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ORIGINAL RESEARCH

Facial Mask Use and COVID-19 Protection Measures in Jefferson County, Kentucky: Results from an Observational Survey, November 5–11, 2020

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Abstract

Introduction: The transmission of respiratory infectious diseases such as COVID-19 can be significantly decreased by mask-wearing. However, accurate information about the extent and proper use of the facial mask is scarce. This study's main objective was to observe and analyze mask-wearing behavior and the level of COVID-19 protection measures in indoor public areas (PAs) of Jefferson County, Kentucky.

Methods: In this observational survey study, the targets were indoor PAs, and ZIP codes were defined as surveying clusters. The number of selected PAs in each ZIP code was proportional to the population and the total number of PAs in that ZIP code. The PA pool in each ZIP code was divided into four groups, followed by random selection without replacement from each group.

Results: A total of 191 PAs were surveyed: 50 of them were grocery stores, 56 were convenience stores or pharmacies, 39 were wine and liquor stores, and 46 were other stores. At least one unmasked and one incorrectly masked member of staff was observed in 26 percent and 40 percent of the sampled PAs, respectively. Also, in 29 percent and 35 percent of the PAs, at least one unmasked and one incorrectly masked visitor were observed, respectively. The rates varied by PA size and county district. Eighty percent of unmasked staff and 75 percent of the unmasked visitors were male. The rate of unmasked males varied from 50 percent to 100 percent across districts. About 66 percent of unmasked staff among all Jefferson County districts were young adults. More than one-fourth of all the PAs provided hand sanitizer for visitors' use, but only 2 percent of the PAs provided masks to their visitors.

Conclusion: Messaging about (correct) mask use may need to particularly target the 19–44-year-old male population, as these individuals were the most prevalent among those unmasked and masked incorrectly. Additionally, the protective measures practiced by particular businesses may depend on their resources. Hand sanitizer is easier to offer visitors, while staffing to regularly sanitize carts or funds to provide a sufficient number of wipes, gloves, or masks may present further opportunities for government assistance.

Introduction

Using a facial mask mitigates the transmission of airborne infectious diseases, including COVID-19.[1–5] Accurate information about the extent and proper use of the facial mask is vital to make informed public health interventions and policies. Accurate information on mask use, however, is scarce. The available information on the prevalence of mask-wearing is either old (e.g., the New York Times phone interview survey,[6] conducted in July 2020) or drawn from a specific sub-population (e.g., Facebook users).[7] Besides being out-of-date or suffering from selection bias, what is known about the extent of mask use is merely based on self-report. Moreover, there is limited information about the proper use of facial masks in communities.

Given the deficiencies of current mask use data, the Louisville Metro Department of Public Health and Wellness (LMPHW) and the University of Louisville School of Public Health and Information Sciences conducted an observational survey of mask use in Jefferson County, Kentucky (population estimate: 766,767 in 2019).[8] A randomly selected number of indoor public areas (PAs) across different districts of the county were observed for a one-week period from November 5 to November 11, 2020, to monitor staff and visitors' mask-wearing behavior. Protective measures in place at the selected PAs were also observed. Using the results of the survey, this study reports disparities in the extent and proper use of facial masks across different county districts and PAs of different capacities. In addition, it reports key demographic characteristics of the unmasked and improperly masked persons by district. Further, this study reports the variation of protective measures by district.

Methods

In this study, Jefferson County residents' facial mask–wearing behavior (prevalence, proper use, and type) was observed and documented in indoor public areas. Therefore, this was non-experimental research that used a naturalistic method to systematically observe subjects' behavior in the environment in which it typically occurs.[9] This study was approved by the University of Louisville Institutional Review Board (IRB# 20.0966).

"Mask" or "facial mask" was defined as any form of protective facial covering (e.g., N99, N95, disposable masks, cloth masks, neck gaiters, bandana, and face shield) worn over the nose and mouth that acts as a barrier to reduce the spread of infectious agents such as bacteria or viruses. A masked individual was one wearing the mask appropriately so that it covered both the individual's nose and mouth. An unmasked individual was one with no covering on either the nose or the mouth. An incorrectly masked individual was one not wearing the mask correctly such that it either did not cover the nose or did not cover the mouth of the individual. Throughout this study, "masked" is used synonymously with proper use of a facial mask, and "incorrectly masked" is used synonymously with improper use of a facial mask.

Visitors' and staff's mask-wearing was observed and recorded separately. Staff were identified by their uniform or location in the PA—for example, individuals wearing uniforms or name tags that displayed the PA's proprietary brand. Also, staff were identified as individuals working behind counters, checkout registers, or service area desks.

Sampling technique

Surveying clusters were defined by ZIP codes, and targets were indoor PAs. The number of selected PAs in each ZIP code was proportional to the population and the total number of PAs in the ZIP code. The PA pool in a ZIP code was divided into four groups, followed by random selection from each group. The four groups were: (1) grocery stores; (2) convenience, departmental, and discount stores and pharmacies; (3) wine and liquor stores; and (4) other stores—e.g., auto parts, firewood, furniture, gifts, grills, hardware and lumbar, lawnmowers, mattresses, office equipment, pet supplies, and variety. The study excluded the PAs that required personal service (e.g., restaurants, bars, barbershops, nail salons) to keep the study merely observational and non-interventional.

