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# Mask Use Experiences, COVID-19, and Adults with Asthma: A Mixed-Methods Approach



Barbara J. Polivka, PhD<sup>a</sup>, Kamal Eldeirawi, PhD<sup>b</sup>, Luz Huntington-Moskos, PhD<sup>c</sup>, and Sharmilee M. Nyenhuis, MD<sup>d</sup>  
Kansas City, Kan; Chicago, Ill; and Louisville, Ky

**What is already known about this topic?** Masks reduce the risk of COVID-19 by providing a barrier between the wearer and others to reduce the spread of respiratory droplets and by reducing the inhalation of these droplets by the wearer themselves.

**What does this article add to our knowledge?** Most adults with asthma reported wearing a mask in public places. Lower asthma control and longer daily mask wearing were associated with more self-reported problems with wearing masks.

**How does this study impact current management guidelines?** Participants recommended “Just wear it.” To increase wearability using a comfortable mask that fits, staying calm, breathing slowly and deeply were recommended. Recommendations also included taking safe “mask breaks” when needed.

**BACKGROUND:** Although masks are recommended for those with asthma in the era of COVID-19, there is limited research exploring the extent of and problems related to mask use in adults with asthma.

**OBJECTIVE:** We sought to describe in adults with asthma: (1) the extent masks are worn and attitudes and beliefs about wearing masks; (2) participant characteristics associated with problems experienced while wearing a mask, and (3) participant experiences and recommendations regarding masks.

**METHODS:** The Mask Use in Adults with Asthma online survey was conducted with 501 adults with asthma (96.6%) primarily from the United States. A Mask Effects Scale (MES) was compiled from items addressing problems experienced wearing a mask with higher total scores indicating more problems. Open-ended questions explored factors considered when choosing a mask, problems experienced while wearing a mask, and recommendations to others with asthma. Survey data were analyzed descriptively and via multiple regression. Themes were generated from open-ended items.

**RESULTS:** Almost all participants (98.4%) indicated wearing a mask in public, and most (67.4%) wore a mask  $\leq 3$  hours per day. Poorer asthma control and wearing a mask longer were significantly associated with higher MES scores ( $P \leq .001$  and  $.005$ , respectively). Participant recommendations included “Just wear it,” use a comfortable, well-fitting mask, take mask breaks, and carry your inhaler.

**CONCLUSIONS:** Wearing a mask in public was almost uniformly adhered to by participants, despite reporting problematic effects. Implementing recommendations, such as planned mask breaks, can support and enhance the experience of wearing a mask for adults with asthma. © 2021 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2022;10:116-23)

**Key words:** Asthma; Masks; Face coverings; COVID-19; Asthma control; Coronavirus

Wearing a mask when outside of one’s home is strongly recommended for all individuals over 2 years of age during the coronavirus/COVID-19 pandemic, including for those with asthma.<sup>1-3</sup> Masks reduce the risk of COVID-19 infection by (1) providing a barrier between the wearer and others to reduce the spread of respiratory droplets, and (2) reducing the inhalation of these droplets by the wearer himself or herself.<sup>4</sup> Studies addressing mask use by the general public revealed that most respondents wore a mask and were more comfortable if others wore a mask in public places<sup>5,6</sup> and at work.<sup>7</sup> The most common type of mask reportedly used was a cloth mask, followed by surgical masks, and N95 type of masks.<sup>7,8</sup> A survey of young adults in Poland during the COVID-19 pandemic found that most wore a mask daily for 2 or fewer hours and that those with a history of atopy were more likely to wear a mask.<sup>8</sup> Focus group participants from North Carolina indicated that protecting/respecting others and themselves from COVID-19 was a primary motivation for wearing a mask; however, a number of challenges with wearing a mask were

<sup>a</sup>School of Nursing, University of Kansas, Kansas City, Kan

<sup>b</sup>Department of Population Health Nursing Science, Chicago College of Nursing, University of Illinois, Chicago, Ill

<sup>c</sup>School of Nursing, University of Louisville, Louisville, Ky

<sup>d</sup>Division of Pulmonary, Critical Care, Sleep and Allergy, Chicago Department of Medicine, University of Illinois, Chicago, Ill

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Corresponding author: Barbara J. Polivka, PhD, School of Nursing, University of Kansas, 3901 Rainbow Blvd, Kansas City, KS 66160. E-mail: [bpolivka@kumc.edu](mailto:bpolivka@kumc.edu).

