Who is wearing a mask? Gender-, age-, and location-related differences during the COVID-19 pandemic

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Abstract

Masks are an effective tool in combatting the spread of COVID-19 but wearing them remains controversial and has not been studied in the United States. To understand the demographics of mask wearers in the US, we observed shoppers (*n* = 5517) entering retail stores. 41.5% of the observed sample wore a mask. The odds of an individual wearing a mask increased significantly with age, and was also 1.5x greater for females than males. Additionally, the odds of observing a mask on an urban or suburban shopper were ~4x that for rural areas. Thus, gender, age, and location factor into whether American shoppers wear a mask or face covering. Regardless, all demographics wore masks at substantially lesser rates than required to stop the spread of COVID-19.

Introduction

Wearing a mask in public is currently a controversial and politicized issue in the United States, even with case evidence from other countries that face coverings help to control the spread of coronavirus disease 2019 (COVID-19) [1]. As Taiwan, Hong Kong, South Korea, and other countries with almost universal masking have been some of the most successful at reducing daily case and death rates [2,3], the United States is trending in the other direction, setting national and state records for daily new cases of COVID-19 at the end of June 2020. Despite the controversy, COVID-19 is a virus that can be transmitted through respiratory droplets from infected individuals and even asymptomatic cases can be contagious [4]. Thus, without a vaccine in distribution, masks are one of the few control measures available for protection against the virus because they serve as a physical barrier between people [5,6]. Not only do masks protect the wearer from aerosolized droplets, but they also provide source control, stopping large droplets coming from a wearer before they become airborne. Study of the filtration efficiency of different fabrics has shown that even cotton weaves and blends can block viral transmission [7], so masks can be made virtually cost-free with household materials.

Though the evidence of the efficacy and cost-effectiveness of masks is clear, store policies and public mandates requiring masks in America have been met with protests [8] and, in rare cases, violence [9,10]. Public health research shows these measures may already have reduced cases in the United States by 450,000 through May 22nd [11], but the messaging from government officials has been inconsistent [12] and polling suggests that a sizeable portion of the general population are still going out in public without masks [13,14]. Learning what demographic groups are wearing masks will help officials to better target public health messaging that promotes the intervention among groups with lower usage, and self-reported behavior is not always reliable. To facilitate greater understanding and reliable data on whether gender, age,

and location influence mask wearing in the United States, we conducted a direct observational study at retail stores in southeastern Wisconsin.

Thus, the aim of our study was to determine mask use by gender expression, estimated age, and location. We hypothesized that mask use among females would be greater than males across all age groups and locations. Additionally, that mask use would be greater among older adults (>65 years old) than middle-age (30-65 years old) and young individuals (2-30 years old) and would be less in rural than in urban or suburban areas.

Materials and Methods

We answered our research question by visiting 36 different retail locations across five different counties in southeastern Wisconsin. Multiple logistic regression analysis was performed to determine the impact of gender, age, location, and their interactions on mask wearing.

Retail stores selected for observation were based largely on geographical convenience to researchers but spread across Milwaukee and the surrounding area was also considered. In the interest of exploring mask wearing among urban, suburban, and rural stores, we designated a center point of the city (345 W St. Paul Ave, Milwaukee, WI, USA) and recorded the linear distance of each store to the city center. Based on distance, stores were then placed into urban (<6.1 km from city center; n = 15, 3.3 ± 1.8 km to city center), suburban (11.5-32.1 km; n = 12, 20.5 ± 7.2 km), and rural (>36.9 km; n = 9, 55.8 ± 21.4 km) store groups. Visits to stores (n = 36) occurred at various times between 9am and 8pm (June 3rd-9th, 2020) and typically lasted less than an hour, with observers recording data with writing utensil and paper or mobile device. Stores consisted of grocery and other large big-box retail stores and shoppers were not aware they were being observed. Children under the estimated age of two were not recorded. Additionally, 60 individuals who were wearing their mask or face covering improperly (not over nose and mouth) were recorded but excluded from further analysis as they could not be

grouped into a dichotomous outcome (mask/no mask). 5517 observations remained, and data summary sheets were crosschecked by other observers prior to analyzing differences in the odds of wearing a mask between gender and across age and location. All procedures involved public observation or accessed public information and did not require review by an Institutional Review Board.

