



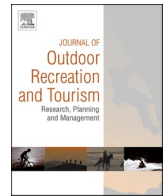
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Cases and context: Mask-related behaviors among U.S. trail visitors during the COVID-19 pandemic

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ABSTRACT

The challenge of simultaneously providing outdoor recreation opportunities while protecting the public from SARS-CoV-2 virus and COVID-19 transmission, as well as future pandemics, remains foremost on managers' minds. Safe spaces and cultures are paramount for managers and visitors alike. Recommended protective measures against COVID-19 included physically distancing 1.8 m (six-feet) between parties and mask-wearing when distancing is not possible. Adoption of these protective measures is relatively unknown but essential to inform recreation management and planning through future health crises. Such adoption is likely influenced by both the pandemic context and site context, particularly related to visitor density. An observational study assessed mask-wearing behaviors among trail walkers on multiple trails in the United States from November 2020 through May 2021. Trained observers identified if walking groups were prepared to mask or had masks correctly worn as well as if encounters were compliant with the 1.8 m recommendations. Data collected across seven U.S. states enabled comparisons of mask-related behaviors across sites as well as considerations to: the influence of the pandemic context in terms of cases and vaccination rates, mask mandates, and trail density. Results from nearly 3000 encounters revealed significant variance in visible masks, low compliance of mask-wearing in encounters less than 1.8 m, significant influence of both COVID-19 cases and vaccination rates on mask wearing at half the sites, and no impact of state-level mask mandates when controlling for cases and vaccinations. Integrating public health data can inform predictions of compliant behaviors, or lack thereof, and needs exist to advance a safety culture.

Management implications

Site specific approaches that simultaneously promote leisure time physical activity and protect visitors are essential as visitors' preparedness to mask was generally low and varied across sites and even within communities.

Supporting a safety culture through enhanced educational efforts and examples of correct mask-wearing are one path to protection given the low compliance with mask-wearing, particularly with non-local

visitors.

Pandemic context and modelling can inform mask-related behaviors; subsequently integrating public health information into management plans is paramount as are integrated planning approaches for future pandemics.

1. Introduction

Outdoor recreation participation rates soared during the onset of the

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COVID-19 pandemic in many countries (Morita, HiroyoshiNakamura, & Hayashi, 2020; Outdoor Industry Association, 2020; Venter, Barton, Gundersen, Figari, & Nowell, 2020). Observational and mobility data revealed significant changes in behavioral and temporal patterns across all facets of life, including visits to parks, trails, and public greenspaces (Ritchie, 2020). For many, close-to-home outdoor and leisure-time physical activity (LTPA) were treasured escapes from the confines of home, affording mental and physical health breaks (Rice et al., 2020; Salari et al., 2020; Samuelsson, Barthel, Colding, Macassa, & Giusti, 2020) at a time when mental health issues were exacerbated (Abbot, 2021) and leisure-time physical activity options limited.

As the pandemic progressed, national and international health organizations recommended a variety of protective measures against the SARS-CoV-2 virus and subsequent COVID-19 transmission, including physical distancing of 1.8 m (six-feet) between parties and mask wearing, particularly when distancing was not possible (WHO, 2019; U.S. Center for Disease Control and Prevention (CDC) 2020a, 2020b). As COVID-19 endured, so did recommendations to stay 1.8 m apart in the outdoors, and wearing a face mask was recommended (CDC, 2020c) and even mandated in some areas if distancing could not be maintained (Boulder, CO, USA; Seoul, South Korea). For example, since February 2021 the U.S. National Park Service has required masks in facilities and on NPS-managed lands when distancing is not possible (National Park Service, 2021); masking recommendations remain for those not vaccinated through the fall 2021 season (National Park Service, 2021). Even when mask requirements are not prescribed outdoors at national parks (e.g., Costa Rica), “some people keep their mask handy in case they pass others along the trail” (Turnbull-Houde & Houde, 2021, para. 38).

Safe visitor experiences are the responsibility of both managers and visitors (Rickard, McComas, & Newman, 2011). To understand the visitor side and inform management response, physical distancing compliance in parks and trails has been observed in the United States (Bias et al., 2021; Wynveen et al., 2021; Wynveen et al., in press). Physical distancing alone may not be enough to get and keep people active as Kim and Kang (2021) found distancing did not completely quell perceived risk among their Korean sample. Those concerns are not without cause, as conservative analysis revealed non-compliance exposed 61.5% of individual trail users to COVID-19 risk (Schneider, Shinew, & Fernandez, 2014). Rader et al.'s (2021) analysis revealed U.S. communities with both high self-reported distancing and mask-wearing had greater control of COVID-19 transmission than communities using only one approach. As such, mask use is also of interest to park and recreation managers, planners and researchers (Cohen et al., 2021; Schneider et al., 2021; Wynveen et al., 2021) to reduce the risks of outdoor recreation and maximize its physical and health benefits.