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*Abbreviations used*

*ACT- Asthma Control Test*

*BMI- Body mass index*

*GCAS- Global COVID-19 and Asthma Study*

*MES- Mask Effects Scale*

identified including difficulty breathing, glasses fogging up, and difficulty hearing others speak.<sup>6</sup> Although no clinically significant changes in oxygen saturation or carbon dioxide levels were identified with wearing a mask, mask wearing has been associated with headaches, facial irritation/itching, increased facial temperature, increased humidity, and breathing difficulties.<sup>9</sup> Although mask use is recommended for those with asthma,<sup>10</sup> there is limited research specifically exploring the extent of and issues related to mask use in adults with asthma. For adults with asthma in the era of COVID-19, we sought to (1) determine the extent that masks are worn, attitudes and beliefs about wearing masks, and the problems experienced while wearing a mask; (2) identify factors (eg, body mass index [BMI], education, and asthma control) associated with problems experienced when wearing a mask; and (3) describe participant experiences of wearing a mask and their recommendations to others.

**METHODS**

Study participants were adults with asthma who previously responded to the online Global COVID-19 and Asthma Study (GCAS)<sup>11</sup> REDCap survey. The GCAS addressed the impact of COVID-19 on factors such as use of disinfectants and hand sanitizers and exposures to environmental tobacco smoke. Those indicating willingness to participate in additional studies (N = 712) were emailed a request through REDCap to complete the online Face Mask Use in Adults with Asthma survey addressing mask use during the COVID-19 pandemic. The emailed request included a link to the online survey. The GCAS REDCap generated participant survey identifiers linked participant records from the GCAS to their Face Mask Use in Adults with Asthma responses. The survey was deployed between November 2020 and February 2021 as cases were surging in the United States, and internationally, over 70% of the US population were wearing masks before the widespread availability of COVID-19 vaccines.<sup>12,13</sup> We received 505 (71%) total responses with 501 completed surveys. Surveys took an average of 6 minutes to complete. The study was approved by the Institutional Review Board at the University of Kansas Medical Center.

**Measures**

The Face Mask Use in Adults with Asthma survey included 45 items. Participants were asked if they typically used a mask/face covering in public indoor spaces, the likelihood of wearing a mask during their next grocery/restaurant visit, and their comfort level with employees and patrons wearing a mask in these settings.<sup>5</sup> Participants were queried about the number of hours per day they wore a mask, the type of mask worn,<sup>7,14</sup> and if they carried an inhaler when wearing a mask. The survey included 9 pictures of ways people wear a mask,<sup>3</sup> and participants were asked to identify the picture(s) that illustrated how they usually wore their mask. Two of the pictures illustrated proper mask wearing. Employed participants reported if wearing a mask while working is required and number of hours a mask was typically worn

**TABLE 1.** Demographic characteristics of survey respondents (N = 501)

Characteristics	n (%)
<b>Sex</b>	
Male	76 (15.3)
Female	415 (83.3)
Other	4 (0.8)
Prefer not to answer	3 (0.6)
<b>Race (check all that apply)</b>	
Arab	1 (0.2)
Asian	27 (5.4)
American Indian/Alaskan Native	11 (2.2)
Black/African American	26 (5.2)
Native Hawaiian/Pacific Islander	2 (0.4)
White	447 (89.2)
Other race	4 (0.8)
Multiple races	10 (2.0)
Hispanic/Latinx descent	28 (5.6)
US resident	483 (96.6)
<b>Geographic area</b>	
Large city	113 (22.6)
Suburb	187 (37.3)
Small city/town	141 (28.2)
Rural	60 (12.0)
<b>Own/rent home</b>	
Own home	276 (55.1)
Rent/live with family/friends/other	225 (44.9)
<b>Education</b>	
High school/GED/or less than HS	53 (10.6)
Some college/2-year degree	80 (16.0)
4-year college degree	102 (20.4)
Some education beyond college	46 (9.2)
Graduate/professional degree	220 (43.9)
<b>COVID-19</b>	
Confirmed/suspected COVID-19 positive	58 (11.6)
Confirmed negative/no COVID-19 symptoms	442 (88.4)
<b>Asthma Control Test</b>	
Well-controlled asthma (ACT ≥20)	332 (66.5)
Not well-controlled asthma (ACT 16-19)	90 (18.0)
Uncontrolled asthma (ACT ≤15)	77 (15.4)
Age (y), M (SD)	46 (15.2)
Body mass index, M (SD)	29.9 (7.8)