Mask wearing was treated as a binary dependent variable in this study, so a multiple logistic regression analysis was used to evaluate adjusted odds ratios of wearing a mask in different sample subgroups. Gender expression, age, and location independent variables were dummy coded and entered into a backward elimination procedure with their associated interactions (gender-age, gender-location, age-location, and gender-age-location). Limit for variable removal and test classification cutoff were set at 0.025 and 0.5, respectively. Adjusted odds ratios (aOR) are expressed with respect to reference groups (gender: male, age: young, location: rural) with 95% confidence intervals and significance was determined at $p < 0.05$. All analyses were performed with IBM Statistical Package for Social Sciences version 26 (IBM, Armonk, NY, USA).

Results and Discussion

Of the 5517 individuals we observed (Fig 1), 41.5% were wearing a mask or face covering with the general trend across gender, age, and location largely aligning with our original hypotheses (Table 1). Females wore masks 7.6% more than males (Fig 2A). Additionally, masks were seen at a higher percentage in older than middle-age (+16.1%) and young (+19.8%) individuals (Fig 2B). Urban and suburban mask wearing was similar but was much lower at rural stores (Suburban: -28.7%; Urban: -26.4%; 55.81 ± 21.37 km) (Fig 2C).

Regression analysis revealed that gender, age, and location all significantly impact the odds of an individual being observed to wear a mask ($p < 0.001$; Fig 3). Results indicate the odds of a

female wearing a mask are significantly greater than males (aOR = 1.470, 95% CI = 1.313-1.646). Odds are also greater for middle age (aOR = 1.597, 95% CI = 1.359-1.877) and older adults (aOR = 3.434, 95% CI = 2.811-4.195) than younger individuals. The odds of observing someone in urban (aOR = 3.847, 95% CI = 3.157-4.689) or suburban (aOR = 4.124, 95% CI = 3.418-4.975) areas wearing a mask is also much higher than in rural locations, reflecting the much lower prevalence of masks seen at rural stores. The significant age-location interaction effect ($p < 0.001$) is largely driven by differential changes in mask-wearing behavior between older adults and the other age groups (Fig 2D).

Though no peer reviewed, and direct, observational studies of mask wearing are available for comparison, our data can be discussed in relation to national polls and surveys that address mask wearing. A recent survey of adults in Wisconsin and four other surrounding states indicated 45.1% always wear a mask when they leave home [13], and data in our study lends credibility to this number. Notably, other regions of the United States surveyed reported different habits (33.5-64% mask usage) so direct observational studies in other parts of the country would be beneficial to confirm national variability. Another poll conducted in mid-April indicated that only 36% of adults always wear a mask or face covering when outside the home [14], so perhaps usage nation-wide is gradually improving. Women also reported wearing a mask more often than men. So why are men wearing masks in public places less than women? Perhaps masks are viewed as a sign of fragility or weakness among some men in the USA, as suggested in previous preprint work [15]. Public health messaging that focuses on aligning masks with masculinity would likely be beneficial to improve usage among males in the United States.

It is not surprising that our data show older individuals wear masks more than middle-age and young people because older adults are at higher risk for more severe cases of COVID-19. However, the low percentage of young individuals wearing a mask combined with their potential

to be asymptomatic [16] creates problems for case containment. A key and underreported benefit of masks is source control, so mask wearing is important across all age groups. Lower-risk individuals put older adults and those with preexisting conditions of all ages at risk of severe illness by not wearing a mask due to the potential for asymptomatic viral transmission.

One of the most interesting findings of the current study is the evidence of drastically different mask-wearing behavior in rural areas compared with urban and suburban shoppers. The odds of urban and suburban shoppers wearing a mask is about 4x greater than for rural store-goers, possibly reflecting the fact that individuals shopping in rural areas perceive lower risk. However, it has been previously reported that mask-wearing habits do not appreciably differ between counties with low and high numbers of COVID-related deaths [14]. Further, while living population density may be lower in rural regions, the size of retail stores is relatively uniform. Thus, differences in the density of shoppers in stores across regions is likely far less than the actual population density differences reflect. Understanding why rural shoppers are wearing masks less across all age groups is an important issue because the health care system in these areas of the United States may be less equipped to handle large spikes in cases. Rural residents may also need to travel further for emergency care, putting them at greater risk for severe consequences of infection. For these reasons, public health messaging that promotes masks in rural communities is very important.