The total number of designated PAs in a cluster (i.e., ZIP code) was either five, six, or seven—five PAs if a cluster contained less than 2 percent of the county population, six PAs if between 2 percent and 4 percent, and seven PAs if greater than 4 percent (total 193 PAs). If five PAs were designated, then two from PA group 1 and one from each of the other PA groups were selected. If six PAs were designated, then two from PA groups 1 and 2 and one from PA groups 3 and 4 were selected. If seven PAs were designated, then three from PA group 1, two from PA group 2, and one from PA groups 3 and 4 were selected. PAs were randomly sampled per cluster. Given the list of PAs provided by indexedamerica.com, the within-cluster probability of inclusion under random sampling was calculated. Since the PA distributions were not always equal among the clusters, statistical adjustments were made to accommodate the sample's actual data.[10] A random sample without replacement was performed on the PA list by ZIP code.

Study implementation

The observational survey of the PAs was conducted from November 5, 2020, through November 11, 2020. Once a PA was identified, a surveyor went to its location as a customer on a specific weekday/weekend between 10 a.m. and 5 p.m., observed protective measures and personal protection behavior at the PA for a specific period (10–30 minutes depending on the store size) and filled out an electronic survey, created using Microsoft Forms.

While in a PA, the surveyor paused occasionally to fill the survey questionnaire on their cellphone. The researchers designed the mobile version of the survey instrument to resemble a shopping list. The surveyors did not employ any other data collection method (e.g., pen and paper or an electronic tablet) to avoid attracting any attention and affecting subjects' behavior. No identifiable information (including picture, name, birth date, address, exact age, data collection date, and HIPAA protected information) was collected from any visitor of the PA or any PA staff. During the implementation phase, a few exceptions to the ideal design were encountered, which were handled by an adaptive consensus design—as practiced in clinical trials—to maximize data collection integrity and adjust to variations that occur in real-world research contexts.[11] For example, the address of some of the pre-selected PAs had changed, or other businesses were opened at the location; in such cases, new PAs were randomly drawn.

Results

To improve the data analysis, as well as the usability and interpretability of the survey's results, Jefferson County's ZIP codes were grouped into seven districts: South & South West (14% of the county population), North West (11%), North Center (13%), West Center (10%), Central (17%), South East (16%), East & North East (19%) (**Figure 1**). These seven districts were determined according to the population demographics and geographic locations of the ZIP codes (**Table 1**).

During the study period, the surveyors observed a total of 191 PAs (out of the total 193 designated PAs). Of the total PAs surveyed, Groups 1, 2, 3, and 4 comprised 50, 56, 39, and 46 PAs, respectively. Depending on size and capacity, each PA was categorized as small, medium, or large. Large PAs included typical big-box stores, medium PAs included typical pharmacies or discount stores, and small PAs included micro pop-up stores, small single-line stores, and specialty stores. The majority of the surveyed PAs (60%) were small in capacity, and only 15 percent of the PAs were large.

The extent and proper use of a facial mask

At least one unmasked staff person was observed in 26 percent of sampled PAs, and at least one unmasked visitor was observed in 29 percent of sampled PAs (**Figure 2**). The likelihood of observing an unmasked individual (staff or visitor) increased as the PA size decreased. At least one unmasked staff person was observed in 30 percent of small PAs, compared to 23 percent and 11 percent of medium-size and large PAs, respectively (**Figure 2a**). Also, at least one unmasked visitor was observed in 35 percent, 23 percent, and 14 percent of small, medium-sized, and large PAs, respectively (**Figure 2b**).

Unmasked staff were observed in about a third of sampled PAs at the West Center, Central, and North West districts. In the sampled PAs in the South & South West, South East, and East and North East districts, the surveyors reported that a quarter of the staff were unmasked. The likelihood of observing an unmasked staff person was significantly smaller in PAs at the North Center district than in other districts (**Figure 3a**). Incorrectly masked staff were observed in about half of PAs at the West Center and North West districts. In other districts, incorrectly masked staff were observed in 29 to 39 percent of the surveyed PAs (**Figure 3a**). Unmasked visitors were observed in 43 percent and 46 percent of sampled PAs at the Central and South & South West districts, respectively, and in at least a quarter of sampled PAs at the North West, West Center, South East, and East & North East districts (**Figure 3b**). The likelihood of observation of unmasked visitors was significantly smaller in the sampled PAs at the North Center district. In contrast, observation of incorrectly masked visitors was significantly more likely at this district's PAs (**Figure 3b**).

Sex of the unmasked

Eighty percent of unmasked staff were male among all Jefferson County districts. Surveyors noted an even split among male and female unmasked staff in the South & South West district. Unmasked staff in PAs in other districts were predominately male. Notably, in the North Center, West Center, and South Eastern districts, all unmasked staff were males (**Figure 4a**). The highest proportion of unmasked visitors in the sampled PAs was also male (75%). All unmasked visitors in the North Central district were male, and over 80 percent of the unmasked visitors in the South East and North West districts were male (**Figure 4b**).