ACT, Asthma Control Test; GED, General Educational Development; HS, high school; M, mean; SD, standard deviation.

while working. Participants then responded to 17 Likert-type items (1 = none of the time, 5 = all of the time) addressing potential effects experienced (eg, discomfort, wheezing, and anxiety) while wearing a mask.<sup>9,15</sup> Responses to these 17 items were summed for a Mask Effects Scale (MES) with scores ranging from 17 to 85 with higher scores indicating a more negative experience of mask use. Cronbach's alpha for the MES was 0.88. Additional items of the survey included COVID-19 diagnosis, the 5-item Asthma Control Test (ACT),<sup>16,17</sup> and 3 open-ended questions probing factors considered when choosing a mask, experiences wearing a mask, and recommendations to others with asthma regarding masks.

**TABLE II.** Use of masks by adults with asthma during the COVID-19 pandemic (N = 501)

Variable	n (%)
The last time you went out in public to an indoor shopping space, did you:	
Wear face mask	493 (98.4)
Feel more comfortable when you saw employees wearing masks?	441 (88.0)
Feel more comfortable when you saw other shoppers wearing masks?	447 (89.2)
The next time you plan to go to a grocery store (N = 488), how likely to wear a mask?	
Extremely likely	468 (95.9)
Likely	14 (2.9)
Unlikely/extremely unlikely	6 (1.2)
The next time you plan to go to a restaurant (N = 345), how likely to wear a mask?	
Extremely likely	321 (93.0)
Likely	12 (3.5)
Unlikely/extremely unlikely	12 (3.5)
On typical day, how long do you wear your mask? (N = 493 participants who indicated wearing a mask in public places/gatherings)	
0 h	14 (2.9)
≤1 h	218 (44.5)
2-3 h	98 (20.0)
4-5 h	47 (9.6)
6-7 h	30 (6.1)
≥8 h	84 (16.9)
Type of mask usually worn (check all that apply)	
Cloth mask with 2 or more layers	328 (66.5)
Surgical/procedural mask	219 (44.4)
Cloth mask with 1 layer	115 (23.3)
N95-type mask	63 (12.8)
Bandana/neck fleece/gaiter	17 (3.4)
Correctly identified pictures demonstrating a proper way to wear a mask	449 (91.1)
If use inhaler (N = 480), do you carry it when wearing a mask?	
None of the time	103 (21.5)
A little/some of the time	114 (23.8)
Most/all of the time	263 (54.8)
If employed (N = 348), are you required to wear a mask at work? (yes = 195)	
Hours/day mask typically worn during work hours	
≤1 h	18 (9.2)
2-3 h	26 (13.3)
4-5 h	30 (15.4)
6-7 h	30 (15.4)
8 h	54 (27.7)
≥9 h	37 (19.0)
When wearing a face mask, have you experienced:	
Trouble breathing/shortness of breath	

(continued)

**TABLE II.** (Continued)

Variable	n (%)
None of the time	123 (24.6)
At least a little of the time	376 (75.4)
Wheezing	
None of the time	336 (67.7)
At least a little of the time	160 (32.3)
Itchy/runny/stuffy nose	
None of the time	111 (22.2)
At least a little of the time	389 (77.8)
Itchy/watery eyes	
None of the time	354 (70.9)
At least a little of the time	145 (29.1)

### Data analysis

Quantitative data were downloaded from REDCap into an SPSS, Version 27 (IBM SPSS Statistics for Windows, Version 27, Armonk, NY) file for analysis. Demographic data from the original survey were merged by each participant's GCAS survey identifier. Descriptive analyses examined the extent of mask use and assessed the frequency of problems experienced when wearing a mask. We also conducted Pearson correlation analysis and multiple regression to determine participant characteristics associated with higher MES scores. Responses to the 3 open-ended survey items were downloaded from REDCap and uploaded into Dedoose qualitative software for content analysis.<sup>18</sup> Themes were generated for each of the 3 survey items. Each response was coded by 1 of 2 coders. A third coder reviewed all results, and discrepancies were discussed until 100% agreement was reached.