Conclusions

Masks are an essential public health intervention for combatting the pandemic, and averting cases of COVID-19 will save lives. To that end, masks should not symbolize frailty or fragility of the individual, but a public health service. Wearing a mask is not about stopping transmission of all cases but minimizing case rates and lessening the public health burden. Importantly, the long-term effects of COVID-19 are still unknown so mask wearing is also vital to reduce burden

from future comorbidities that may result within individuals who were infected. Modeling studies suggest mask usage needs to be to nearly universal (>80%) to have a significant effect on the epidemiological curve [17,18]. Based on our data, we conclude that public health messaging and mask designers may benefit from marketing to males, younger individuals, and rural communities as these populations tend to wear masks less. Less than 50% of individuals observed in our sample were wearing a mask, however, indicating stronger messaging that advocates mask wearing is desperately needed across all demographic groups. As officials around the United States work to take control of the COVID-19 pandemic by putting mask mandates in place at local and state levels, information that about half of population needed to control the virus are currently wearing masks serves as useful baseline knowledge and confirms that major improvements can be made. Individuals may also consider this information in conjunction with store policies to evaluate the potential risks of in-person shopping based on location and the age and gender of the store's clientele.

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Fig 1. **Mask-wearing percentages by Wisconsin county**. Data shown indicates the number of observations collected (percentage of people wearing a mask) in each county where retail stores were visited. ★: City center location used for identifying urban, suburban, and rural stores.