Masking as a mitigation factor has been explored in a limited quantitative manner, primarily through intentions to mask assessed via questionnaires (Timmons et al., 2020). Actual mask-related behavioral data is less prevalent and limited. To date, a handful of masking studies exist within the outdoor recreation literature. Cohen et al. (2021) observed people within a single U.S. metropolitan area in August 2020 across 30 sites and found 60% of those observed had masks; in parks, equal percentages had no masks or wore masks correctly (43.9% and 43.4%, respectively). In pilot testing spring-summer 2020, we observed 11% of visitor groups, at sites across six states, included at least one person wearing or with a mask (we did not collect data on correct wearing behavior).

1.1. Purpose

Given the importance of mask-wearing in the risk mitigation against COVID-19 and other viruses, this project seeks to understand the use of masks on recreational trails. Specifically, the goals of this investigation were to: 1) document if and how often trail visitors complied with CDC-masking recommendations; 2) determine if compliance varied by trail site; 3) compare contextual factors reflecting pandemic status (i.e.,

number of cases and percent of population fully vaccinated) and masking mandates relationships with masking compliance across sites; and 4) assess if and how visitor density predicted mask-related behaviors.

Although previous work is limited, risk frameworks reveal perception and mitigation behaviors are context dependent (Gstaettner, Lee & Rodger, 2018; Timmons et al., 2020). As such, we anticipated 1) the percentage of visitors with masks would vary by location, 2) the number of COVID-19 cases would positively relate to visitors with masks whereas the vaccination rate would negatively relate, 3) the presence of a mask mandate was hypothesized to positively relate to mask presence whereas days since masking order started would negatively relate, 4a) situational factors of trail-user density would positively relate to and predict mask presence, and 4 b) those within 1.83 m (6 feet) of others would be more likely to wear a mask.

2. Context

The novel situation of COVID-19 posed unprecedented viral exposure, unclear behavioral norms, and ultimately, risky situations. Although risk-taking can motivate or even define some groups for adventure or outdoor recreation (Haegeli & Probst-Haider, 2016), health-related risks are different. Further exacerbating risk in the outdoors is the unpredictability of outdoor recreation (Saunders, Weiler, Scherrer, & Zeppel, 2019). While safe spaces are of paramount importance during a pandemic, perceptions of those spaces likely evolve through a pandemic due to new information, uncertainty, and changing personal health situations (i.e. COVID-19 contraction). Indeed, among avid outdoor recreationists, Mateer et al. (2021) found perceived risk in the top three factors influencing outdoor recreation during the pandemic.

2.1. Safety culture

Safe spaces emanate from a culture of safety. Despite several decades of development, a common safety culture definition and its measurement remain elusive (Guldenmund, 2000; Zohar, 2010). From a participant's perspective, Andkjaer and Arvidsen (2015) define safety culture as a “system of shared beliefs, values, customs, behaviors and artifacts that the members of a group use to cope with safety” (pg. 142). Specifically, through interviews and focus groups, they articulated profiles of various water-based recreationists focused on six safety categories: 1) values and motives, 2) education and training, 3) equipment and clothing, 4) knowledge and skills, 5) risk assessment and attitudes, and 6) behavior and habits. Having and correctly wearing a mask to mitigate COVID-19 could clearly relate to participants' perceptions of a culture of safety and similarly differentiate visitors.

Distancing and mask-wearing mitigate risk but these behaviors are context dependent (Qian et al., 2020; Setti et al., 2020; van Doremalen et al., 2020). In a sample of U.S. residents in December 2020, Timmons et al. (2020) reported the most frequently cited risk factors for COVID-19 transmission as number of people, distance between parties, location, hand hygiene, and masks; a more recent survey would likely also include vaccination status. As such, this observational study included the situational factors related to the site density, pandemic status of cases and vaccinations, as well as mask mandates.

As the number of COVID-19 cases ebb and flow across the globe and within communities, people's behaviors necessarily change. For example, as the number of cases and hospitalizations fluctuate, local governments remove or add travel restrictions, stay-at-home orders, and mask mandates (Webber & Hollingsworth, 2020). Moreover, as vaccinations become available and people are increasingly protected via partial or full vaccination, people evolve into a ‘vaccinated’ life with greater social opportunities, increased confidence, and some return to routine. For example, a club goer in Leeds was quoted “This has been like life has come back to normal all of a sudden,” referring to the

relaxation of COVID-19 restrictions in the United Kingdom (Shearing & Lee, 2021, para. 19). Similarly, if and as cases rise, concerns return (Ipsos, 2021). Both of these factors, number of cases and percent of population vaccinated, obviously influence mask-related behaviors and recommendations.

In October 2019, the World Health Organization ‘conditionally recommended’ cloth face masks worn by asymptomatic people in severe epidemics or pandemics. Although focused on influenza, the guidelines were timely as COVID-19 emerged and the prevention of exhaled droplet dispersion became even more important. While other countries adopted or had mask-wearing policies in place shortly thereafter (He & Laurent, 2020), it was April 2020 when the U.S. Center for Disease Control and Prevention recommended cloth masks be worn in public spaces to prevent COVID-19; 62% of the public indicated they would follow the order (CDC 2020b). In June, the U.S. CDC clarified that masks should be worn in the outdoors when distancing was difficult (CDC 2020d). U.S. states varied in their policy responses to masking in public spaces, with 39 of the 50 states imposing mask mandates at some point in the pandemic. In 2021, four states, including Florida and Texas, instituted policies preventing local districts from instituting their own mask wearing rules. Thus, the opportunity to understand the role of masking-mandates and outdoor recreation behavior presented itself. While the outdoors are deemed safer than the indoors for COVID-19 transmission, masking in high-density situations was recommended, particularly among those not vaccinated and when visitors are within 1.8 m (six feet). As of July 2021, indoor mask-wearing mandates existed in eight U.S. states for those not fully vaccinated against COVID-19 and, when in the outdoors if unable to maintain 6 feet of distance from others. Across the globe, mask-mandates vary. For example, as of July 2021, France required masks in public, even for those fully vaccinated; Canada suggested mask-wearing in any shared space with people from outside one’s own household, but in Australia mask-wearing was not mandatory (Bloomberg News, 2021).