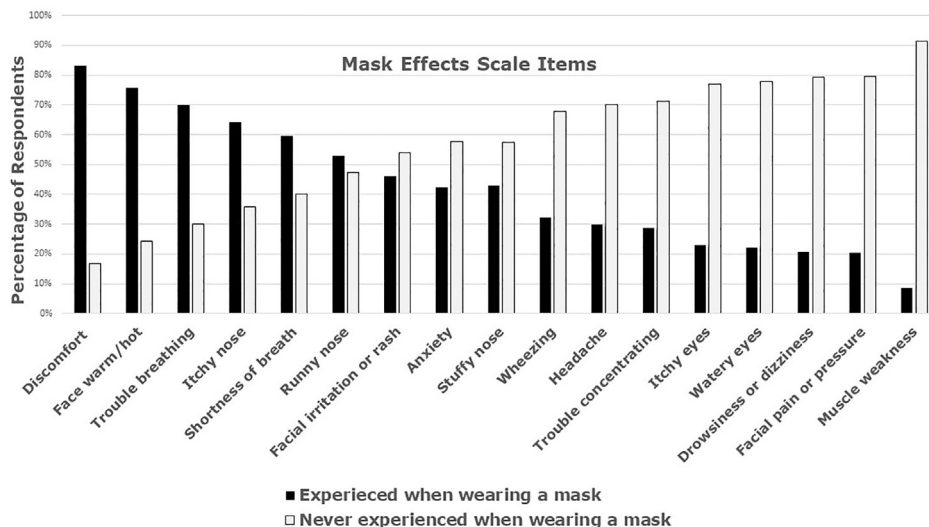
### RESULTS

Participants (N = 501) were primarily female, White, college educated, US residents, lived in urban/suburban areas, owned their home, and had well-controlled asthma (mean ACT score = 20.1 ± 4.2) (Table I). US participants (n = 483) were from 39 states and Washington DC, with most from Kentucky (12.8%), Ohio (9.7%), Illinois (9.3%), Kansas (5.6%), New York (5.2%), California (4.5%), Missouri (3.9%), Tennessee (3.7%), Minnesota (3.5%), Maryland (3.1%), and Florida (2.9%). Approximately 4% of participants were international, including India (n = 10), Canada (n = 3), United Kingdom (n = 2), Guam (n = 1), and Kosovo (n = 1). Participants ranged in age from 20 to 88 years (M = 46.1 ± 15.2) with most (56%) having a BMI of <30. Most participants reported no history of COVID-19 symptoms or had a confirmed negative COVID-19 test (88.4%).

### Mask use

Almost all participants indicated that they wore a mask in public spaces (98.4%) and were more comfortable when store employees and patrons wore a mask (88.0% and 89.2%, respectively) (Table II). Most participants planning to go to a grocery store or to a restaurant indicated that they were extremely likely to wear a mask (95.9% and 93.0%, respectively). For those indicating that they typically wear a mask when in a public place or gathering (N = 497), approximately 67.4% indicated wearing a mask ≤3 hours per day.

The most common types of masks worn were cloth masks with at least 2 layers (65.5%) and surgical/procedural masks



**FIGURE 1.** Mask Effects Scale items. Bars represent percentage of respondents (N = 501) indicating symptoms experienced/not experienced when wearing a mask

(44.4%). Although most participants (91.1%) correctly identified at least 1 of the 2 pictures depicting the proper way to wear a mask, 4.8% selected the picture depicting a mask worn below the nose, and 3.4% chose the picture with the mask below the chin.

Over half of the participants (54.8%) who indicated that they used an inhaler reported carrying one most/all of the time when wearing a mask. For those required to wear a mask during work hours (N = 195), almost half (46.7%) wore it for at least 8 hours per day. Approximately half (49.1%) of the participants who wore glasses (N = 389) indicated that their glasses fogged up most/all of the time.

### Factors associated with the MES score

Descriptive analysis of the MES items revealed that participants experienced discomfort (83.5%), warm/hot face (76.1%), trouble breathing (70.5%), itchy nose (64.7%), shortness of breath (59.8%), runny nose (52.9%), facial irritation/rash (46.6%), anxiety (42.5%), stuffy nose (42.4%), wheezing (32.3%), headache (30.3%), trouble concentrating (29.8%), itchy eyes (23.2%), watery eyes (22.1%), drowsiness/dizziness (21.3%), or facial pain (20.9%) when wearing a mask (Figure 1). Most participants (75.4%) indicated that they had trouble breathing or shortness of breath at least a little of the time when wearing a mask (Table II). Similarly, most participants (77.8%) had either an itchy, runny, or stuffy nose at least a little of the time. In contrast, most participants indicated that they never had itchy or watery eyes (70.9%) or muscle weakness (91.2%) when mask wearing.