Sex of the incorrectly masked

Among the staff incorrectly wearing masks, males made up 47 percent across districts. The districts with the highest proportions of males wearing their masks incorrectly were the North Center and the East & North

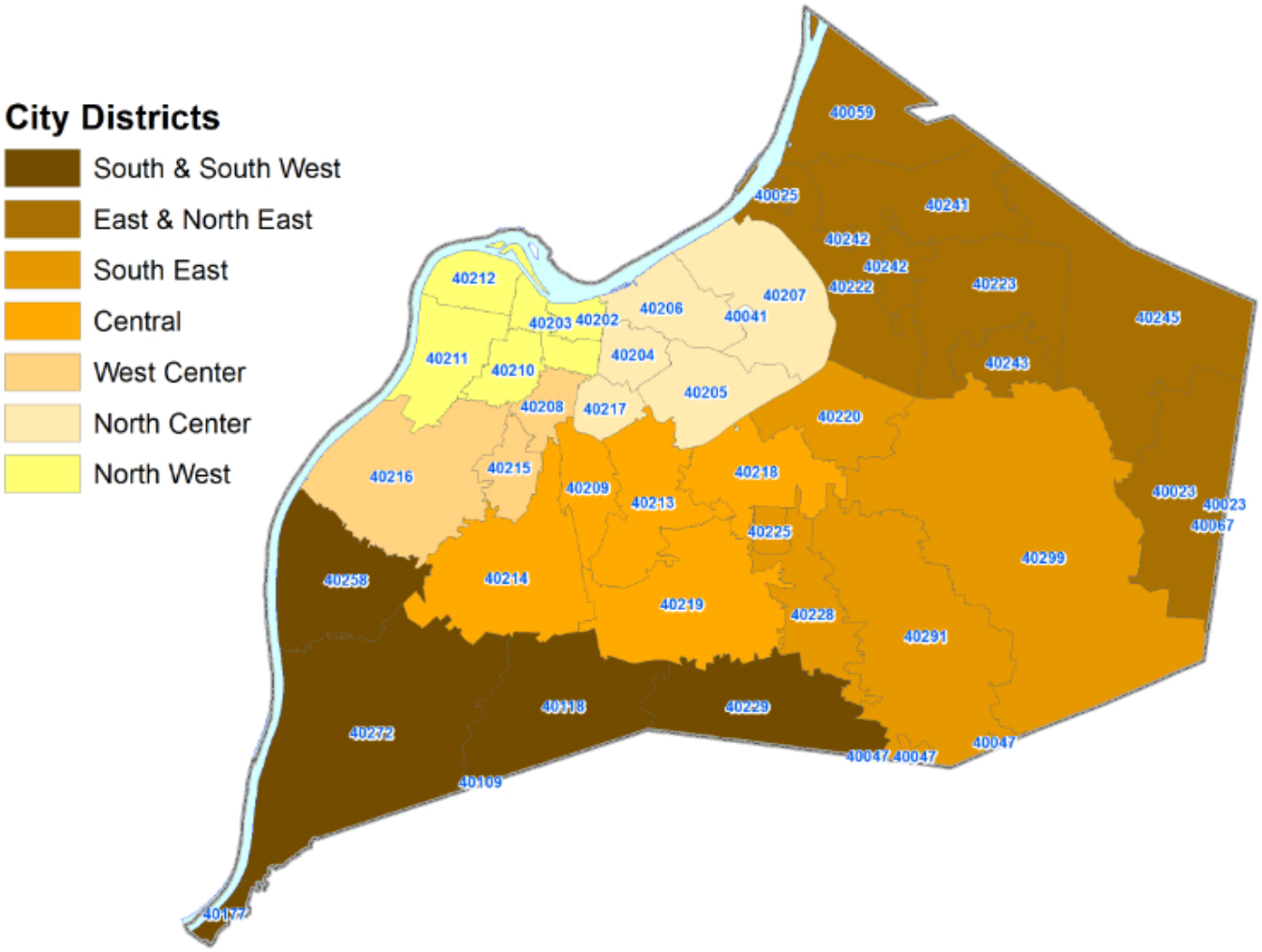

Figure 1. Districts of Jefferson County, Kentucky.

Table 1. Characteristics of ZIP codes and districts of Jefferson County, KY.

