

Article

A Survey on the Perception of Disinfectant Use Amongst CUNY Students Before, During and Immediately After the COVID-19 Pandemic

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Abstract

This study investigated the perceptions and practices of disinfectant use among students at the City University of New York (CUNY) before, during, and after the peak of the COVID-19 pandemic, with a focus on behaviors observed following a controversial statement made by President Donald Trump in April 2020 suggesting the potential use of disinfectants as a treatment for a SARS-CoV-2 infection. Utilizing an online survey of 441 CUNY students, data was collected on cleaning and disinfection behaviors during four distinct periods: pre-pandemic (January–February 2020), during the pandemic's height (March–April 2020), after the pandemic's height (June–August 2020), and following the aforementioned presidential statement. Data patterns illustrate an increase in cleaning frequency and disinfectant use during the peak of the pandemic, followed by a notable decrease after the presidential statement. The data also illustrated potentially dangerous practices, such as misting the body with cleaning sprays and using household cleaners on bare skin, though these behaviors generally decreased after the peak of the pandemic. The study highlights the impact of public health communication and the role of misinformation in shaping hygiene practices during a crisis. It underscores the need for clear, evidence-based messaging to promote safe and effective disinfectant use and to counter misinformation that may lead to harmful behaviors. This novel research contributes to the understanding of how a specific student population responded to the pandemic and provides insights for future public health interventions.



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1. Introduction

This research presents a study on the perception and practice of disinfectant use among CUNY students before, during, and after President Trump's April 2020 speech which seemed to indicate the use of bleach on the human body to treat a SARS-CoV-2 infection and after the COVID-19 pandemic. It explores the differences between disinfectants and antiseptics, highlights the risks associated with disinfectant misuse, and examines how the pandemic and related information, including a president's speech, impacted cleaning practices.

1.1. Disinfectants and Antiseptics

Disinfectants like bleach and Lysol are strong chemicals used to clean and reduce microbial life forms on surfaces [1]. On the other hand, antiseptics like hydrogen peroxide and rubbing alcohol are advised on human tissue as they are less harmful [1]. Disinfectants can be toxic to humans; therefore, injecting disinfectants into the body as a treatment for a SARS-CoV-2 infection is not recommended. Household bleach, for example, has a pH between 11 and 12, and ingesting it produces free radicals in the body [2]. These free radicals are toxic to tissues and cells, causing lipid peroxidation, which is harmful to the body [2]. Research shows that disinfectants can cause accidental injury or death by inhalation [3,4], ingestion [5–8], or injection [4,9,10]. Due to the significant toxicity of disinfectants, they are not recommended for use other than cleaning and disinfecting inanimate objects [11,12].

1.2. Disinfectant Use During the COVID-19 Pandemic

In May 2020, a survey conducted by the CDC revealed that 39% of the respondents engaged in at least one high-risk cleaning/disinfection practice not recommended by the CDC to prevent SARS-CoV-2 transmission [13]. These included using bleach on food items (19%), using cleaning and disinfectants on animate surfaces (18%), misting the body with cleaning or disinfectant sprays (10%), inhaling vapors from household cleaners or disinfectants (6%), and drinking or gargling diluted bleach solutions (4%) [13]. In addition, 25% of the respondents experienced adverse health effects when they increased their use of household cleaning in response to the pandemic [13]. The study concluded that there were knowledge gaps regarding the safe use of cleaners and disinfectants among U.S. adults. Researchers recommended safe and effective cleaning practices to prevent the transmission of SARS-CoV-2 [13]. They encouraged agencies to inform constituents that misusing bleach and disinfectants can cause tissue damage and corrosive injury. The NYC poison control center also advised against using household disinfectants on the human body [14].

A study surveyed 1047 people in Lebanon, Jordan, and Tunisia to investigate changes in hygiene practices during the pandemic [15]. Tunisians showed a 22.3% increase in using disinfectants to clean fresh fruits and vegetables [15]. There was also an increase in cleaning food with chemical agents among Jordanian (16%) and Lebanese (26%) groups [15]. Proper cleaning methods, such as handwashing, significantly rose [15]. It was noted that over 36% of respondents did not follow guidelines, and almost half used high-risk cleaning practices, including misusing soaps and chlorine bleach solutions [15]. The study concluded that unsafe practices were standard among participants [15].