MES scores ranged from 17 to 85 (mean = 28.6 ± 8.8). Variables found to be significantly associated with MES scores on bivariate correlational analysis included the ACT score, hours mask worn per day, BMI, and level of education (Table III). Participants with higher MES scores had significantly lower ACT scores ( $P < .001$ ), wore a mask longer ( $P = .005$ ), had a higher BMI ( $P = .009$ ), and had lower levels of education ( $P < .001$ ). No relationship was found between MES scores and age ( $P = .305$ ). Multiple regression analysis revealed that only ACT and

**TABLE III.** Pearson correlation coefficients depicting associations between mask effect scale (MES) scores and participant characteristics (N = 501)

Variable	Pearson correlation coefficient	95% confidence interval	P
MES score	1.00		
Asthma Control Test	-0.430	-0.499, -0.355	<.001
Mask use on a typical day (h)	0.127	0.039, 0.212	.005
Body mass index	0.118	0.030, 0.203	.009
Education	-0.156	-0.241, -0.070	<.001
Age (y)	-0.046	-0.133, 0.042	.305

Note: Education: 1 = some grade school, 2 = some high school, 3 = high school diploma/General Educational Development, 4 = some college/2-year degree; 5 = 4-year college graduate; 6 = some school beyond college; 7 = graduate/professional degree.

hours mask worn per day significantly predicted the MES score ( $R^2 = 0.19$ ,  $F = 22.6$ ,  $P < .001$ ).

### Participant experiences wearing a mask and recommendations to others

There were 439 (87.5%) participants who answered at least 1 of the 3 open-ended survey questions. The themes, percent of participants who addressed each theme, and exemplary quotes are noted in Table IV. Most participants who responded to the open-ended items addressed factors to consider when choosing a mask. The comfort/fit of the mask was the most reported factor (67.3%) followed by effectiveness (38.1%) and protection of the mask for themselves as well as for others (22.7%). Fewer than 10% of the participants addressed the ability to clean the mask or cost as factors when choosing a mask.

When asked to comment about their experiences wearing a mask, almost half (45.8%) indicated that they had problems breathing/increased coughing when wearing a mask. However,

**TABLE IV.** Themes and exemplar quotes for open-ended items addressing mask wearing experiences by adults with asthma and recommendations

