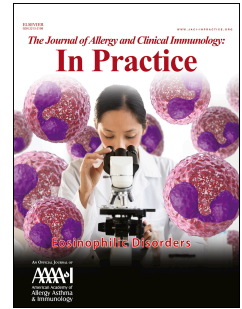


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Increased Disinfectant Use Among Adults with Asthma in the Era of COVID-19

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**1 Increased Disinfectant Use Among Adults with Asthma in the Era of COVID-19**

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47 **Clinical Implications**

48 Health care providers should recognize the potential impact of cleaning/disinfecting  
49 practices on people with asthma, particularly the use of disinfectants with strong odors  
50 which are known asthma triggers. Individuals with asthma should be provided with safer  
51 cleaning/disinfecting options.

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53 **Figure 1:** Household Use of Disinfectants  $\geq 5$  Times per Week Prior to and Since  
54 COVID-19

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72           The COVID-19 pandemic has rapidly impacted the United States (US) population  
73 and is a substantial concern among individuals with chronic respiratory diseases.  
74 Asthma is a complex, multi-faceted respiratory disease that affects over 19 million US  
75 adults.<sup>1</sup> As individuals are sheltering at home for longer periods of time, those with  
76 asthma contend with asthma triggers and new chemical exposures as they sanitize their  
77 home environments to prevent COVID-19. Household asthma triggers may also include  
78 air pollutants,<sup>2</sup> such as air particulate matter from secondhand smoke and molds. The  
79 current COVID-19 crisis has altered usual cleaning practices and amount of time at  
80 home. It is unknown how these changes impact adults with asthma.

81           The Centers for Disease Control and Prevention (CDC) recommend initially cleaning  
82 residential surfaces with soap and water followed by disinfecting surfaces with a US  
83 Environmental Protection Agency (EPA) registered household disinfectant.<sup>3</sup> Research  
84 specific to the impact of residential exposures and cleaning/disinfecting products on  
85 asthma is limited. However, research from occupational studies suggests that  
86 exposures to cleaning/disinfecting agents may be associated with an inflammatory  
87 response and airway remodeling and may lead to sensitizer-induced asthma through  
88 IgE and non-IgE pathways as well as irritant-induced asthma.<sup>4</sup> Weekly use of spray  
89 cleaning products was associated with asthma<sup>5,6</sup> and decreased lung function in adults.<sup>7</sup>  
90 For women who reported use of bleach 4-7 times per week, the odds of asthma  
91 increased compared to those who never used bleach.<sup>8</sup> While cleaning and disinfecting  
92 products are known asthma triggers, the extent to which adults with asthma are  
93 impacted when use is increased during the COVID-19 pandemic is unknown. This study  
94 examined self-reported household disinfectant use and its impact on asthma control  
95 during the COVID-19 pandemic.

96           This cross-sectional, online survey, launched in May 2020, included adults  $\geq 18$   
97 years old who could read and write English, and who self-reported that they have been  
98 told by a health professional that they have asthma and still have asthma. Participants  
99 were recruited using multiple strategies including email distribution lists, social media,  
100 and ResearchMatch®. Interested and eligible individuals were provided with a link to the  
101 REDCap survey, which took 15-20 minutes to complete. The study had the University's  
102 Institutional Review Board approval.

103 Survey items discussed in this paper include demographics, the 5-item Asthma  
104 Control Test (ACT), and questions addressing handwashing and use of alcohol hand-  
105 sanitizer. We queried how many times per week, prior to and since the onset of COVID-  
106 19, participants recalled that they or anyone in their household used disinfectant wipes,  
107 disinfectant spray, bleach and water solution for disinfecting surfaces/objects, or other  
108 disinfecting liquids. Responses were dichotomized as  $\geq 5$  versus  $< 5$  times per week.