Another study analyzed over 4000 tweets on six COVID-19 conspiracy theories [15]. The study found that the misuse of disinfectants was a common topic among X users formerly known as Twitter and generated up to 50% of the conversation related to coronavirus misinformation [16]. Among the six theories researched, one included using bleach and other household cleaners as a treatment for a SARS-CoV-2 infection [16]. Researchers hypothesized that conservative X users would participate in all topics relating to COVID-19 misinformation while liberal X participants would have no involvement, but their analysis found no significant relationship between the keywords “bleach” and “conservative Twitter” [16]. The study found that criticism against the president’s statement to employ bleach as a treatment for a SARS-CoV-2 infection commonly occurred [16].

This study aims to assess CUNY students’ cleaning and disinfecting practices surrounding the pandemic and the period following President Trump’s April 2020 speech. A search of major academic databases—including PubMed and Google Scholar—using keywords such as CUNY, City University of New York and COVID-19, revealed no published studies specifically addressing disinfectant usage among this population, establishing

this study as a novel contribution to the field. Existing research on CUNY students as it relates to the COVID-19 pandemic includes a study that surveyed students to examine how the COVID-19 pandemic affected their health and financial stability and another that frames COVID-19 as a barometer that highlighted existing social and health inequities in NYC [17,18]. To address this gap in the literature, this study explored the following research question: What were CUNY students' cleaning and disinfecting practices and behaviors pre-pandemic, during the first wave of the pandemic, after the height of the first pandemic wave, and after former President Trump's speech [19]?

2. Materials and Methods

2.1. Participants

A total of 441 participants were recruited from 1 August to 6 September 2020. Students were recruited from 21 of the 23 City University of New York (CUNY) campuses and ranged from Freshmen to Ph.D. candidates. In Table 1, of the 441 survey participants, 75% ($n = 330$) identified as female, 24% ($n = 108$) identified as male, and 1% ($n = 3$) identified as other. The median age for respondents was 29. The race and ethnicity breakdown consisted of 29% ($n = 129$) who identified as African American/Black, 37% ($n = 163$) identified as Hispanic, 17% ($n = 74$) identified as white, 11% ($n = 49$) identified as Asian and 6% ($n = 27$) identified as other. In total, 23% ($n = 100$) were first-year students, 30% ($n = 132$) were sophomores, 17% ($n = 73$) were juniors, 19% ($n = 83$) were seniors, and 12% ($n = 52$) were completing either a master's or doctorate. The socioeconomic status indicated that 18% ($n = 79$) stated they had a total household income less than \$10,000, 50% ($n = 222$) made between \$10,000 and \$44,999, 18% ($n = 77$) made between \$45,000 and 74,999, and 14% ($n = 64$) earned more than 75,000 a year [20].

Table 1. Demographics of Study Sample.

Characteristics	Frequency	
	<i>n</i>	%
Gender		
Male	108	24.5
Female	330	74.8
Other	3	0.7
Courses Taken by Students ¹		
STEM	341	27.7%
Non-STEM	884	71.9%
Missing	5	0.4%
Race/Ethnicity		
Hispanic	163	37.0
African American	129	29.3
Asian	48	10.9
American Indian or Alaska Native	4	0.9
White	74	16.8
Mixed	7	1.6
Middle Eastern	8	1.8
Other *	6	1.4
First Language		
English	299	68.0
Spanish	68	15.5
Other **	73	16.6

Table 1. *Cont.*

Characteristics	Frequency	
	<i>n</i>	%
Total Household Income		
Less than \$10,000	78	17.7
\$10,000–\$44,999	222	50.3
\$45,000–\$74,999	77	17.5
\$75,000–\$100,000+	64	14.5
Education Level		
Freshman	99	22.4
Sophomore	132	29.9
Junior	73	16.6
Senior	83	18.8
Graduate Level ***	52	11.8
Major Type ¹		
STEM	341	77.3
Non-STEM	65	14.7
Undeclared	27	6.1
Dual Degree	5	1.1
Non-Degree	3	0.7
Previous Experience with Online Courses?		
No	302	68.5
Yes	139	31.5