Themes by open-ended question (% addressing each theme)	Exemplar quotes
<b>1. Factors you consider when choosing a mask for yourself (N = 428 respondents)</b>	
Comfort/fit of mask (67.3%)	<ul style="list-style-type: none"> <li>• <i>If it completely covers my nose and is able to pinch at my nose to ensure a snug and appropriate fit, and also if it reaches well beyond my chin, if the ear loops are comfortable as I do get irritation behind the ears, the thickness/layers, softness</i></li> <li>• <i>Material that isn't itchy, which is a safety issue as much as a comfort issue because with eczema it's super hard for me to not touch to my face to scratch</i></li> </ul>
Effectiveness of masks in preventing COVID-19 (38.1%)	<ul style="list-style-type: none"> <li>• <i>I try to purchase masks that have a filter, also 3 layers and bacteriostatic material</i></li> <li>• <i>Of a quality to reduce particles in or out</i></li> </ul>
Protection from COVID-19 for self/others (22.7%)	<ul style="list-style-type: none"> <li>• <i>I need to protect myself from others and others from me</i></li> <li>• <i>It protects my lungs and it protects others also</i></li> </ul>
Mask appearance (11.4%)	<ul style="list-style-type: none"> <li>• <i>Is the fabric pretty</i></li> <li>• <i>Attractive, design on mask</i></li> </ul>
Availability/access to masks (11.4%)	<ul style="list-style-type: none"> <li>• <i>Fortunately my employer provides us with masks</i></li> <li>• <i>Whatever I can get a hold of</i></li> </ul>
Ability to clean masks (9.1%)	<ul style="list-style-type: none"> <li>• <i>My choice of a cloth mask was to be able to wash and reuse</i></li> <li>• <i>Ability to clean relatively easy by hand or disposable</i></li> </ul>
Cost (7.2%)	<ul style="list-style-type: none"> <li>• <i>Something that will work but not cost a lot</i></li> <li>• <i>I choose the cheapest</i></li> </ul>
<b>2. Your experiences wearing a mask (N = 428 respondents)</b>	
Difficulty breathing/increased coughing (45.8%)	<ul style="list-style-type: none"> <li>• <i>It is very difficult to breathe in a mask, but I would not think of going without it</i></li> <li>• <i>Sometimes I have to cough when I put on the mask. People look at me. I bet they suspect I have COVID-19, I try to suppress the cough but that makes it worse</i></li> </ul>
No change in asthma/asthma symptoms (39.0%)	<ul style="list-style-type: none"> <li>• <i>I have zero problems wearing a mask due to my asthma</i></li> <li>• <i>No difference in asthma with or without a mask</i></li> </ul>
Miscellaneous effects (eg, itching, watery eyes, fogging glasses, warm/hot face) (23.8%)	<ul style="list-style-type: none"> <li>• <i>I am hearing impaired. This is my hardest issue with wearing a mask. I cannot read lips if I'm speaking with someone</i></li> <li>• <i>Foggy glasses</i></li> </ul>
Don't like to wear a mask, but wear it anyway (11.0%)	<ul style="list-style-type: none"> <li>• <i>It's been difficult at times, but it's necessary</i></li> <li>• <i>It can be tough to breathe, but I don't mind so much because I know it's what's best for everyone</i></li> </ul>
Protection from COVID-19 for self/others (7.9%)	<ul style="list-style-type: none"> <li>• <i>I feel much safer, and I want everyone to wear them around me</i></li> <li>• <i>I always wear my mask over nose and mouth. This is to protect me and those around me</i></li> </ul>
Anxiety (7.2%)	<ul style="list-style-type: none"> <li>• <i>I find it hard to breathe at times and get very anxious</i></li> <li>• <i>Causes anxiety as well as makes me cough more than normal</i></li> </ul>
Don't always wear a mask (5.4%)	<ul style="list-style-type: none"> <li>• <i>Refuse to wear one</i></li> <li>• <i>I don't wear a mask when I'm outside</i></li> </ul>
Avoid others when out (4.4%)	<ul style="list-style-type: none"> <li>• <i>I distance myself if others are not wearing them</i></li> <li>• <i>I often avoid going to places or visiting with family so that I don't have to wear a mask</i></li> </ul>
Improved asthma/asthma symptoms (2.3%)	<ul style="list-style-type: none"> <li>• <i>Sometimes, I think wearing a mask makes me breathe better, because I feel safer from pollen and the other debris that fly in the air when it's windy. The warmth also helps on cold days</i></li> <li>• <i>I breathe easier without all the dust particles and chemical irritants when I go out</i></li> </ul>
<b>3. Recommendations about wearing a mask for others with asthma (N = 396 respondents)</b>	
Just wear a mask (33.1%)	<ul style="list-style-type: none"> <li>• <i>Just wear it!</i></li> <li>• <i>Just do it!</i></li> <li>• <i>Wear a mask!</i></li> </ul>
Comfort/fit of mask (31.6%)	<ul style="list-style-type: none"> <li>• <i>Keep trying to find a mask that you feel comfortable in. If you are comfortable, you will be more likely to wear it and keep it in place correctly</i></li> <li>• <i>Wear cotton masks as they are lightweight and more moisture-wicking than synthetic material, which includes surgical masks</i></li> <li>• <i>Surgical masks feel better than cloth masks, easier to breathe</i></li> <li>• <i>Get a mask that loops lightly around the ears but has an additional tie for more security</i></li> <li>• <i>Pinch the nose piece for a tighter fit. It takes a little practice to get used to</i></li> <li>• <i>Get one that does not suck in as you breathe</i></li> </ul>
Protection from COVID-19 for self/others (18.7%)	<ul style="list-style-type: none"> <li>• <i>Being at higher risk of serious side effects with COVID, it seems senseless not to protect oneself and others</i></li> <li>• <i>Wear the most protective mask you can find in any situation where you could be encountering people you don't know or people who may be infected with COVID</i></li> <li>• <i>Wear one that covers nose and mouth</i></li> </ul>

(continued)