Given the relative recency of COVID-19 and infrequency of pandemics, research on mask-related behaviors is limited. In terms of perceived risk, Timmons et al. (2020) found situations where masks were worn by one or both parties reduced risk 3 to 8 points. In December 2020, this same U.S. sample reported not distancing was riskier than going where no one wears a mask (Timmons et al.).

The impact of mask-mandates and policy on mask-wearing is of interest but the limited existing research reveals mixed results. A cross-sectional study revealed that self-reported mask-wearing did not significantly change after a mandate was introduced in the United States (Rader et al., 2021). A study of the influence of stay-at-home orders in the US revealed they positively influenced risk reduction behaviors such as mask-wearing (Liu & Mattke, 2020). Subsequently, other COVID-19 protective behaviors like distancing may be of interest as a correlate to masking as well. For example, Hoeben, Liebst, Bernasco, Van Baak, and Lindegaard (2021) estimated physical distancing on a busy street corner in and reported greater distancing compliance when shelter-at-home restrictions were in place. Such compliance, however, appears to wane over time as demonstrated by the general public observations (Hoeben et al.), a multi-state longitudinal study (Hamidi & Zandiatashbar, 2021), and trail groups (Wynveen et al. in press). Still, after observing park closure compliance in New Jersey, Volenec, Abraham, Becker, and Dobson (2021) offer that such policies can impact behavior and mitigate crises. Indeed, German researchers found a 40% decrease in the daily growth rate of reported COVID-19 cases in communities with mandates (Mitze, Kosfeld, Rode, & Walde, 2020).

Beyond policy, site-level characteristics influence mask-wearing behaviors as well. For example, if a trail or recreation area is deemed crowded and difficult to maintain a safe distance from other people, visitors might consider masking as a way to protect themselves. Although research is limited in this area, again we can consider general public behaviors related to the CDC-recommended physical distancing in crowded situations. Hoeben et al.’s (2020) camera observation

revealed a strong relationship between the number of people on the street and distancing non-compliance. In contrast, Schneider, Budruk, et al. (2021) found paved trail user group distancing behaviors were inconsistently impacted by density in a study of seven different trails: only four of the seven study sites revealed a significant relationship between density and distancing, and they were in different directions. Further, only two of the four were moderately strong. Planful-problem solving, such as bringing a mask, is one way to cope with potential stress and risk in the outdoors (Schneider & Hammit, 1995; Schneider & Wilhelm Stanis, 2007).

3. Methods

3.1. Observation

Observational research across fifteen multiple-use trails in seven states provided insight on mask wearing in a variety of social and physical environments (Fig. 1). Observations occurred throughout the day and week between November 25, 2020 through May 30, 2021. This research expanded on-going physical distancing observations described elsewhere (Schneider et al., 2021; Wynveen et al., 2021) where the first observed group, defined as one or more people travelling together, was tracked throughout a predetermined zone, noting the number of encounters with other groups. The extension to this observation work included mask-presence and mask-wearing as well as a trail site in Arizona. Specifically, the Mormon trail in the Phoenix metropolitan area was added to the database. Winding within South Mountain Park in the Phoenix metropolitan area (population 4.7 million, US Census Quick facts), the unpaved, up to 12-foot (3.65 m)-wide Mormon trail hosts 122, 950 visitors annually with up to 14,000 visitors monthly during spring who walk, hike, and enjoy the desert surroundings (D. Gronseth, personal communication, July 26, 2021). South Mountain park is part of the Phoenix Metropolitan Park System, which has more than 185 parks and more than 200 miles of trails (City of Phoenix Parks and Recreation Department).

3.2. Variables observed

Of particular interest to this study was the documentation of mask presence and mask-wearing among observed trail groups. Specifically, trained observers noted how many people in an observed trail group had a mask visible or were wearing a mask correctly (covering nose and mouth). The observers did not make observations on the type of mask or its material for two reasons. First, CDC and local public health recommendations often did not provide enough detail on which to base an observation. And second, material type, thickness and sometimes mask design were difficult to observe from a distance. Hence, we included any facial covers that could cover the mouth and nose as “masks” in our observations.

In line with previous work (Schneider et al., 2021; Wynveen et al., 2021) and to understand the relationship between CDC-recommended behaviors, we also included observer-estimated distance between observed and encountered groups (contact, .31 - 0.913 m (1–2.99 feet), 0.914–1.825 m (3–5.99 feet) or 1.83 m or more (6 feet or more), a trail density proxy (maximum number of observations per observation period, average 2 h), activity of the group encountered (walk, bike, etc.) and group size.