Note. *N* = 441. * The “Other” category within Race/Ethnicity represents students who did not select one of the eight represented racial groups but wrote in Jamaican, Afro-Latinx, Caribbean, Indo-Caribbean, and European. ** The “Other” category within First Language represents students whose primary language was not a part of the majority, such as Cantonese, Russian, and Azerbaijan. *** Graduate level included both Master’s and Ph.D. students. ¹ The ‘Courses Taken’ category captures the distribution of coursework students completed in Spring 2020, with many students enrolling in a combination of STEM and non-STEM courses (e.g., Biology or Chemistry alongside Sociology or Art). The ‘Major Type’ category identifies the academic discipline in which each student was majoring during the Spring 2020 semester.

2.2. Procedure

The study’s methodology was a survey to understand CUNY students’ use of disinfectants before the pandemic, during, after the pandemic and after president Trump’s 23 April 2020 speech regarding the use of disinfectants to treat the SARS-CoV-2 virus.

Invitations to participate in the IRB-approved study (#2020-0521) were emailed to the Vice Presidents of students’ success at respective City University of New York (CUNY) campuses. The Vice Presidents distributed the Google Forms survey link to students who took courses at CUNY during the Spring 2020 semester. The survey consisted of 6 questions generated by the researchers, including three meticulously selected questions from a previous CDC disinfectant study (See Appendix A) [13]. Survey respondents were anonymous to promote comfort amongst individuals to share legitimate information. To achieve a 95% confidence level for generalizing to the CUNY student population, a sample size of 384 or more respondents was estimated as necessary. This study successfully obtained 441 responses.

2.3. Data Analysis

To analyze the disinfectant survey, we compiled and cleaned the data using Microsoft’s Excel program to measure the variables before, during, after the pandemic and after the President’s speech. The cloud-based version of Google Forms software was used to collect responses and IBM’s SPSS version 28.0 and 32.0 to analyze the data [21]. The exclusion criteria included those under 18 years of age, those not a CUNY student, students who did not take courses at CUNY in Spring 2020, and those with incomplete or missing data points.

The “pre-pandemic” variable measured participant responses to disinfectant use from January to February 2020. The “during the first pandemic wave” variable measured responses on disinfectant use from March 2020 to April 2020. The “after the height of the first pandemic wave” variable measured participant responses from June 2020 through August 2020. The “after former President’s speech” variable measured participant responses after the President’s 23 April 2020 press briefing.

For each behavior, pairwise comparisons were performed between the pre-pandemic period and each subsequent time period. Because multiple hypothesis tests were conducted, *p*-values were adjusted using the Benjamini–Hochberg false discovery rate (FDR) procedure to control the expected proportion of false-positive findings. Statistical significance was defined as a two-sided adjusted *p* < 0.05.

3. Results

Of the 441 study participants, 44 respondents (9.1%) were infected with SARS-CoV-2 at the time of the survey, while 70 (14.5%) had a household member infected. In total, 173 respondents (35.9%) had a close associate who was infected. Moreover, 254 respondents (52.7%) had not experienced SARS-CoV-2 infection themselves or through family/friends. Although the survey was administered in August 2020, students were asked to retrospectively report their experience with COVID-19 infection up to June 2020.

4. Frequently Practiced Cleaning Behaviors Data

In Table 2, 403 participants (91%) reported increased home cleaning practices during the first pandemic wave compared to 241 (57%) pre-pandemic, representing a 67% relative increase. This increase was statistically significant during the first pandemic wave (*p* < 0.001), after the height of the pandemic’s first wave (*p* < 0.001), and following the President’s speech (*p* < 0.001). Slightly decreased to 380 (86%) after the height of the first pandemic wave, a 5.7% decline from the pandemic peak. Following the President’s speech, reported participation in increased home cleaning practices dropped to 146 (33%), a 61% relative decrease from the preceding height of the pandemic period.