109 As of September 16, 2020, data were collected from 795 US participants. We  
110 used chi-squared statistics to examine the associations of household use of  
111 disinfectants with participant characteristics. Binary logistic regression models examined  
112 the associations of disinfectant use with uncontrolled asthma (ACT score  $\leq 19$ ). Multiple  
113 logistic regression analyses were adjusted for age, education, gender, race/ethnicity,  
114 residential area, and home ownership. These potential confounding variables were set a  
115 priori. Statistical analysis was performed in SAS 9.4 and a p-value  $< 0.05$  indicated  
116 statistical significance.

117 The mean age was  $43.9 \pm 15.2$  years. Most participants were female (81%), white  
118 (83%), had a 4-year college degree or higher (71%), resided in urban or suburban areas  
119 (62%), and owned their home (54%). Almost 40% reported uncontrolled asthma in the  
120 past 4 weeks. (Table E1).

121 Over 95% of participants reported increased handwashing practices while 89%  
122 reported increased use of alcohol-based sanitizer since the COVID-19 pandemic. The  
123 percent of participants who reported household disinfectant use  $\geq 5$  times per week  
124 increased 138% for disinfectant wipes, 121% for disinfectant sprays, 155% for bleach  
125 and water solutions, and 89% for other disinfecting liquids since the COVID-19  
126 pandemic (Figure 1). Household use of disinfectants  $\geq 5$  times per week since the  
127 COVID-19 pandemic was higher among less educated participants, participants from  
128 small towns/rural areas, non-white, and those residing with family and/or friends. (Table  
129 E2).

130 In unadjusted analyses, household use of disinfectant wipes, disinfectant sprays,  
131 bleach and water solutions, and other disinfecting liquids  $\geq 5$  times per week (versus  $< 5$   
132 times per week) significantly increased the odds of uncontrolled asthma (Table 1). In  
133 adjusted analyses, the elevated ORs persisted for household use of disinfectant wipes,

134 disinfectant sprays, bleach and water solutions, and other disinfecting liquids, although  
135 only significantly elevated for wipes and other liquids.

136 Our findings indicate that handwashing increased dramatically as did use of  
137 alcohol-based hand sanitizers. Similarly, use of disinfectant wipes, spray, bleach and  
138 water solutions, and other disinfecting liquids increased in the households of  
139 respondents. Our results are consistent with a US survey that found 60% of participants  
140 increased cleaning/disinfectant practices since the COVID-19 pandemic.<sup>9</sup>

141 We found that significantly more participants who were less educated, non-white,  
142 or living in small cities or in non-urban areas reported using disinfectants more often  
143 and that increased use of disinfectant wipes and other disinfecting liquids was  
144 significantly related to poorer asthma control. These findings are consistent with  
145 previous studies conducted primarily in occupational settings showing increased  
146 exposure to disinfectants related to increased asthma symptoms and exacerbations.<sup>5,6</sup>

147 The cross-sectional study design precludes assessment of the causal  
148 relationship between the increased frequency of disinfecting and uncontrolled asthma.  
149 In addition, participants were primarily female, white, and well-educated which limits  
150 generalizability. The exposure and outcome measurements were self-reported, which  
151 could have led to information bias.

152 We found stark increases in disinfectant use among adults with asthma since the  
153 COVID-19 pandemic. While this is not unexpected due to the attention on reducing  
154 COVID-19 transmission, the unexpected impact on the high use of disinfectants needs  
155 further attention. Health care providers should recognize the potential impact of  
156 cleaning/disinfecting practices on people with asthma, particularly the use of known  
157 asthmagens such as bleach and other disinfectants. Individuals with asthma should be  
158 provided with safer cleaning/disinfecting options such as the guidance found on the US  
159 EPA's website (<https://www.epa.gov/coronavirus>). Our findings will guide development  
160 of interventions and strategies to address the high use of disinfectants in populations  
161 most vulnerable to their negative effects.

