3. Relative percentages, and Chi-square tests of the participants' performance of household cleaners and disinfectants; responses distributed according to gender, age, educational level, and previous diagnosis of COVID-19.

Variable	Gender		Age				Education		Have you been Diagnosed with COVID-19?	
	Male	Female	18-29	30-39	40-49	50+	High School or Less	University level	No	Yes
P1	52.5	52.7	52.4	53.6	52.6	51.3	47.6	47.6	56.1	46.5
	P > 0.05		P > 0.05				P > 0.05		P = 0.004	
P2	79	83.6	86.7	84.2	82.2	63.7	78.1	83.4	78.9	88.1
	P > 0.05		P < 0.001				P > 0.05		P < 0.001	
P3	83.4	89.2	88.1	86.7	85.9	88.5	81.9	89	90.6	82
	P = 0.011		P > 0.05				P = 0.006		P < 0.001	
P4	96.9	97.4	96.3	97.3	98.5	100	98.1	97.1	96.5	98.6
	P > 0.05		P > 0.05				P > 0.05		P > 0.05	
P5	80.3	92.4	90.9	86.7	87.4	86.7	80.5	91	92.1	83.1
	P < 0.001		P > 0.05				P < 0.001		P < 0.001	
P6	82.4	90.7	88.4	87.1	88.9	89.4	81.4	90	92.4	80.9
	P < 0.001		P > 0.05				P = 0.001		P < 0.001	
P7	98.3	99.9	98.8	100	100	100	100	99.2	99.7	100
	P > 0.05		P > 0.05				P > 0.05		P > 0.05	
P8	97.3	97	96	97.3	99.3	98.2	99	96.5	96.7	97.8
	P > 0.05		P > 0.05				P > 0.05		P > 0.05	
P9	78	78.2	74	77.9	89.6	82.3	82.4	77	73.1	87
	P > 0.05		P = 0.001				P > 0.05		P < 0.001	
P10	72.2	58.1	57.8	59.7	65.9	83.2	68.6	60.6	62.1	62.6
	P < 0.001		P = 0.001				P = 0.035		P > 0.05	
P11	40.7	65.1	61.1	55.5	51.1	57.5	47.1	60.7	65.8	44
	P < 0.001		P > 0.05				P < 0.001		P < 0.001	

*Values in bold show significant p-values less than 0.05

4. Discussion

This study assessed the Lebanese community's awareness and performance regarding the safe handling of household cleaners and disinfectants, in the context of the global SARS-CoV-2. It was performed to throw light on the significance of prevention measures using chemical-based disinfectants and cleaning products, and their impact on the public health within domestic settings. To date, there have not been similar studies conducted in Lebanon where all the published studies had focused on community awareness and performance regarding the general preventive measures (physical distancing, mask use, and frequent handwashing) instead of the safe use of the chemical-based disinfectants and household cleaning products [18]–[20]. The study finding is foreseen to

provide the Lebanese Ministry of Public Health and healthcare professionals in Lebanon with new evidence regarding the public use of household cleaning products and disinfectants and their implications. Findings and implications can not only be applicable to the pandemic era but can also inform practices post-COVID, during day-to-day use of these products. The findings could also provide insight for new studies and stress the need for public health initiatives to grow awareness of chemical safety.

The study population showed somewhat lower percentages of awareness than performance regarding the safe use of disinfectants and household cleaners. Focusing on the low percentages of their awareness and performance, some key points should be discussed to limit the misconceptions and misuse of chemicals in household

settings such as the parental use of sanitizers for children without referring to the label instruction and/or CDC recommendations [21]. As a result of this misconception, children (especially those aged up to 6 years old) will be exposed to the danger of poisoning by ingesting residual alcohol when eating food or putting their fingers in their mouths directly after the disinfection [22]. Knowing that the elevated use of household cleaning products can lead to an increased risk of exposure to hazardous chemicals during improper use [6], [23], the population in Lebanon should be warned to avoid using locally filled detergents without packaging labels, which are characterized by the absence of ingredient descriptions and expiry dates. Reading the label is always a must to ensure the effectiveness of a chemical product and limit adverse effects as it relates to improper use [24]. The high trustiness of the cleaning practices among participants might reinforce their intent to avoid reading the product label for instructions. This explains, why precautions such as wearing gloves, face masks, and safe storage, to limit inhaling the released gases and their subsequent body irritations are not well-known by the participants [7], [25]. In lieu of the pandemic, the public fear of SARS-CoV-2 has increased the frequency of household cleaning among most of the study population. Thus, the Lebanese MOPH and the Public health researchers should collaborate to develop interventions that would raise awareness based on WHO and CDC recommendations [26], [27]. On another hand, studies in the literature proved that the empowerment, management, and improvement of public healthcare centers are proved essential for supporting the public during the time of health crises and pandemics to enhance public awareness and performance during health crises and/or pandemics [28]–[30]. Thus, the MOPH should support the creation of such healthcare facilities or improve the currently established ones with resources, whether financial or human, and regularly monitor its performance and management to benefit the public with correct health information and practices based on WHO guidelines.