Table 2. Prevalence of cleaning and disinfecting behaviors across pandemic-related time periods among respondents.

Reported Behaviors	Pre-Pandemic	During 1st Pandemic Wave		After Height of Pandemic’s 1st Wave		After Trump’s Speech	
	<i>n</i> (%)	<i>n</i> (%)	<i>p</i> -Value	<i>n</i> (%)	<i>p</i> -Value	<i>n</i> (%)	<i>p</i> -Value
Increased frequency of home cleaning	241 (54.6%)	403 (91.4%)	<0.001	380 (86.2%)	<0.001	146 (33.1%)	<0.001
Cleaned or disinfected packages or mail	134 (30.4%)	362 (82.1%)	<0.001	320 (72.6%)	<0.001	124 (28.1%)	0.827
Cleaned or disinfected groceries	110 (24.9%)	363 (82.3%)	<0.001	311 (70.5%)	<0.001	113 (25.6%)	0.948
Misted the body with cleaning spray	75 (17.0%)	199 (45.1%)	<0.001	168 (38.1%)	<0.001	80 (18.1%)	0.874
Used household cleaners to clean or disinfect bare skin	78 (17.7%)	118 (26.8%)	0.003	100 (22.7%)	0.146	47 (10.7%)	0.007
Washed fruits, vegetables or food products with bleach	58 (13.2%)	50 (11.3%)	0.779	63 (14.3%)	0.874	30 (6.8%)	0.004

Table 2. *Cont.*

Reported Behaviors	Pre-Pandemic	During 1st Pandemic Wave		After Height of Pandemic's 1st Wave		After Trump's Speech	
	<i>n</i> (%)	<i>n</i> (%)	<i>p</i> -Value	<i>n</i> (%)	<i>p</i> -Value	<i>n</i> (%)	<i>p</i> -Value
Drank or gargled diluted bleach	2 (0.5%)	2 (0.5%)	1	2 (0.5%)	1	3 (0.7%)	0.874
Drank or gargled soapy waters	3 (0.7%)	6 (1.4%)	0.63	4 (0.9%)	0.874	3 (0.7%)	1
Drank or gargled household cleaner	3 (0.7%)	4 (0.9%)	0.874	3 (0.7%)	1	2 (0.5%)	0.874
Inhaled the vapor of household cleaners (e.g., bleach)	4 (0.9%)	5 (1.1%)	0.885	3 (0.7%)	0.874	3 (0.7%)	0.874
Injects household cleaners like bleach	6 (1.4%)	8 (1.8%)	0.874	6 (1.4%)	1	3 (0.7%)	0.63
None of the listed behaviors	192 (43.5%)	27 (6.1%)	<0.001	48 (10.9%)	<0.001	320 (72.6%)	<0.001

Note: Values are presented as *n* (%). Percentages were calculated using the total sample size of 441 respondents. *p*-values represent pairwise comparisons between each pandemic-related time period and the pre-pandemic period. *p*-values were adjusted for multiple comparisons using the Benjamini–Hochberg false discovery rate (FDR) procedure.

4.1. Cleaned or Disinfected Packages or Mail

Before the pandemic, 134 respondents (30%) cleaned or disinfected their packages or mail. During the first pandemic wave, this number rose to 362 (82%), a 170% relative increase. After the height of the pandemic's first wave, it decreased by 12% to 320 (73%). However, the period immediately following the former President's speech saw a sharp decline to 124 (28%), representing a 66% relative decrease from the peak pandemic levels. These changes were statistically significant during the first pandemic wave ($p < 0.001$) and after the height of the pandemic's first wave ($p < 0.001$), but not after the speech ($p = 0.827$).

4.2. Cleaned or Disinfected Groceries

Pre-pandemic, 110 respondents (25%) indicated practices of cleaning or disinfecting their groceries. This increased to 363 (82%) during the first pandemic wave, a 230% relative increase. After the pandemic's peak, the count decreased to 311 respondents (71%), a 14% relative decrease. In the period following the President's speech on April 23rd, 113 respondents (26%) indicated they practiced cleaning or disinfecting groceries, a 69% relative decrease from the pandemic peak. These increases were statistically significant ($p < 0.001$) during the first pandemic wave and after the height of the pandemic ($p < 0.001$), while the decline after the speech was not statistically significant ($p = 0.948$).