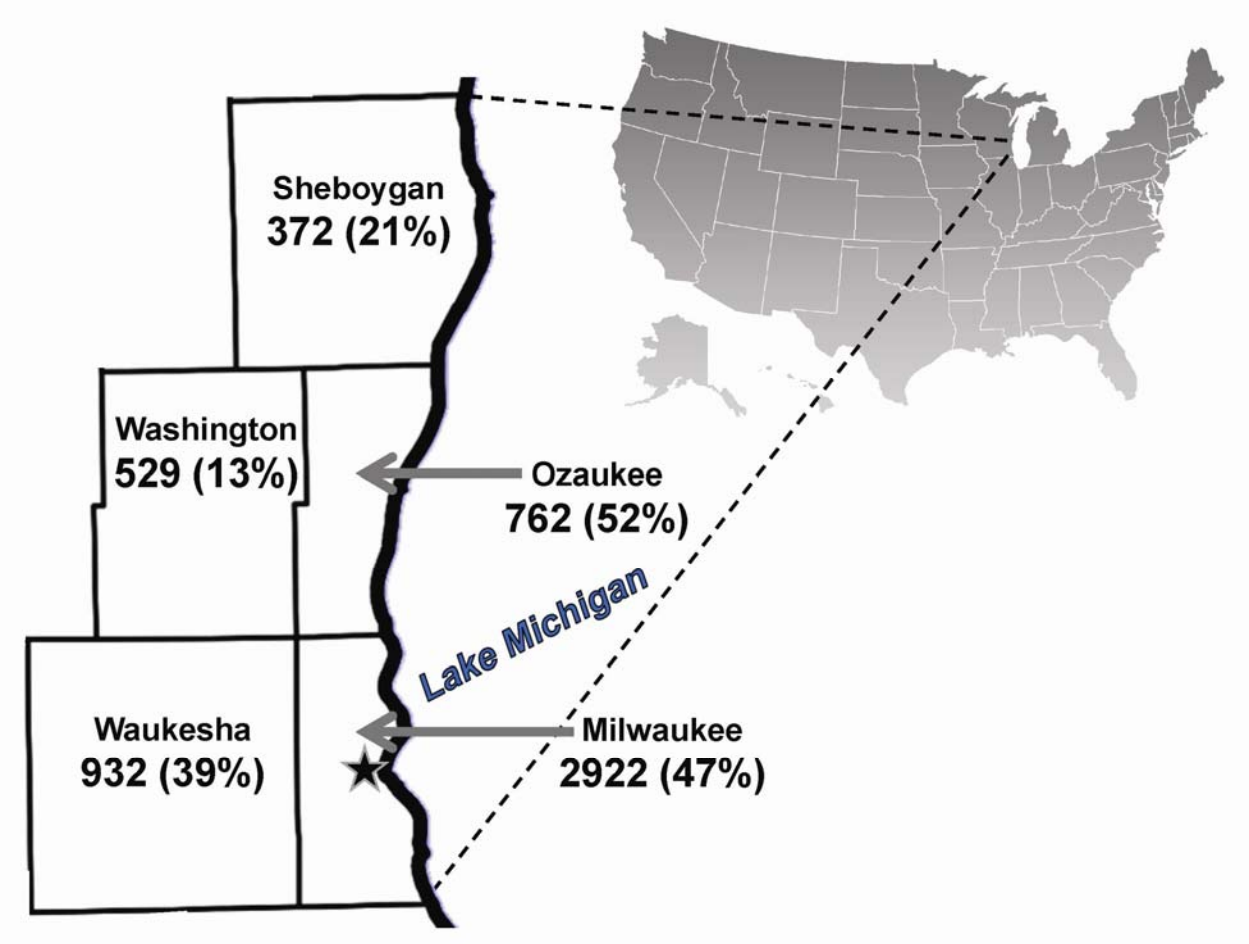


Fig 2. **Mask-wearing percentages across gender, age, and location**. **A**. Females wear masks more than males. **B**. Older adults wear masks more than other individuals. **C**. Mask-wearing habits are similar in urban and suburban areas, but usage drops off considerably at rural stores. **D**. Mask wearing plotted by location highlights how the mask-wearing behavior of older adults (O) is less impacted by shopping in a rural area than the behavior of young (Y) and middle-age (MA) individuals.