3.3. COVID-19 context: cases and mandates

Beyond site-situation specific variables of density and distancing, the context of the pandemic was captured by including the number of cases in the past seven days per 100,000 residents for the counties containing the trails in this study (New York Times, 2021). The analysis included partial and full vaccination percentages of those over 18 by county (Centers for Disease Control, 2021) to compare and predict mask-related



Fig. 1. R. Stein, adobe illustrator, 12/16/2021.

behaviors. County-level vaccination rates for Texas were obtained from a different source that aggregated Texas Department of State Health Services data (Sullender, 2021), and vaccination rates were only

available for the 16 or older population. In addition, we assessed if and how a mask-wearing mandate impacted mask-wearing behaviors. Sites with no mask mandate or those with mandates in place for the duration

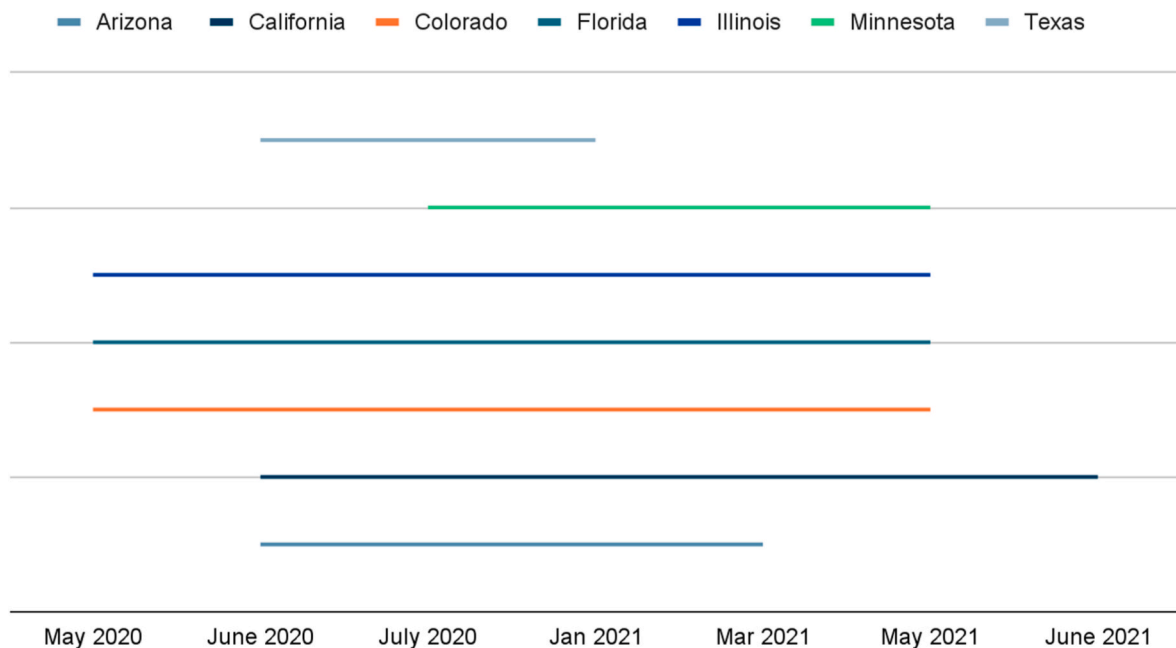


Fig. 2. Timing of state-level masking mandates across study sites.

of data collection, and no change, were not included in this analysis.

3.4. Variable coding

Mask presence, masks worn correctly, and physical distancing compliance were coded as 0 (no mask, not worn correctly, non compliant distance <1.83 m; 6 ft) or 1 (mask, worn correctly, compliant distance ≥1.83 m; 6 ft). Density was defined as the maximum number of observations during an observation period per site (i.e., the greater the number of observations, the greater the use density during the observation period; 1–81). We also assessed if a mask-mandate was in place on the day of observation and calculated the number of days elapsed between the observation date and the mask mandate start date for each trail locale (Fig. 2).

3.5. Analysis

Walkers were of primary interest for this mask-related observation as walking/hiking is one of the most common forms of leisure-time physical activity (Outdoor Industry Association, 2021, p. 27) and the messaging on mask-wearing among more physically vigorous activity types (running, biking) evolved during the study period. Thus, we selected observations of walkers from the database and assessed mask-related behaviors through descriptive and comparative analysis across sites and contexts. Two Colorado sites did not have enough cases and were eliminated from analysis and data were only collected in the winter for a Minnesota site, so we removed that site as well (n = 2895). Chi-squared tests compared the probability of mask-wearing between sites and logistic regression models quantified associations between trail-density proxy, pandemic factors (7-day case rate, vaccination rates, complete and single-dose) and mask-wearing. All analyses were done in R.

4. Results

4.1. Encounters

Observed walker groups most frequently consisted of solo or a pair of walkers (85% of groups) with an average group size of 1.83 (SD = 1.060). Similarly, the majority of encountered groups (88.3%) consisted of 1–2 people (M = 1.63, SD = 0.958).