	District	ZIP Code	Census 2010 Population	Age Group (%)				Non-Hispanic (%)		Hispanic (%)	Household Income†
				0–18	19–44	45–64	65+	White	Black		
1	South & South West	40118	9,724	26%	35%	27%	11%	86%	2%	9%	52,848
		40229	36,852	28%	38%	24%	10%	87%	6%	4%	58,685
		40272	37,394	26%	33%	27%	14%	91%	4%	3%	55,052
		40258	26,465	26%	33%	27%	14%	84%	11%	2%	51,184
		Weighted Average		*27%*	*35%*	*26%*	*12%*	*88%*	*6%*	*4%*	*55,143*
2	North West	40202	6,772	11%	54%	28%	6%	38%	54%	3%	17,940
		40203	19,694	28%	36%	24%	12%	31%	64%	2%	16,862
		40210	14,822	30%	31%	26%	12%	7%	89%	1%	23,330
		40211	22,612	31%	30%	26%	13%	4%	93%	1%	27,565
		40212	17,685	29%	31%	28%	11%	36%	60%	1%	24,957
		Weighted Average		*28%*	*34%*	*26%*	*12%*	*21%*	*75%*	*1%*	*22,848*
3	North Center	40204	14,236	15%	47%	27%	11%	85%	9%	2%	52,179
		40205	23,678	19%	35%	31%	16%	93%	3%	2%	76,802
		40206	18,865	17%	42%	28%	13%	84%	9%	3%	55,156
		40207	29,745	21%	32%	28%	18%	90%	3%	3%	78,750
		40217	12,507	17%	44%	27%	12%	86%	7%	2%	50,498
		Weighted Average		*18%*	*38%*	*28%*	*15%*	*88%*	*6%*	*2%*	*66,402*
4	West Center	40208	13,227	20%	53%	21%	6%	61%	29%	4%	28,026
		40215	22,287	29%	36%	26%	9%	57%	32%	7%	32,306
		40216	40,746	25%	32%	29%	14%	60%	34%	3%	43,358
		Weighted Average		*25%*	*37%*	*27%*	*11%*	*59%*	*33%*	*4%*	*37,469*
5	Central	40213	16,796	23%	37%	27%	14%	71%	18%	8%	42,437
		40214	45,291	25%	37%	26%	12%	68%	14%	9%	41,449
		40218	31,658	26%	37%	25%	12%	47%	39%	8%	44,587
		40219	38,032	25%	36%	25%	14%	63%	21%	12%	46,931
		Weighted Average		*25%*	*37%*	*26%*	*13%*	*62%*	*23%*	*9%*	*43,911*
6	South East	40220	33,109	21%	34%	28%	17%	76%	14%	5%	62,366
		40228	15,743	26%	34%	27%	14%	77%	15%	4%	66,687
		40291	35,427	25%	35%	28%	12%	82%	10%	4%	70,234
		40299	38,371	26%	33%	29%	13%	85%	8%	4%	76,587
		Weighted Average		*24%*	*34%*	*28%*	*14%*	*81%*	*11%*	*4%*	*69,642*
7	East & North East	40023	4,118	27%	31%	34%	9%	94%	2%	2%	73,775
		40059	16,708	30%	24%	34%	12%	87%	4%	2%	142,354
		40222	21,359	19%	34%	26%	20%	82%	7%	4%	73,220
		40223	22,011	25%	29%	31%	15%	82%	9%	4%	78,076
		40241	28,988	24%	32%	29%	15%	78%	10%	4%	78,331
		40242	10,930	23%	34%	27%	16%	82%	8%	5%	68,004
		40243	10,210	22%	28%	28%	22%	87%	5%	4%	73,448
		40245	30,109	29%	34%	29%	8%	81%	9%	3%	114,092
		Weighted Average		*25%*	*31%*	*29%*	*14%*	*82%*	*8%*	*4%*	*91,141*

† 2018 median (USD)

Figure 2. Mask use in Jefferson County, Kentucky, indoor public areas by public area capacity, Nov. 5–11, 2020.

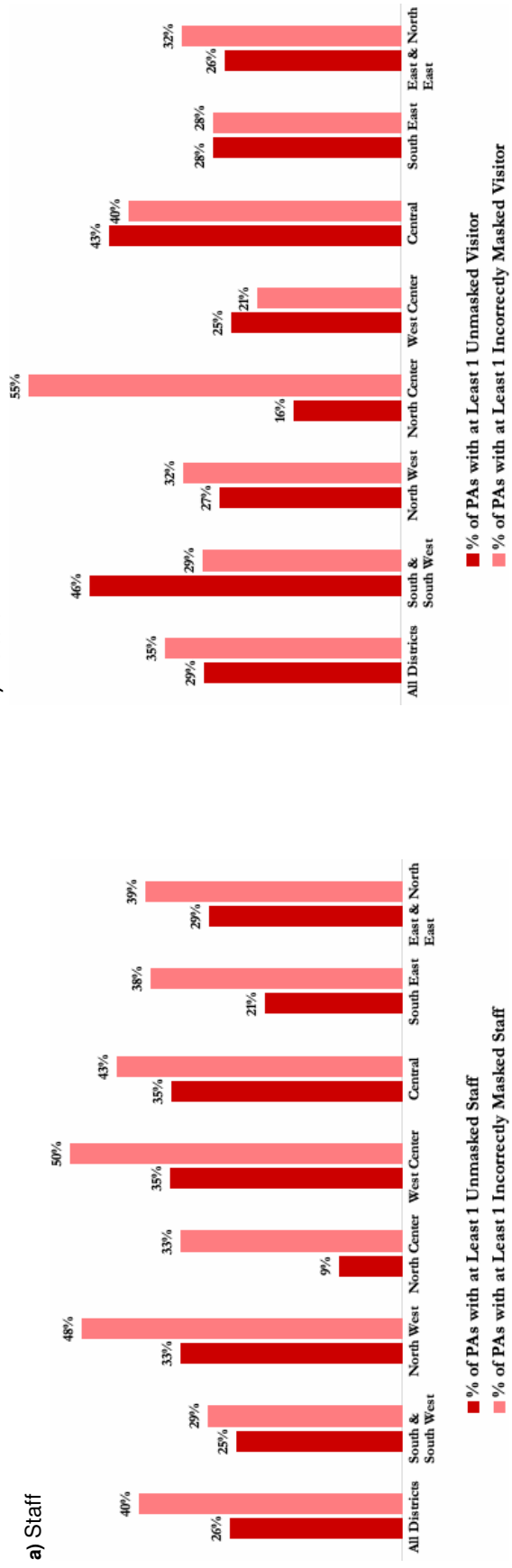

Figure 3. Mask use in Jefferson County, Kentucky, indoor public areas by district, Nov. 5–11, 2020.