4.3. Misting the Body with Cleaning Spray

Seventy-five respondents (17%) misted their bodies with cleaning spray pre-pandemic. This behavior spiked to 199 participants (45%) during the first pandemic wave, a 165% relative increase. The numbers slightly declined to 168 respondents (38%) post the height of the pandemic's first wave, a 16% relative decrease. Following the former President's speech in April, the number of respondents reduced to 80 (18%), a 60% relative decrease from levels during the height of the pandemic. These changes were significant during the first pandemic wave ($p < 0.001$) and after the height of the first wave ($p < 0.001$), but not after the speech ($p = 0.874$).

4.4. Used Household Cleaner to Clean or Disinfect Bare Skin

Before the pandemic, 78 people (18%) used household cleaners to disinfect their bare skin. This increased to 118 (27%) during the first pandemic wave, a 51% relative increase. After the height of the pandemic's first wave, the count decreased to 100 (23%), a 15% relative decrease. Following the April 23rd speech, 47 participants (11%) reported the use of disinfectants on bare skin, a 60% relative decrease from the pandemic peak. The increase during the first pandemic wave ($p = 0.003$) and the decrease after the speech ($p = 0.007$) were statistically significant, while the change after the height of the pandemic's first wave was not ($p = 0.146$).

4.5. Washing Fruits, Veggies, or Food Products with Bleach

In total, 58 participants (13%) used bleach to wash food pre-pandemic, which fell to 50 respondents (11%) during the first pandemic wave, a 14% relative decline. After the pandemic's peak, the number increased to 63 participants, (14.3%), a 26% relative increase. However, after the speech, the number dropped by 40% to 30 participants. Following the speech, the count dropped to 30 (6.8%), a 40% relative decrease from the pre-pandemic baseline. The change after the speech was statistically significant ($p = 0.004$), whereas earlier time periods were not ($p = 0.779$ and $p = 0.874$).

4.6. None of the Listed Behaviors

Before the pandemic, 192 participants (44%) reported engaging in none of the listed cleaning behaviors. This number significantly decreased to 27 (6.1%) during the first pandemic wave ($p < 0.001$) and 48 (10.9%) after the height of the pandemic's first wave ($p < 0.001$). Following the President's speech, the number of participants who indicated they did not engage in any of the listed behaviors rose significantly to 320 (73%, $p < 0.001$).

5. Infrequently Practiced Cleaning Behaviors Data

Several infrequent and high-risk cleaning behaviors were reported by a small number of participants. The practice of drinking or gargling diluted bleach remained steady at two respondents (0.5%) pre-pandemic, during the first pandemic wave ($p = 1$), and after the pandemic's peak ($p = 1$), before rising to three respondents (0.7%) following the President's speech ($p = 0.874$). Six respondents (1.4%) reported drinking or gargling soapy water during the first pandemic wave ($p = 0.63$); this number decreased to four (0.9%) after the height of the pandemic's first wave ($p = 0.874$) and then to three (0.7%) following the speech ($p = 1$). Inhaling household cleaner vapors was reported by four respondents (0.9%) pre-pandemic, increasing to five respondents (1.1%) during the first pandemic wave ($p = 0.885$), and then decreasing to three (0.7%) after the height of the first pandemic wave ($p = 0.874$) and after the speech ($p = 0.874$). Finally, the injection of household cleaners was reported by six respondents (1.4%) pre-pandemic, rising to eight (1.8%) during the first pandemic wave ($p = 0.874$), returning to six (1.4%) after the height of the pandemic's first wave ($p = 1$), before declining to three (0.7%) following the speech ($p = 0.63$). It should be noted that because these high-risk behaviors were reported by a very small number of participants ($n = 2-8$), they may represent measurement artifacts, as discussed in research by Litman et al. [22].