4.2. Mask wearing

4.2.1. Overall masking and site

Our initial research questions focused on describing if and how the trail walkers were prepared to mitigate risk and then, as necessary, comply with CDC-masking recommendations. Overall, 33.1% of observed visitor groups included visible masks (Table 1). As hypothesized, visible masks observed varied by site, with Arizona groups having

Table 1 Mask-visibility and wearing among trail sites observed, November 2020 to May 2021.

	Overall	AZ	CA	CO CH	CO SA	FL DP	FL HRT	FL LOB	IL	MN	TX CB	TX WRT	Chi squared	Cramer's V
% groups with at least 1 mask visible or worn	33.1 (n = 2848)	10.4 ^{de}	40.6 ^{ab}	45.4 ^{ab}	75.1 ^c	40.2 ^{ab}	27.7 ^{bd}	11.6 ^{de}	49.3 ^a	18.9 ^{de}	11.7 ^{de}	12.1 ^e	499.00***	.403***
% groups with masks worn correctly within 6 feet of other party	24.2 (n = 1020)	9.5 ^{a-h, j}	32.1 ^{a-h}	21.5 ^{a-h}	67.7 ⁱ	33.3 ^{efgh}	38.1 ^{b, d, f, h, i}	9.1 ^{a-h, j}	39.3 ^{cdghi}	9.9 ^{ej}	4.3 ^{aj}	6.9 ^j	232.71***	.451***

AZ - Arizona, Mormon Trail; CA-California, Baywood Park, CO CH -Chautauqua Trail; Colorado, CO SA Sanitas Valley Trail, Colorado. FL DP -Depot Park Florida; FL HRT-Hawthorne Rail Trail; Florida; FL LOB-Loblolly Woods, Florida; Illinois-Hessel Park Trail. MN Lake of the Isles, Minnesota; TX CB-Cotton Belt Trail, Texas; TX WRT-Waco River Trail, Texas. Each subscript letter denotes a subset where the column proportions do not significantly differ.

the fewest visible masks (10%) and Colorado the most frequently visible masks (75% at SA) (p-value for between-site heterogeneity <0.001). Within Colorado and Florida communities, mask-wearing related differences existed. Mask visibility was significantly higher at Colorado's SA site than the CH site; similarly, Florida's DP site had higher mask visibility than its LOB site.

4.2.2. Masking and physical distancing

Compliance with 6-foot distancing guidelines was positively associated with mask visibility, with compliant encounters having a 30% higher odds of mask-wearing (95% CI: 4%–62% higher, p = 0.02). The majority of observed encounters were less than six-feet apart (53.4%; n = 1911), and within these, 24.2% included observed group members correctly wearing masks (Chi square 232.71, p < 0.001). The two sites with significant associations between mask-visibility and distancing had opposite effects, with odds ratios of 0.52 (FL DP) and 6.4 (TX CB). Correct mask-wearing was lowest at Texas sites (4–6%) and highest at a Colorado site (SA, 67.7%; Table 1). Similar to mask visibility and readiness, the rate of correct mask wearing was significantly higher at Colorado's SA site than the CH site; similarly, Florida's DP site had higher mask correct wearing than its LOB site (both p < 0.001). The odds

Table 2 Effect of distancing (<vs. > 6 feet between groups) on the probability that any member of the observed group had visible or correctly worn masks.

Site	Predictor: Distancing Between Observed & Encountered Groups					
	Outcome: Mask Visibility ⁺			Outcome: Correct Mask-Wearing*		
	OR	95% CI	p-value	OR	95% CI	p-value
CA	1.22	(0.355, 4.190)	0.753	0.80	(0.223, 2.920)	0.744
CO:CH	1.49	(0.978, 2.260)	0.064	1.26	(0.726, 2.180)	0.412
CO: SA	1.37	(0.587, 3.200)	0.466	0.94	(0.391, 2.260)	0.89
FL: DP	0.52	(0.274, 0.998)	0.049	0.66	(0.332, 1.350)	0.261
FL: HRT	1.5	(0.398, 5.650)	0.549	1.15	(0.300, 4.430)	0.835
FL: LOB	-	-	-	-	-	-
IL	2.36	(0.653, 8.510)	0.19	0.94	(0.242, 3.710)	0.938
MN	1.14	(0.713, 1.820)	0.587	1.74	(0.982, 3.090)	0.058
TX: CB	6.42	(1.230, 33.300)	0.027	6.42	(1.230, 33.300)	0.027
TX: WRT	1.53	(0.644, 3.650)	0.334	2.64	(1.030, 6.760)	0.044
AZ	-	-	-	-	-	-

AZ - Arizona, Mormon Trail; CA-California, Baywood Park, CO CH -Chautauqua Trail; Colorado, CO SA Sanitas Valley Trail, Colorado.

FL DP -Depot Park Florida; FL HRT-Hawthorne Rail Trail; Florida; FL LOB-Loblolly Woods, Florida; Illinois-Hessel Park Trail.

MN Lake of the Isles, Minnesota; TX CB-Cotton Belt Trail, Texas; TX WRT-Waco River Trail, Texas.

+ = Any observed group member had a visible mask.

* = Any observed group member was wearing a mask correctly.