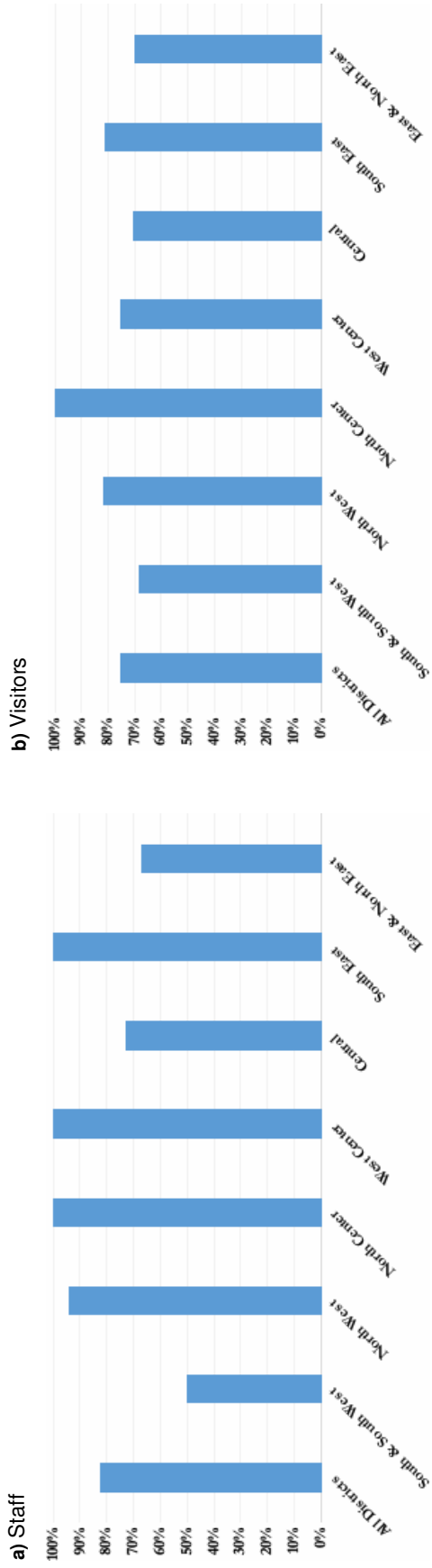

Figure 4. Percentage of men among the unmasked in Jefferson County, Kentucky, indoor public areas by district, Nov. 5–11, 2020.

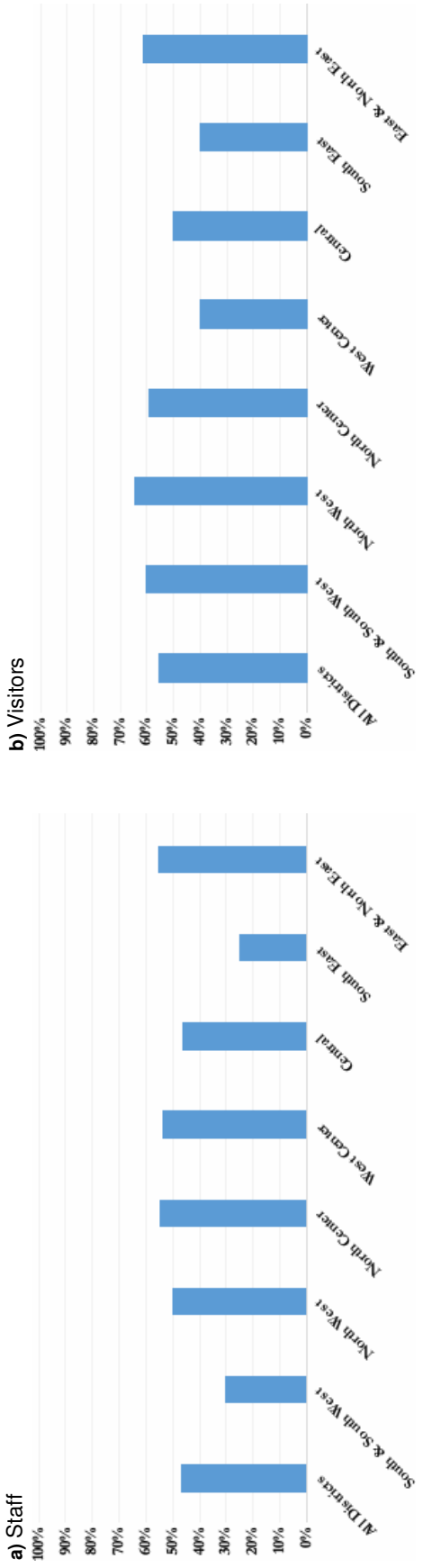

Figure 5. Percentage of men among the incorrectly masked in Jefferson County, Kentucky, indoor public areas by district, Nov. 5–11, 2020.

East district (55%) (**Figure 5a**). Among the visitors incorrectly wearing masks, males made up 56 percent across districts. The districts with the highest proportions of males wearing their masks incorrectly were the North West and the East & North East districts (**Figure 5b**).