6. Discussion

The observed patterns of this survey's data illustrate shifts in cleaning and disinfecting practices among CUNY students throughout the COVID-19 pandemic. Notably, a substantial increase in cleaning frequency was observed during the first pandemic wave, supporting findings from both the CDC and international studies [14,15,23]. The surge in cleaning

behaviors aligns with heightened public health concerns and widespread messaging about hygiene and disinfection to mitigate the transmission of a SARS-CoV-2 infection [13,24,25].

The survey question asked, “On 23 April 2020, during a White House press briefing President Donald Trump stated, “And then I see the disinfectant, where it knocks it out in a minute. One minute! And is there a way we can do something like that? By injection inside or almost a cleaning” how did this statement influence your cleaning behaviors?” The study’s descriptive findings illustrate that participants reported a marked decrease in disinfectant usage coinciding with the President’s speech in April 2020. There are several plausible explanations for the decline in hygiene practices during this period. Previous research indicates that many individuals were critical of the suggestion of using disinfectants as a treatment for a SARS-CoV-2 infection [15,26]. The negative reaction and subsequent decrease in disinfectant use suggest that public health communication and the credibility of information plays a crucial role in shaping individual behaviors during a crisis. These observed trends underscores the importance of accurate, evidence-based information from trusted sources, as misinformation or controversial suggestions can lead to behavioral changes that may not align with public health recommendations [27,28]. An alternative explanation for this shift is behavioral normalization, often referred to as pandemic fatigue or a reduction in acute-phase vigilance, as the initial shock of the pandemic subsided [29,30]. However, it is also possible that the timing of this decline, which coincided with the controversial speech regarding disinfectant use, may represent a genuine re-evaluation of safety practices by the student population. It is likely that both factors—the broader normalization of behaviors as the pandemic subsided and the public reaction to the presidential statement—contributed to the observed trends.

Despite the initial surge in cleaning and disinfection, the data also reveal a gradual decline in cleaning frequency after the peak of the pandemic [24]. This could reflect several factors. As initial fears subsided and public health measures evolved, individuals may have relaxed their stringent cleaning routines. Additionally, fatigue with constant cleaning or a shift in focus towards other preventive measures, such as vaccination, could have contributed to this decline. Understanding these shifts is important for future public health responses, as sustained adherence to hygiene practices may require ongoing communication and reinforcement as suggested by Tan et. al. [31].

Furthermore, the data on specific behaviors, such as misting the body with cleaning spray or using household cleaners on bare skin, is concerning. Although the frequency of these high-risk behaviors was noted to have decreased after the height of the pandemic’s first wave and coinciding with the President’s speech, the fact that they were practiced at all, especially during a period of heightened awareness about health and safety, suggests knowledge gaps or misinterpretations of public health guidance. This highlights and supports previous research findings that indicate the need for clear, targeted education to dispel myths and promote safe practices regarding disinfectant use [31].

The steady rate of a few respondents engaging in extremely dangerous practices such as drinking or gargling diluted bleach is alarming but could be an artifact as reported in a study authored by Litman [22]. While the numbers are small, as seen with the CDC study, it is important to note that any true instance of such behavior indicates a serious misunderstanding of disinfectant safety [13,19]. This behavior underscores the critical need to reiterate effective public health practices that not only promote appropriate cleaning behaviors but also explicitly warn against misuse that could lead to harm during pandemics.

Study Limitations

The survey on disinfectant perception and practices during the COVID-19 pandemic at CUNY received 441 responses, representing approximately 0.16% of the 271,242 students

enrolled across 23 CUNY colleges. This study's descriptive findings offer insights into the experiences of a specific subset of CUNY students who participated in the Spring 2020 semester. However, generalizability to the entire CUNY student population is limited due to the sample size and recruitment methods. A number of responses were excluded for not meeting IRB-approved criteria, specifically being under 18 years of age or not being enrolled in CUNY during the spring 2020 semester.

Additionally, the recruitment strategy introduced potential selection bias. The study involved the distribution of the survey to students through Vice Presidents of Student Success; therefore, the sample may overrepresent students who are more engaged with institutional communications or student support services. This recruitment method was not randomized and can limit the ability to generalize the descriptive findings to the broader, more diverse CUNY student body [32].

