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Use of face coverings by the public during the COVID-19 pandemic: an observational study

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Abstract: Public health agencies have recommended that the public wear face coverings as a major non-pharmaceutical intervention to mitigate COVID-19 transmission. However, there is concern whether or not the public has adopted this recommendation. An observational study of 3,271 members of the public was conducted during the COVID-19 pandemic and examined the use of face coverings at grocery stores across 20 Wisconsin counties between May 16th and June 1st, 2020. Of the total individuals observed, we found that only 41.2% used face coverings. Individuals who appeared to be adults (aOR = 1.65; 95% CI = 1.20-2.27) or older adults (aOR = 3.67; 95% CI = 2.59-5.19) were more likely to be wearing face coverings than younger individuals. Additionally, individuals with female gender expression (aOR = 1.43; 95% CI = 1.24-1.66) and individuals shopping at a more expensive grocery store (aOR = 1.95; 95% CI = 1.69-2.25) were more likely to be wearing face coverings. We did not find an association between county level prevalence of COVID-19 cases and face covering use. To our knowledge, this is the first study using direct observations to examine face covering behavior by the public and our findings have implications for public health agencies.
**Background:** The Centers for Disease Control and Prevention (CDC) recommends that the public wear face coverings as a major non-pharmaceutical intervention to mitigate COVID-19 transmission (1), particularly when physical distancing is difficult. Given that the United States does not have a culture of face covering use by the public and recent media reports of violent retaliation by people asked to wear a face covering (2), there is concern regarding widespread adoption of this recommendation. A recent survey by Gallup reported 68% of U.S. adults claim to ‘always’ or ‘sometimes’ wear a face covering in public (3). To date, however, there have been no direct observational studies examining face covering usage by the general public in the United States.

**Objective:** To determine face covering usage by the public visiting grocery stores using a convenience sample of Wisconsin residents.

**Methods:** We used direct observations of individuals exiting 26 grocery stores to assess face covering use across 20 counties in Wisconsin between 16 May and 1 June 2020 (Figure 1A). No stores required face coverings upon entry. Two simultaneous observers recorded the shoppers’ apparent age (minor, young adult, adult, older adult), gender expression (female/male), and face covering use (present/absent: any type of cloth, surgical mask, or N95 respirator). Inter-rater reliability was assessed for 307 observations using Cohen's kappa coefficients.

The price index for each store was calculated as a relative z-score based on the price of 12 staple food items (onion, potato, apple, soda, yogurt, milk, and two types of eggs, chicken, and butter) to determine if face covering use was associated with expense.

We used multiple logistic regression with face covering usage as the dependent variable, to examine associations between age category, gender expression, price indices, and county-level COVID-19 case prevalence (4). Adjusted odds ratios (aOR), including these covariates, and 95% confidence intervals were calculated. Analyses were conducted using glm in R version 4.0.

To determine the representativeness of the sample, we used a two-sided Kolmogorov-Smirnov (KS) test to evaluate whether the U.S. census tract of the observed locations reflected the distribution of race (percent non-white) and median family income reported across Wisconsin (5).

**Findings:** We observed a total of 3,271 individuals, 41.2% of whom were observed wearing face coverings when exiting grocery stores. There was a higher prevalence of face covering use by older adults (59.5%) compared to minors (26.2%), young adults (34.8%), and adults (39.9%) and by females (44.8%) compared to males (36.9%) (Table 1). In the multiple logistic regression analyses, we found that age categories of adult and older adult, female gender, and observations at higher price index stores were statistically significantly associated with higher odds of face covering usage (Figure 1B). However, case prevalence was not associated with higher odds of face covering usage.

The Cohen's kappa coefficients for age (0.79, ‘substantial agreement’), gender expression (0.98, ‘almost perfect agreement’), and face covering usage (0.92, ‘almost perfect agreement’) indicate these variables were robustly collected across observers independently. Additionally, we found no significant difference between the sample and Wisconsin at large using the KS test (median income: p = 0.751, D = 0.145; percent non-white: p = 0.203, D = 0.24).

**Discussion:** We found face covering usage in public was not widely practiced, despite recommendations by multiple public health agencies, including the Wisconsin Department of Health Services (4). Our study has limitations due to its cross-sectional design and the potential of misclassifying face covering use if the covering was removed prior to the observation at the store’s exit door. However, our results have important implications for public health agencies. Our results suggest the need to develop and test interventions to promote face covering usage by the general public in the United States. Future directions from this report include examining the reasons why some individuals choose not to wear face coverings in public.
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Table 1. Multi-county observation data of face covering use by the public at grocery stores in Wisconsin