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**Figure 1:** Household Use of Disinfectants  $\geq 5$  Times per Week Prior to and Since COVID-19

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Table 1. Association of Household Disinfectant Use  $\geq 5$  Times per Week since Covid-19 with Lack of Asthma Control ACT (19 or less) among US-based Participants

Disinfectant Type	Crude		Adjusted <sup>a</sup>	
	OR	95% CI	OR	95% CI
Disinfectant Wipes	1.97*	1.47-2.65	1.69**	1.22-2.34
Disinfectant Sprays	1.83*	1.36-2.47	1.37***	0.98-1.90
Disinfectant Water and Bleach	2.33*	1.62-3.33	1.49***	0.99-2.24
Other Liquids	1.78*	1.32-2.39	1.55**	1.12-2.16

<sup>a</sup> Adjusted for age, education, sex, race/ethnicity, residential area (large city or suburban area versus small city, town, or rural area), and home ownership

\*p-value <0.001 \*\* p-value <0.05 \*\*\* p-value <0.

**Table E1.** Sample Characteristics

Variable	n	%
Age in years (Mean, SD)	43.9	15.2
18-29	155	19.57
30-39	202	25.51
40-49	164	20.71
50-59	111	14.02
60+	160	20.20
Highest Level of Education		
High School or Less	73	9.18
Some College or 2-Year Degree	154	19.37
4-Year College	164	20.63
Post College or graduate/professional degree	404	50.82
Gender		
Male	142	17.93
Female	639	80.68
Other	11	1.39
Race/Ethnicity		
White	658	83.08
Non-white	134	16.92
Location: Which best describes the area in which you live?		
Large city or suburb	491	61.76
Small city, town, or rural area	304	38.24
Rent or Own: Home Ownership		
Rent	252	31.74
Own	431	54.28
Live with family/friends	97	12.22
Other	14	1.76
Type of Current Home		
Single Family House	505	63.52

Apartment	206	25.91
Townhouse	53	6.67
Mobile home	4	0.50
Other	27	3.40
Asthma Control Test Score		
19 or less	316	39.95
20 or higher	475	60.05

**Table E2.** Association of Participant Characteristics with Household Disinfectant Use  $\geq$  5 time per week since Covid-19

Variable	Disinfectant Wipes	Disinfectant Sprays	Disinfectant Water and Bleach	Other Liquids
Age in years (Mean, SD)				
18-29	36.77*	35.48*	16.13	28.39*
30-39	38.31	39.80	19.90	38.81
40-49	56.44	44.79	26.38	49.69
50-59	41.67	36.11	22.22	38.89
60+	35.9	26.28	14.10	32.69
Highest Level of Education				
High School or Less	68.57*	64.29*	52.86*	62.86*
Some College or 2-Year Degree	41.83	39.22	20.92	37.25
4-Year College	37.04	32.72	14.81	30.25
Post College or graduate/professional degree	38.65	32.42	15.21	36.66
Gender				
Male	41.84	34.75	26.95*	31.21
Female	41.36	37.24	18.38	39.30
Race/Ethnicity				
White	40.15	34.46*	17.54*	36.46
Non-white	48.87	47.37	30.08	45.11
Which best describes the area in which you live?				
Large city or suburb	38.45*	32.52*	15.54*	34.76*
Small city, town, or rural area	46.80	43.43	26.26	42.76
Home Ownership				
Rent	36.25*	38.25*	17.53*	37.05
Own	41.51	31.60	17.69	36.79
Live with family/friends	56.70	54.64	31.96	43.30

Other	35.71	35.71	28.57	42.86
Type of Current Home				
Single Family House	44.27	37.02	20.12	37.63
Apartment	35.61	36.59	19.02	37.56
Townhouse	37.74	32.08	15.09	35.85
Mobile home	50.00	50.00	0	0
Other	44.44	37.04	25.93	51.85
Asthma Control Test Score				
19 or less	51.76*	45.05*	27.48*	46.33*
20 or higher	34.75	30.70	14.29	31.98

**Figure 1:** Household Use of Disinfectants  $\geq 5$  Times per Week Prior to and Since COVID-19