Age of the unmasked

Sixty-six percent of unmasked staff among all Jefferson County districts were young adults (approximately 19–44 years old). The share of young adults among the unmasked staff was highest in the West Center district (86%) and lowest in the East & North East district (42%) (**Figure 6a**). Among unmasked visitors, young adults also had the greatest share (53%), but the share varied by district—between 68 percent and 73 percent in South & South East, North West, and North Center districts, 56 percent in South East, 41 percent in Central, 38 percent in West Center, and 20 percent in East & North East districts (**Figure 6b**). Older adults (approximately 45–64 years old) were the group with the second-highest share among the unmasked, both staff and visitors (**Figure 6**).

Age of the incorrectly masked

Sixty-five percent of incorrectly masked visitors among all Jefferson County districts were young adults. The share of young adults among the incorrectly masked staff was highest in the North Center district (82%) and lowest in the South & South East district (50%) (**Figure 7a**). Among unmasked visitors, young adults had the greatest share (53%) as well. Young adults' share in the incorrectly masked was 80 percent in West Center, 31 percent in East & North East, and between 40 percent and 60 percent in other districts (**Figure 7b**). For both staff and visitors, the second-highest share among the incorrectly masked belonged to older adults (**Figure 7**).

Protective measures at the selected PAs

There were six questions in the survey instrument related to the practice of protective measures in the PAs: the availability of separate entrance and exit, checking whether visitors were wearing masks at the entrance of the PA, providing masks to visitors, providing cleaning wipes to visitors, providing hand sanitizer for visitors' use, and sanitization of shopping carts.

The most common COVID-19 protection measure in the observed PAs was the provision of hand sanitizer for visitors' use (29%). The second most common measure was the separation of entrance and exit (16%), and the next most common measures were checking whether visitors had masks (11%), sanitizing shopping carts (10%), and providing cleaning wipes for visitors' use (8%). Only 2 percent of the PAs provided masks to their visitors (**Figure 8**).

This study estimated that 89 percent of the large PAs provided hand sanitizer to their visitors, compared to 33 percent for medium-size PAs and 13 percent for the small capacity PAs. The rate of taking other COVID-19 protection measures was also positively correlated with PA size. The percentage of PAs that provided facial masks for their visitors' use was particularly low. Even among large PAs, only 7 percent provided facial masks (**Figure 8**).

Moreover, the findings of this study suggest that protective measures were better in PAs located in East & North East district, North Center district, and South East district compared with the other districts. For example, hand sanitizer was provided in 42 percent, 38 percent, and 29 percent of PAs located in these districts, respectively. As another example, 13 percent, 28 percent, and 18 percent of the observed PAs in these three districts separated entrance and exit, respectively. The least COVID-19 protection measures were taken in PAs of the North West, West Center, and Central districts (**Figure 9**).

Discussion

Across seven districts, 191 public areas and 33 ZIP codes within Jefferson County, Kentucky, were observed in this study. Most of the observed public areas were small, and most observations occurred in grocery or convenience stores. Observers also visited liquor stores, pet stores, automotive stores, department stores, and other PAs.

Most available information on mask use is based on self-report. Moreover, data on the proper use of masks is limited. An observational survey does not suffer from potential self-reporting bias and is suitable to document the proper use of facial masks. This study showed that improper mask-wearing was more common than not wearing a mask in Jefferson County, Kentucky. This finding was consistent across all PA sizes and most districts of the county, whether visitors or staff of the selected PAs were observed. Staff and visitors of public areas were categorized separately in this study, as the length of their potential exposure to the coronavirus may be different.

Not wearing a mask, whether a visitor or staff, appeared more common within small establishments. In addition, this study documented the sex and approximate age of the unmasked and incorrectly masked. The majority of the unmasked, whether staff or visitors, were male. However, there was a relatively even split between men and women in terms of improper use of a mask. Most unmasked and improperly masked, whether staff or visitors, were adults versus children and the elderly. Among adults, younger adults had a greater share.

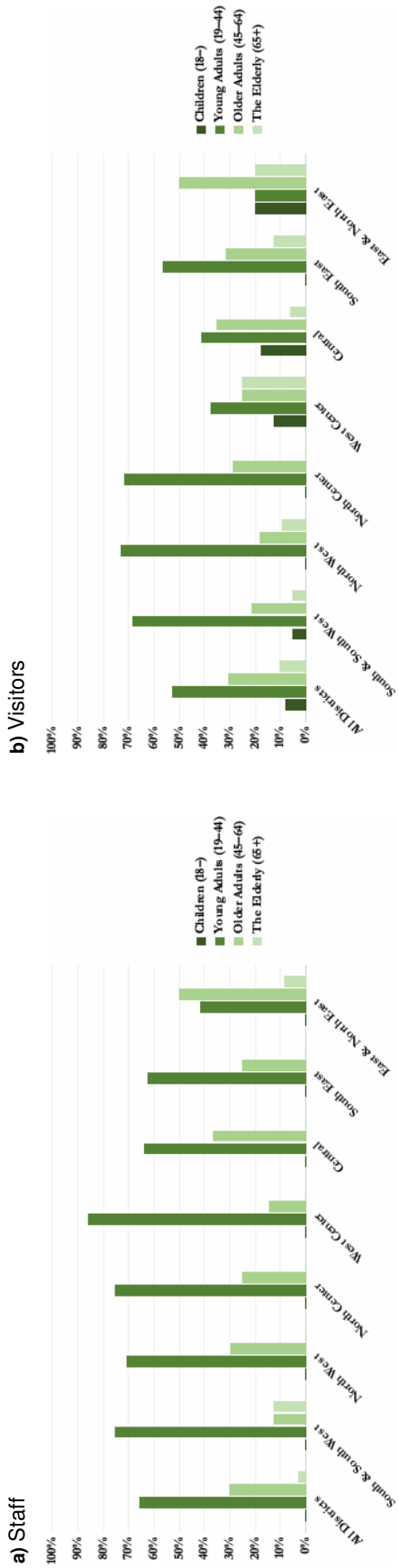

Figure 6. Age distribution of the unmasked in Jefferson County, Kentucky, indoor public areas by district, Nov. 5–11, 2020.