A primary limitation of this study is the potential for recall bias. As data was collected in August 2020, participants were asked to reflect on cleaning and disinfecting behaviors occurring up to eight months prior. This extended time lag poses a challenge for the reliability of the baseline data, as participants' ability to accurately recall and differentiate hygiene routines across these distinct time periods may be diminished. Furthermore, these responses represent a single point in time and may not reflect evolving opinions or disinfection practices among CUNY students throughout the national COVID-19 response. Future research should aim for a larger number of respondents to achieve a more representative sample of the CUNY student population.

Another primary limitation of this study is that the analysis is descriptive. Consequently, determining the statistical significance of differences between the time periods and identifying independent determinants associated with cleaning behaviors pose a limitation. Future research incorporating inferential statistical modeling is warranted to confirm these patterns.

Regarding less frequent cleaning behaviors, 8 out of 441 eligible participants reported unsafe practices, such as gargling with soapy water, which may be an outlier or artifact [22]. A larger participant pool in future studies could provide further insight into this small group and either validate or challenge these descriptive findings.

Another limitation of this study is the temporal overlap between the 'during the first pandemic wave' period (March–April 2020) and the period following the former President's speech on 23 April 2020. Because these conditions are temporally inseparable in the data, there may exist a limitation to isolate the effect of the speech from the behavior observed during this period. Consequently, descriptive findings related to the speech represent associations rather than causal evidence.

7. Conclusions

Overall, this study provides valuable insights into how a specific population, CUNY students, responded to the COVID-19 pandemic regarding cleaning and disinfection practices. It reveals the influence of official communication, public perception, and the evolving nature of the pandemic on these behaviors. The data's observed trends suggest the importance of clear, consistent public health messaging, and the need for ongoing monitoring and evaluation of public health interventions during times of crisis.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data is unavailable due to privacy or ethical restrictions based on the CUNY BCC IRB guidelines.

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Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A Survey Questions

1. Prior to the COVID-19 outbreak (January and February 2020), which of the following cleaning behaviors did you or a household member engage in to prevent bacterial or viral infections at home? (Select all that apply).
2. During the height of the outbreak (March and April 2020), which of the following cleaning behaviors have you, or a household member, engaged in to prevent coronavirus? Select as many as apply
3. After the height of the outbreak (June 2020), which of the following cleaning behaviors have you, or a household member, engaged in to prevent coronavirus? Select as many as apply.
4. On 23 April 2020, during a White House press briefing President Donald Trump stated, "And then I see the disinfectant, where it knocks it out in a minute. One minute! And is there a way we can do something like that? By injection inside or almost a cleaning" how did this statement influence your cleaning behaviors? Select as many as apply

Answer choices for questions 1–4: Increased frequency of home cleaning, Cleaned or disinfected packages or mail, Cleaned or disinfected grocery store items like bags or food packages, Misted the body with cleaning spray or alcohol spray after being in public spaces, Used household cleaner to clean or disinfect hands or bare skin, Washed fruits, vegetables, or other food products with bleach, Drank or gargled diluted bleach solution, Drank or gargled soapy water, Drank or gargled a household cleaner, Inhaled the vapor of household cleaners like bleach, Inject household cleaners like bleach, and None of these.

5. On 23 April 2020, during a White House press briefing President Donald Trump stated, "And then I see the disinfectant, where it knocks it out in a minute. One minute! And is there a way we can do something like that. By injection inside or almost a cleaning" how did this statement influence your thoughts about your cleaning behaviors and Coronavirus? **(open-ended)**
6. On 23 April 2020, during a White House press briefing President Donald Trump stated, "And then I see the disinfectant, where it knocks it out in a minute. One minute! And is there a way we can do something like that? By injection inside or almost a cleaning" how did this statement influence your thoughts about President Trump and his response to COVID-19?

Answer choice for question 6: very dissatisfied, moderately dissatisfied, slightly dissatisfied, neutral, slightly satisfied, moderately satisfied, and very satisfied.

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