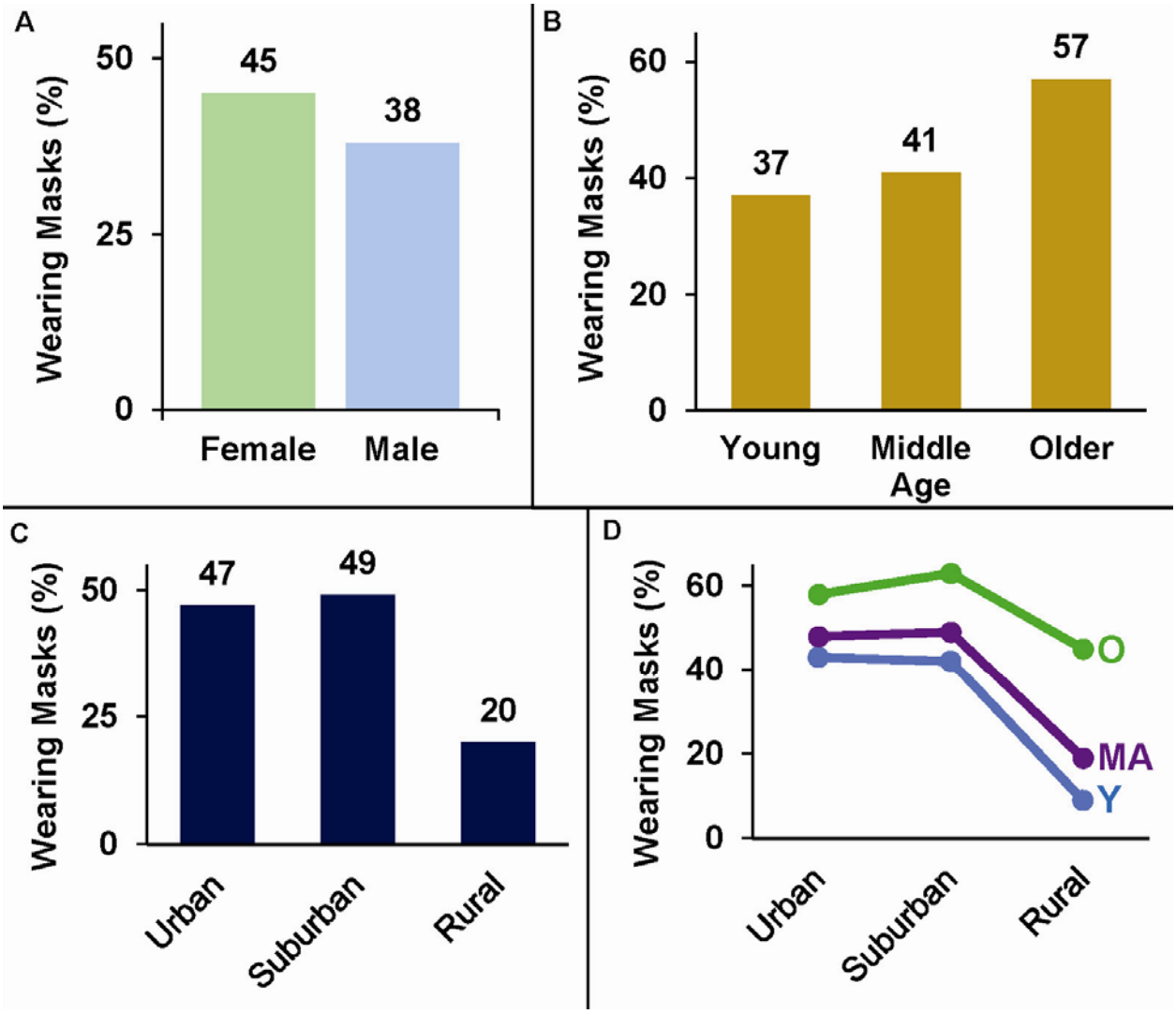
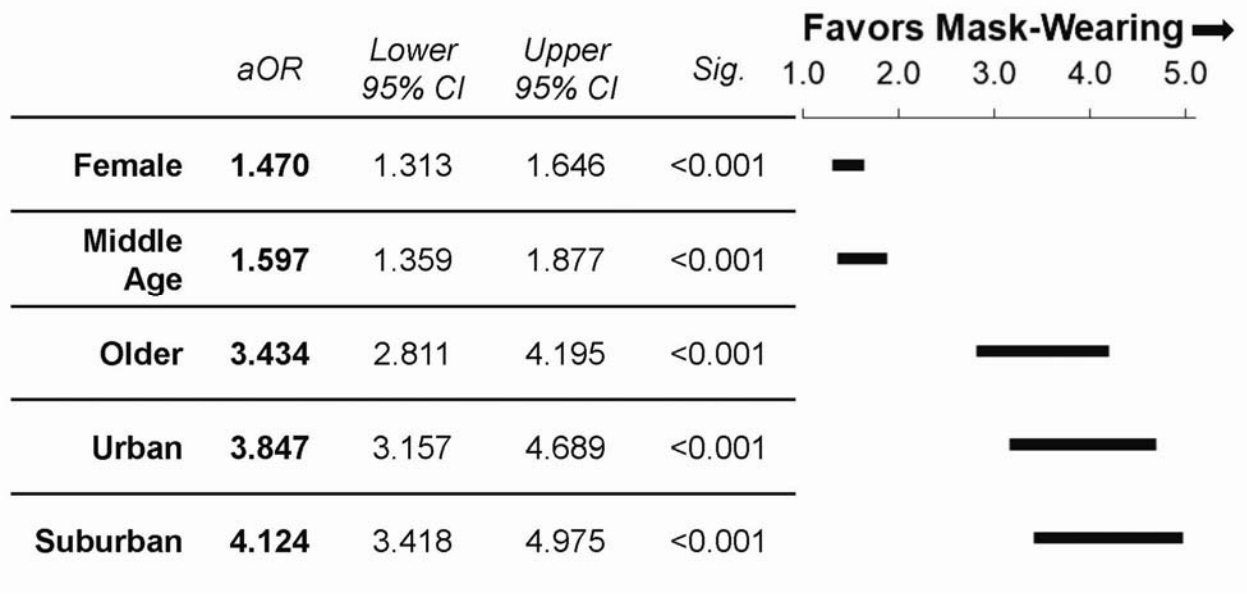


Fig 3. Odds of wearing a mask. Adjusted odds ratios (aOR) and 95% confidence interval plots of mask usage for gender expression, age, and location. Odds ratios are expressed in relation to reference groups (gender: male; age: young; location: rural).



	aOR	*Lower 95% CI*	*Upper 95% CI*	*Sig.*
Female	**1.470**	1.313	1.646	<0.001
Middle Age	**1.597**	1.359	1.877	<0.001
Older	**3.434**	2.811	4.195	<0.001
Urban	**3.847**	3.157	4.689	<0.001
Suburban	**4.124**	3.418	4.975	<0.001

Table 1. Observed odds ($\frac{mask}{no\ mask}$) of wearing a mask by age and location*

	Young		*Middle Age*		*Older*	
	Female	Male	Female	Male	Female	Male
Urban	0.879	0.639	1.022	0.863	2.115	1.049
Suburban	0.886	0.567	1.257	0.763	2.113	1.468
Rural	0.076	0.117	0.287	0.172	1.094	0.600

* Odds > 1 show odds of wearing a mask are greater than not wearing a mask

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