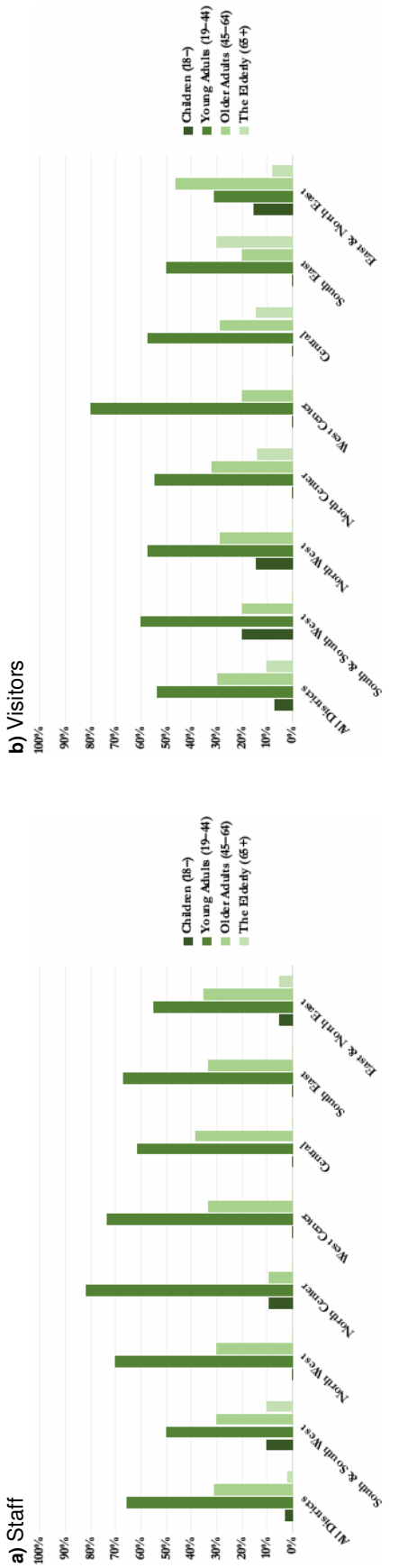

Figure 7. Age distribution of the incorrectly masked in Jefferson County, Kentucky, indoor public areas by district, Nov. 5–11, 2020.

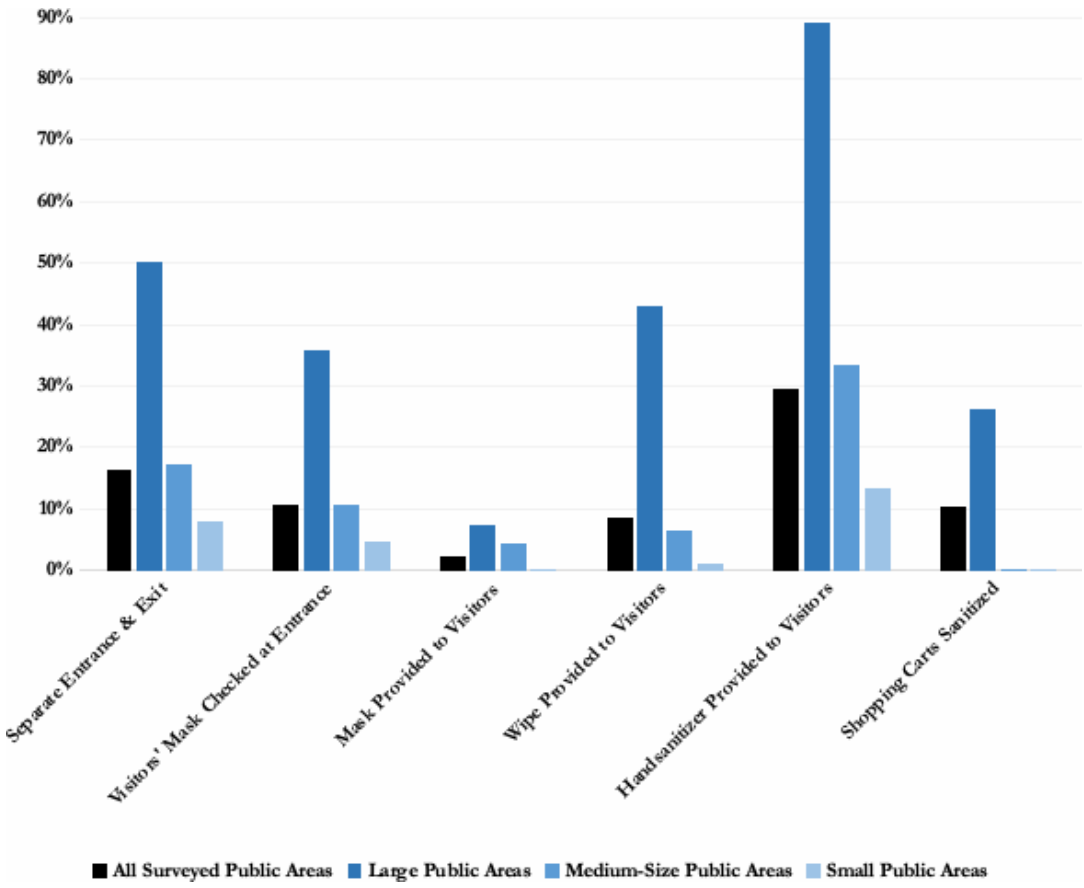

Figure 8. Percentage of indoor public areas by practice of protective measures and capacity.