The results from the comparative analysis performed on the study variables showed that females had higher percentages of awareness and performance regarding the safe use of household cleaning products and disinfectants compared to males. Compared to the latter, females are the main homemakers and the major users of household detergents in domestic settings. Thus, their awareness and performance are expected to be highly influenced by their searching interests in effective hygiene protocols and advertisement of high-standard hygiene products [31]. Another important variable was the effect of the level of education. Indeed, and in alignment with the literature, well-educated participants (university degree holders) also showed a higher level of awareness and performance concerning the safe use of disinfectants [5], [9], [32], [33]. Young and educated participants are more likely to read and understand the label instructions and the recommendations for COVID-19 prevention from several

online resources [5], [33], [34]. However, the vast diversity of information on the internet websites and social media platforms may also contain unverified, misinformation that could misguide the public regarding the prevention of COVID-19 [35], [36].

The current study had several limitations that are considered worthy to be mentioned. Indeed, the adoption of a cross-sectional study allowed the authors to collect data from the community regarding the awareness and performance related to the safe use of disinfectants and household cleaners from a large pool of subjects and to compare the differences related to the variables in the group, however, it displays shortages such as the lack of establishment of a cause and effect relationship, the presence of selection bias, and the inability to control possible confounding variables. Additionally, collecting data by a self-responding tool where responding bias (Acquiescence bias, and/or social desirability) could affect the findings. To minimize the responding bias, the questionnaire was designed to be short and written in simple and neutral language to avoid respondent fatigue as well as to keep the questions interesting and relevant to the respondents. The study finding is based on subjective analysis only which may be coherent or not with clinical investigations. The assessment of the public commitment and adherence to the safe processes is expected to be influenced by the awareness [7] and the attitude of the study population [37]. Further, the attitude variable was not investigated to highlight its impact on community performance. Besides, the sampling technique adopted in the current study, which is the convenience sampling technique, caused limitations in the study sample: most respondents were residing in the same province, which as a result, weakened the generalized findings of the study among the Lebanese population, and in the region. An additional limitation was the use of electronic tools for data collection which may decline the randomness of the study sampling, especially for the potential participants who had a lack of awareness of electronic tools or poor communication connectivity. To overcome this limitation of inaccessibility for a part of the public community and to enlarge our sample population, the electronic survey was distributed through several social media platforms as well as electronically through the research office of the academic institution in Lebanon.

The public community recorded higher percentages of performance than awareness along with a high incidence of cough symptoms, indicating the need for incorporating awareness campaigns with technical programs to ensure the community understanding of the safety guidelines regarding the use of household cleaners and disinfectants. The highest percentages of awareness and performance were recorded among females, well-educated people (university level), young people (≤ 29 years old), and individuals not previously diagnosed with COVID-19. It is recommended to conduct additional studies, including repeated measures of the household cleaners and

disinfectant use in domestic settings over a prolonged period of time, and including the wider number of evaluations in different Lebanese and non-Lebanese settings. Community-based interventions are a must to raise awareness of chemical safety and meet the 3rd sustainable development goal (Health and wellbeing, SDG3) in Lebanon.

5. Conclusions

Household cleaners and disinfectants may cause severe negative impacts on public health within domestic settings. Therefore, the present study aimed to assess the awareness and practices of the Lebanese community regarding the safe use and handling of household cleaners and disinfectants during the spread of SARS-CoV-2. The results of the study revealed low levels of awareness and practices in Lebanon with respect to the use of household cleaners and disinfectants in domestic settings. Better understanding and adherence to safe disinfectant practices showing higher levels of awareness and practices were observed among well-educated participants and females. The research outcomes of the study will support informing the Ministry of Public Health (MOPH) and healthcare professionals in Lebanon to curate better practices, guidelines, and awareness campaigns focused on the community's levels of awareness and practices and helping in limiting the wrong practices, misuse and the misconceptions regarding the household cleaners and disinfectants use in domestic settings.

Authors' Contributions

Wissam Ghach and Areej Merhi were involved in the concept of the study, and the analysis of research data. Wissam Ghach, Sara Abou Ibrahim, and Areej Merhi were involved in the design of the study and in drafting the manuscript. Vanessa Buhandan, Nermeen Bou Ghannam, and Rina Salhab worked on the data collection, data entry and cleaning as well as worked on editing the submitted version of the manuscript. The authors approved the final version of the manuscript for submission.

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