- = Could not be estimated.

of any member wearing masks correctly was 33% higher during compliant encounters (Table 2). The two sites with significant associations between correct mask-wearing and distancing had odds ratios of 2.6 and 6.4.

4.2.3. Masking and COVID-19 case and vaccination rate

Seven-day COVID-19 case rate was positively associated with the probability of mask-visibility, with a 1 SD increase in COVID-19 case rate (approximately 150 cases per 100,000 in a 7-day period) resulting in a 25% (95% CI: 16%–35%; $p < 0.001$) increase in the odds of mask-visibility. Effects were somewhat smaller (18% increase in odds of mask visibility for a single SD increase in COVID-19 case rate) after adjusting for site. The strength of association between both COVID-19 case rate and mask visibility was somewhat heterogeneous between sites, with a 1 SD increase in COVID-19 case rate estimated to change the odds of mask wearing by -19% (TX CB) to +130% (AZ M), though neither of these extreme estimates was statistically significant. Odds ratios at six of eleven sites were statistically significant, ranging from 1.58 to 2.07. Also as expected, vaccination rates were significantly and negatively related to mask presence, with every 10% increase in vaccination rate associated with a 25% decrease in the odds of mask visibility (95% CI: 30%–20% decrease; $p < 0.001$). Odds ratios ranged from 0.34 (CO SA) to 1.76 (AZ M); six sites had significant odds ratios ranging from 0.34 to 0.64. Notably, the same six sites (CO CH & SA, FL HRT & LOB, MN LOI, and TX WRT) that showed a significant positive association between COVID-19 case rate and mask presence also showed a significant negative association between vaccination rate and mask visibility (See Table 3).

The presence of a mask mandate was associated with a 281% increase in the odds of mask visibility (95% CI: 189%–402% increase, $p < 0.001$). Adjusting for the COVID-19 case rate did not substantially impact the results. In the four states with mask mandate changes during data collection, the presence of the mandate was significantly related to mask visibility at three of seven sites, with odds ratios ranging from 2.96 to 7.98. After adjustment for COVID-19 case rate, the range of odds ratios was smaller and only one site retained its significance with an odds ratio of 2.81.

4.2.4. Masking and mask-mandates

Within the first 300 days implementing a mask mandate, every 30 days since the implementation of a mandate was estimated to reduce the odds of mask visibility by 16% (95% CI: 29.5% reduction to 0.4% increase, $p = 0.056$). Adjusting for the COVID-19 case rate eliminated the association (OR = 1.022, 95% CI 0.72 to 1.45, $p = 0.9$). Only one site (MN LOI) had a significant relationship between days since mask mandate and mask visibility, with an odds ratio of 0.37. None of the site-specific associations were significant after adjustment for COVID-19 case rate (See Table 3).

4.2.5. Masking and trail density

Visitor density was not significantly related to mask visibility overall, with an estimated odds ratio of 0.964 (95% CI: 0.88 to 1.06, $p = 0.44$) for every 1 SD increase in density. Adjusting for COVID-19 case rate changed the estimated odds ratio to 0.94 (95% CI: 0.857 to 1.03, $p = 0.18$). In unadjusted models, only one site (FL DP) had a statistically significant relationship between density and mask wearing, with every 1 SD density at this site associated with a 47% increase (95% CI: 13%–92% increase, $p = 0.004$) in the odds of mask visibility; other sites had (non-significant) estimated odds ratios ranging from 0.79 to 1.46. In models adjusted for COVID case rate, three sites (CO CH, FL DP, FL HRT) had significant associations between visitor density and mask visibility, with respective odds ratios of 0.59, 1.5, and 2.23 (See Table 3).

5. Discussion & conclusions

Systematic observations of mask-wearing related behaviors among urban trails users across several U.S. states revealed a range of

Table 3 Associations between predictors (COVID Case Rate, Vaccination Rate, select COVID-19 statistics, policy conditions) and observed mask-visibility.

Site	Outcome: Mask Visibility in Observed Group					
	Predictor: COVID Case Rate ⁺			Predictor: Vaccination Rate [*]		
	OR	95% CI	p-value	OR	95% CI	p-value
CA	1.090	(0.833, 1.420)	0.539	0.922	(0.775, 1.100)	0.354
CO:CH	1.760	(1.400, 2.210)	<0.001	0.543	(0.418, 0.704)	<0.001
CO:SA	1.580	(1.040, 2.410)	0.033	0.342	(0.150, 0.777)	0.01
FL:DP	1.180	(0.917, 1.530)	0.196	0.945	(0.760, 1.180)	0.611
FL:HRT	2.070	(1.280, 3.350)	0.003	0.470	(0.266, 0.829)	0.009
FL:LOB	1.580	(1.010, 2.480)	0.043	0.445	(0.267, 0.740)	0.002
IL	1.180	(0.838, 1.660)	0.345	0.851	(0.456, 1.590)	0.613
MN	1.850	(1.410, 2.430)	<0.001	0.632	(0.507, 0.788)	<0.001
TX:CB	0.809	(0.431, 1.520)	0.508	1.210	(0.654, 2.250)	0.542
TX:WRT	1.380	(1.090, 1.750)	0.007	0.642	(0.477, 0.864)	0.003
AZ	2.340	(0.280, 19.600)	0.433	1.760	(0.341, 9.060)	0.5