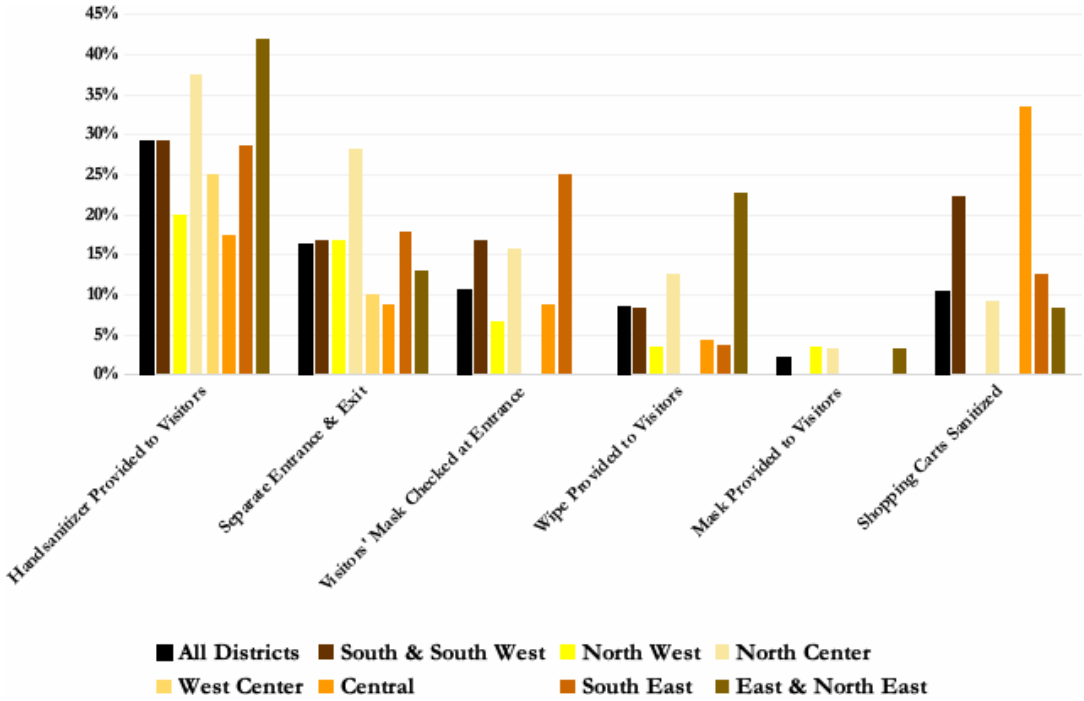

Figure 9. Percentage of indoor public areas by practice of protective measures and district.

The findings of this study (especially the rates of incorrect mask use and the sex and age of the unmasked and incorrectly masked) can inform the targeting of public health campaigns. Messaging of such campaigns must be directed at 19–44-year-old males.

Moreover, the observed geographical variation in the prevalence of mask-wearing and its proper use can inform the determination of the public health campaigns' geographical focus. The likelihood of observing an unmasked or an incorrectly masked staff person was greater in the North West, West Center, and Central districts of the county than in the other four districts (**Figure 3a**). In addition, the percentage of PAs that took COVID-19 protection measures was smaller in these districts than in the other districts (**Figure 3a**). These two observed phenomena may be attributable to businesses in the North West, West Center, and Central districts contending with limited resources, as these three areas are the most disadvantaged districts in the county. For example, median family income in the North West district is $22,848 (in 2018 prices), $37,469 in the West Center district, and $43,911 in the Central district (**Table 1**). These income levels are the lowest of all seven districts of the county. In addition, the percentage of racial minorities (non-whites) is highest in these districts: 76 percent in the North West, 37 percent in West Center, and 32 percent in the Central district (**Table 1**).

Limitations

This study does not provide the rate of mask-wearing in the selected PAs because the total number of visitors and staff were not counted. Also, this observational study excluded PAs that required personal assistance (e.g., restaurants, bars, nail salons, hair salons, etc.) to keep the study non-interventional. Observation of such PAs is critical, as they are associated with an increased case rate of COVID-19 infection.[12] Moreover, the results for the approximate age-range of the unmasked and incorrectly masked need to be interpreted carefully because the age-range of all individuals whose mask-wearing were observed was not collected. If the majority of staff and visitors were young adults, then we would be more likely to see a greater percentage of unmasked and incorrectly masked persons among them. This potential problem, however, does not affect the variations in age-specific rates across districts.

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Conflict of Interest: All authors declared no conflict of interest in relation to the main objective of this work.

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