**TABLE IV.** (Continued)

Themes by open-ended question (% addressing each theme)	Exemplar quotes
Ways to tolerate a mask: take break, breathing techniques, relax (16.4%)	<ul style="list-style-type: none"> <li>• <i>Stay calm, breathe deep, and take frequent breaks in circumstances where you can take your mask off for a few minutes</i></li> <li>• <i>Slow your pace and focus on your breathing. In through the nose and out through the mouth with nice, big, slow, deep breaths</i></li> <li>• <i>Try to be in control and calm</i></li> <li>• <i>Make appropriate ADA accommodations with your employer for scheduled mask-off breaks</i></li> <li>• <i>Try breathing slowly through your nose as opposed through your mouth</i></li> </ul>
Asthma control/asthma medications (10.6%)	<ul style="list-style-type: none"> <li>• <i>Always have inhaler nearby just in case!</i></li> <li>• <i>Stay on top of your meds</i></li> <li>• <i>Use a pulse oximeter to show yourself that you are getting enough oxygen when you wear it</i></li> </ul>
Miscellaneous recommendations (10.1%)	<ul style="list-style-type: none"> <li>• <i>Practice wearing it around the house</i></li> <li>• <i>Use ear savers if it hurts your ears</i></li> <li>• <i>Educate yourself on the science behind mask effectiveness—it is highly motivating!</i></li> <li>• <i>Have several masks handy so you can quickly and easily swap to a fresh one if your mask becomes damp or soiled</i></li> <li>• <i>Apologize to others around you if you have to cough and verbalize you have asthma, so they don't go running away from you</i></li> <li>• <i>Make sure the mask is room temperature, especially if cold triggers your asthma</i></li> <li>• <i>Have them in your car and/or purse, so they are always accessible</i></li> <li>• <i>Use hand sanitizer before touching your mask so it won't become infected</i></li> </ul>
Social distance/limiting exposure/stay at home (8.1%)	<ul style="list-style-type: none"> <li>• <i>If you can't wear a mask safely or you find it too uncomfortable, stay home so you don't increase the risk for yourself and others; and staying away from people, distancing by at least 6 ft or more.</i></li> <li>• <i>Stay home as much as possible</i></li> <li>• <i>Have a plan written out before you go into place you have to wear a mask. It will cut the time in half that you have to wear a mask</i></li> <li>• <i>Use online ordering and drive through or curbside pickup as much as possible</i></li> </ul>
Care of masks (3.8%)	<ul style="list-style-type: none"> <li>• <i>Wash masks in hypoallergenic soap</i></li> <li>• <i>Change masks with every wearing</i></li> <li>• <i>Make sure you have enough reusable masks to have clean ones available while others are being cleaned</i></li> <li>• <i>Put it somewhere where dust and pet fur won't get on it when not in use. I put mine in a zip bag</i></li> </ul>
Don't recommend a mask (2.3%)	<ul style="list-style-type: none"> <li>• <i>Don't wear one</i></li> </ul>

ADA, Americans with Disability Act.

39.0% of the participants commented that they had no change in their asthma or asthma symptoms when wearing a mask. Approximately one-quarter (23.8%) of respondents to this item noted a variety of experiences when wearing a mask including facial itching, watery eyes, foggy glasses, dizziness, general discomfort, headaches, ear irritation, and sweatiness/facial warmth. Comments from other respondents concerning experiences wearing a mask included not liking a mask but wearing it anyway (11.0%), being anxious when wearing a mask (7.2%), and avoiding others when out (4.4%). Of note, approximately 5% of respondents indicated that they do not always wear a mask, whereas 2.3% indicated that they had improved asthma/asthma symptoms when wearing a mask. Participants attributed their improved symptoms primarily to protection against pollen/pollutants that triggered their asthma.

There were a variety of recommendations to others with asthma regarding wearing a mask. One-third of the participants advocated “Just wear it.” Another common recommendation was to assure that the mask was comfortable and fit properly (31.6%). Participants suggested trying different masks until one was found that fit well and did not impede breathing. Other suggestions addressed finding an unoccupied area to safely take a break from wearing a mask, taking slow deep breaths, relaxing, having an inhaler available, maintaining social distancing, and

limiting exposure to others primarily by staying at home. Washing a mask using hypoallergenic soap was also recommended, along with acclimating to a mask at home and using “ear savers” that hook onto the mask ear loops to reduce discomfort. Finally, approximately 2% of participants did not recommend wearing a mask.

## DISCUSSION

To our knowledge, this is the only mixed-methods study to date that examines mask use among adults with asthma during the era of COVID-19. Our findings revealed that almost all adults with asthma surveyed wore a mask in public spaces and most wore masks for  $\leq 3$  hours/day (67.6%). We also found that wearing a mask was associated with an increased number of self-reported problematic effects/symptoms, with a small but significant association found in those with a higher BMI and lower educational level. Similar to other studies, the most commonly used masks reported in our study were cloth, surgical, and then N95 masks.<sup>7,8</sup> Few participants mentioned the use of mask filters so this was not included in our analysis. Interestingly, adults with uncontrolled asthma reported having more discomfort and asthma-like symptoms when wearing a mask. Our study goal was not to examine the mechanisms of symptoms associated with mask wearing, but a