| County         | Total | Female | Male | Minor | Young Adult | Adult | Older Adult | Price Index of Store(s) (interval) | COVID-19 cases per hundred-thousand (total cases) |
|----------------|-------|--------|------|-------|-------------|-------|-------------|-------------------------------------|--------------------------------------------------|
| Adams          | 7/103 | 4/58   | 3/45 | 0/1   | 1/26        | 1/26  | 0/23        | 2/3 (8.7)                          | 19.9 (4)                                          |
| Brown**        | 118/313 | 76/181 | 42/132 | 3/22 | 7/51        | 7/51  | 0/23        | 29/54 (53.7)                      | 893 (2320)                                       |
| Dane*          | 644/934 | 353/485 | 291/449 | 13/35 | 175/287    | 175/287 | 0/23        | 113/136 (83.1)                    | 138.7 (735)                                      |
| Fond Du Lac    | 24/123 | 14/62  | 10/61 | 5/13 | 2/24        | 2/24  | 1/23        | 4/11 (36.4)                       | -0.2                                             |
| Grant          | 38/100 | 22/51  | 16/49 | 5/13 | 9/35        | 9/35  | 0/23        | 11/18 (61.1)                      | 142.8 (74)                                       |
| Iowa           | 57/151 | 44/102 | 13/49 | 5/22 | 12/33       | 12/33 | 0/23        | 14/28 (50)                        | 50.8 (12)                                        |
| Jackson        | 25/105 | 16/61  | 9/44  | 5/14 | 2/23        | 2/23  | 0/23        | 9/52 (17.3)                       | -0.1                                             |
| Kenosha        | 48/100 | 26/55  | 22/45 | 7/12 | 10/26       | 10/26 | 0/23        | 8/16 (56.2)                       | 68.3 (14)                                        |
| Lafayette      | 16/59  | 11/29  | 5/30  | 1/4   | 2/5         | 2/5   | 0/23        | 11/15 (73.3)                      | 149.4 (25)                                       |
| Milwaukee      | 41/100 | 29/62  | 12/38 | 1/11 | 4/15        | 4/15  | 0/23        | 8/14 (57.1)                       | 817.3 (7799)                                     |
| Monroe         | 10/103 | 5/48   | 5/55  | 0/7   | 0/23        | 0/23  | 0/23        | 4/9 (44.4)                        | 33 (15)                                          |
| Outagamie      | 90/200 | 55/109 | 35/91 | 1/7  | 12/40       | 12/40 | 0/23        | 43/60 (71.7)                      | 124.5 (230)                                      |
| Pierce         | 46/118 | 34/68  | 12/50 | 1/5   | 6/26        | 6/26  | 0/23        | 24/65 (36.9)                      | -0.3                                             |
| Polk           | 29/104 | 22/62  | 7/42  | 1/1   | 0/18        | 0/18  | 0/23        | 10/42 (23.8)                      | 109.3 (17)                                       |
| Racine         | 36/100 | 15/62  | 21/38 | 0/5  | 5/14        | 5/14  | 0/23        | 9/16 (56.2)                       | 866.9 (1733)                                     |
| St. Croix      | 19/101 | 12/41  | 7/60  | 0/4  | 0/23        | 0/23  | 0/23        | 17/25 (68)                        | 80.8 (71)                                        |
| Walworth       | 22/100 | 11/47  | 11/53 | 5/12 | 4/27        | 4/27  | 0/23        | 3/16 (18.8)                       | 275.7 (284)                                      |
| Waushara       | 27/98  | 21/60  | 6/38  | 2/3  | 1/8         | 1/8   | 0/23        | 8/25 (32)                         | 33.2 (8)                                         |
| Winnebago      | 27/145 | 17/75  | 10/70 | 1/18 | 8/35        | 8/35  | 0/23        | 14/82 (17.1)                      | 146.5 (249)                                      |
| Wood           | 24/114 | 12/67  | 12/47 | 2/12 | 5/23        | 5/23  | 0/23        | 13/68 (19.1)                      | 15 (11)                                          |
| Total          | 1348/3271 | 799/1765 | 549/1866 | 58/221 | 265/762    | 686/1718 | 339/570    |                                |                                                  |

1Data retrieved from WDHS based on date direct observations were recorded: May 16, 17, 18, 2020 (5). In counties where multiple observations on different dates occurred as marked, the prevalence of the latest date observed was reported.

2Observations recorded from * 3 or ** 5 different stores and price indices were calculated for each store in each respective county.
Figure 1. A. Map of Wisconsin counties represents observation locations where face covering use was quantified. Color of county outline indicates case prevalence per hundred-thousand cases. Fill shade intensity represents the percentage of total individuals that wore a face covering. B. Adjusted odds ratios (aOR) and 95% confidence interval (CI) of face covering usage were calculated and plotted from multiple logistic regression. The aOR for age is in reference to the odds of face covering use by minors. All variables included in the model are shown in the table.