Site	Predictor: Mask Mandate (Y/N) ^{**}						Predictor: Mask Mandate (Days) [#]						Predictor: Visitor Density [@]														
	OR			95% CI			p-value			OR			95% CI			p-value			OR			95% CI			p-value		
	CA	-	-	-	-	-	-	1.050	(0.802, 1.360)	0.743	-	-	-	1.190	(0.907, 1.560)	0.21											
CO:CH	-	-	-	-	-	-	-	-	-	-	-	-	0.585	(0.447, 0.765)	<0.001												
CO:SA	-	-	-	-	-	-	-	-	-	-	-	-	0.728	(0.382, 1.390)	0.335												
FL:DP	2.96	(1.170, 7.480)	0.022	1.340	(0.016, 112)	0.898	1.500	(1.140, 1.960)	0.003	1.500	(1.140, 1.960)	0.003	1.500	(1.140, 1.960)	0.003												
FL:HRT	1.14	(0.220, 5.930)	0.874	0.326	(0.022, 4.87)	0.416	2.230	(1.140, 4.360)	0.018	2.230	(1.140, 4.360)	0.018	2.230	(1.140, 4.360)	0.018												
FL:LOB	1.45	(0.523, 4.040)	0.472	1.070	(0.316, 3.60)	0.918	1.010	(0.526, 1.940)	0.977	1.010	(0.526, 1.940)	0.977	1.010	(0.526, 1.940)	0.977												
MN	7.98	(1.080, 59.100)	0.042	0.368	(0.205, 0.660)	<0.001	1.150	(0.876, 1.510)	0.315	1.150	(0.876, 1.510)	0.315	1.150	(0.876, 1.510)	0.315												
TX:CB	0.57	(0.123, 2.640)	0.472	1.330	(0.329, 5.340)	0.692	0.833	(0.455, 1.530)	0.554	0.833	(0.455, 1.530)	0.554	0.833	(0.455, 1.530)	0.554												
TX:WRT	3.11	(1.550, 6.230)	0.001	0.882	(0.432, 1.800)	0.732	1.020	(0.751, 1.400)	0.877	1.020	(0.751, 1.400)	0.877	1.020	(0.751, 1.400)	0.877												
AZ	-	-	-	-	-	-	0.882	(0.318, 2.450)	0.81	0.882	(0.318, 2.450)	0.81	0.882	(0.318, 2.450)	0.81												

AZ - Arizona, Mormon Trail; CA-California, Baywood Park, CO CH -Chautauqua Trail, Colorado, CO SA Sanitas Valley Trail, Colorado. FL DP -Depot Park Florida; FL HRT-Hawthorne Rail Trail; Florida; FL LOB-Loblolly Woods, Florida; Illinois-Hessle Park Trail. MN Lake of the Isles, Minnesota; TX CB-Cotton Belt Trail, Texas; TX WRT-Waco River Trail, Texas.

+ = Number of new COVID cases in past 7 days per 100,000 residents for the county in which the trail is located.

* = Percentage of adults fully vaccinated for COVID-19 for the county in which the trail is located.

^ = Whether or not a mask mandate was in place on the day the encounter was observed.

= Number of days that a mask mandate had been in place on the day the encounter was observed. Restricted to observations within 300 days of the implementation of mask mandates.

@ = Maximum number of observations during observation period (proxy for trail visitor density).

- = Could not be estimated.

preparedness to meet existing CDC recommendations and low compliance with mask-wearing within six-feet of encountered groups, save one site (CO SA). As expected, COVID-19 cases and vaccination rates were related to mask-wearing behaviors in the expected direction, but with varied strength across sites. Mask mandates were not significantly related to mask-preparedness when controlling for COVID-19 case-related factors and trail density was significant in only three sites, with varying ranges. Research and management suggestions follow.

5.1. General masking

For the majority of sites, results mirror other safety research where visitors are unprepared (Saunders et al., 2019) as less than 50% of visitors had a mask visible or worn. Like Cohen et al.'s (2021) Philadelphia study, our observed visitors demonstrated a range of mask-related behaviors. In this pandemic atmosphere it may be that people are still negotiating the risk of contracting illness in the outdoors. Past research shows that traditionally visitors evaluate risk through the structural and social environment (Groshong, Wilhelm Stanis, Kaczynski, & Hipp, 2020; Kuo & Sullivan, 2001). Eroglu and Harrell (1986) coined the term *functional crowding* to describe the sense of security people perceive when observing other people in an area: people feel 'safe' with some presence of others rather than complete isolation. However, the COVID-19 pandemic altered how people perceive crowds, and, likely, many visitors were adjusting to this new risk of 'others' and 'culture of safety.' Relating Adkjer and Arvidsen's (2015) definition of safety culture as a "system of shared beliefs, values, customs, behaviors and artifacts that the members of a group use to cope with safety" (pg 142) to these data is helpful in that it highlights the *potential lack of* "shared" views and behaviors among the trail users regarding safety measures. Indeed, Barile et al. (2020) found a key predictor of wearing face coverings was seeing others wearing face coverings and positive attitudes impacted intentions to mask among a Korean sample (Kim, Cho, & Kang, 2020). Working toward shared views, agencies evolved messaging and, as of December 2021, most messaging highlights preparation, including masking (i.e. know before you go). Beyond messaging, opportunities to provide masks on site, akin to dog-waste bags, may be useful to both supply and inform newer visitors, forgetful visitors and nudge those uncertain about masking to take the protective step. Branded masks, for sale or sponsored give-aways, may be another approach and strengthen the signal that the agency supports safe recreation. Such actions align with visitor beliefs that safety is a shared responsibility (Rickard et al., 2011). Within community differences existed where Colorado sites had significantly different masking behaviors. Managerial insights indicate the site with more masking had more 'regular' users and likely place-knowledge and attachment than the other site which is a promoted 'tourist' to-do. The 'community' of users may have social norms for and consequences for not masking. An additional consideration is the safety risk of mask-wearing during heavy exercise which could have influenced people at our study sites and even compelled them to go elsewhere.