potential mechanism may be related to the degree of airway obstruction and not oxygen saturation levels.<sup>19</sup> Kyung et al<sup>20</sup> assessed the tolerance of N95 masks in a severe chronic obstructive pulmonary disease population and found that those who had difficulty tolerating N95 masks had forced expiratory volume in 1 second <30% predicted or elevated dyspnea score (Medical Research Council dyspnea scale scores  $\geq 3$ ) at baseline. Tolerance to surgical or cloth masks was not assessed in that study. Additional analysis of our data showed that participants reporting the use of only a cloth mask with at least 2 layers had significantly lower MES scores indicating fewer problems, compared with participants who only wore another mask type ( $M = 26.5 \pm 6$  vs  $M = 30.3 \pm 11$ , respectively,  $P < .001$ ). In contrast, participants only using a cloth mask with 1 layer reported significantly higher MES scores compared with those only using another mask type ( $M = 30.7 \pm 9$  vs  $M = 27.6 \pm 9$ , respectively,  $P = .02$ ), indicating that they had more problems. We found no other significant differences in MES scores for those only using an N95 type of mask ( $P = .55$ ), those using only a surgical mask ( $P = .52$ ), or those using only a bandana type of mask ( $P = .82$ ). We also found no differences in MES scores based on wearing/not wearing glasses ( $P = .127$ ). In attempting to understand why those using masks with only 1 layer had lower MES scores we found that these participants had significantly lower ACT scores compared with other participants ( $M = 18.0 \pm 4.7$  vs  $20.1 \pm 4.3$ , respectively,  $P = .001$ ). This finding suggests that those with uncontrolled asthma may select a mask with 1 layer with the thought that it might be easier to breathe with a thinner mask. Additional studies examining the variables in the MES, type of mask used, and the mechanisms of mask intolerance in adults with asthma are needed to better understand these relationships.

The qualitative feedback we obtained provided additional context to our quantitative findings. We found that most adults with asthma indicated that mask use was important for their safety and the safety of others. Although several studies have shown no increased risk of severe COVID-19 among adults with asthma, the perceived risk of getting severe COVID-19 is high in this population. A recent cross-sectional survey among adults in France found that a history of asthma increased the odds of perceived risk of getting severe COVID-19 (odds ratio: 4.64, 95% confidence interval: 2.22-9.68).<sup>21</sup> The increased perceived risk in adults with asthma may be due to the known association of respiratory viruses (eg, rhinovirus and respiratory syncytial virus) and asthma exacerbations.<sup>22</sup>

Our study demonstrated that mask use was associated with several symptoms, which is consistent with other studies in nonasthma populations.<sup>6,9</sup> A small number of survey respondents ( $n = 10$ ) indicated that their asthma symptoms improved when wearing a mask. This may have been due to reduced exposure to aeroallergens and air pollution. A recent study among nurses with allergic rhinitis found improvements in rhinitis symptoms with mask use.<sup>23</sup> Research is needed to objectively determine the physiologic impacts of mask use in those with asthma.

Recommendations from participants for wearing masks varied from “Just wear it” to suggestions for mask breaks, maintaining social distancing precautions, and use of prescribed asthma medications. This is consistent with public health messaging from asthma organizations such as the Asthma, Allergy Foundation of America; American Academy of Allergy, Asthma and Immunology; and the American College of Allergy, Asthma and

Immunology. Our findings provide evidence that these strategies are an effective way to tolerate wearing a mask in people living with asthma.

This study had several limitations including the inability to determine differences by respondent asthma phenotypes or by lung function. Second, the MES is not a validated tool and no cutpoint has been established to differentiate between high and low problems when wearing a mask. Third, our respondents were primarily female, well educated, and White—thus, limiting generalizability. A strength of our study was the mixed-methods approach that provided qualitative data that enabled further understanding of the experiences of wearing a mask for adults with asthma. In addition, participants provided reasonable recommendations to improve the ability and experiences of those with asthma to tolerate wearing a mask.

In conclusion, wearing a mask in public places was almost uniformly adhered to by survey participants, despite reporting several problematic effects. Efforts are needed to assure that the knowledge and means to secure the most effective and comfortable masks are available to adults with asthma. The recommendations proposed by participants can be incorporated by clinicians as they educate their patients about masks, specifically targeting those with lower ACT scores, higher BMI, and/or lower educational background. Additional recommendations target employers who can provide safe spaces for those with asthma to take “mask breaks,” and others to facilitate and enhance the experience of wearing a mask.

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