5.2. Masking, cases and vaccination rates

In terms of the pandemic status, COVID-19 cases and vaccination rates were clearly influential in mask preparedness in half of the sites. The increased fear and risk associated with rising cases likely influenced the call to action for preparedness. Similarly, the reduction in mask-presence as vaccinations rose perhaps reflects the related decrease in perceptions of contracting and dying from COVID-19 that steadily decreased from January to June 2021 (USC Dornsife, 2021). Questions remain as to why the pandemic status influenced only half the sites, with differences even within communities in Florida and Texas. One possibility is that data collection occurred during high seasons for 'snow birds' in the U.S. south and its possible differences in locals vs tourists exist in terms of mask-related behaviors and that some of these sites

were more frequented by winter visitors than locals.

5.4. Masking and mandates

In contrast to case-rates, a mask mandate did not significantly influence mask-preparedness when considering case rates and sites. These results mirror Rader et al. (2021) findings among the general U.S. public where a mandate had no impact on masking. Exploring the timing and duration of mandate efficacy would be a logical next step. Just as the mandate itself was not significantly influential on mask-related behaviors, neither was time since its inception when including case-rates, except at the Minnesota site. These results contrast with Mitze et al. (2020) who found that as time went on, mask-wearing decreased. Beyond timing, attempting to understand the role of multiple mandates and mandates at different levels would be of interest. With the rise of cases in Los Angeles in summer 2021, a local mask-wearing mandate was implemented July 17, in contrast to state and federal recommendations at that time (Money, Lin, & Hernandez, 2021). The U.S. CDC issued new mask guidelines on July 27 recommending mask wearing for both vaccinated and unvaccinated individuals, indoors in areas of widespread community spread. A federal mask mandate was subsequently implemented on July 29 for governmental employees and contractors. Given the significant political polarization around masking, consideration of visitors political affiliation is also pertinent (Kahane, 2021; Xu & Cheng, 2021). In fact, when controlling for other personality traits, Xu and Cheng (2021) found political affiliation was very influential in predicting who would wear a mask. Another potential confounding factor with the implementation of multiple mandates is the possibility of information overload. In a 2021 study, Mohammed et al. (2021) observed an association between frequency and source of information and information overload. Information overload was clearly present amongst the study participants. The revisions, updates, and changes to mask-wearing protocol by states or counties likely exacerbated miscommunication. Regardless, park and recreation agencies can not rely on state-level mask mandates to influence behavior onsite. Cues and encouragement toward protective behaviors should occur throughout the travel experience, from anticipation through return home. For example, Boulder Open Mountain Space worked with surrounding peer agencies, local hotels, and the tourism bureau to create shared messaging and coordinate visitor use management actions. Communications included social media campaigns, large road-side message boards, on-site educators and billboard-style signage.

5.5. Masking and visitor density

Somewhat surprisingly, there was a lack of relationship between mask-wearing behaviors and trail density. Only three of the sites had positive relationships and their strength varied. Timmons et al. (2021) found the number of people a key factor for estimating COVID-19 risk and thus, one would expect that as the trail density increased people would be more inclined toward protective behaviors like masking. Several possible explanations exist and relate to both behavior and measurement. In terms of behavior, perhaps visitors' evolving expectations of density and changed time-use patterns impacted people's preparedness. Trail density evolved through the pandemic with 'irregular' patterns during its onset and then a return to patterns typical of pre/post work hours seen before COVID-19 onset. Given the percent of newer or first time users, it is possible that visitors did not accurately estimate trail use and subsequently were unprepared for dense trail conditions. Also, as in other situations where people overestimate their skills and experience, perhaps people thought they could distance or would take actions to do so. For example, 5–42% of paved trail visitors observed in spring 2020 went off trail to avoid others and maintain a 'safe' distance (Schneider, Budruk, et al., 2021). Alternatively, a different trail density measure may be more related to mask-wearing behavior.

5.6. Future research

Clearly future research opportunities exist to elaborate on these findings as well as expand understanding beyond the U.S. border. Indeed, as the United States were relatively inexperienced with mask-wearing, mask-related behaviors are likely quite different in other parts of the world where masks may be more frequently worn in non-pandemic times. Beyond the border expansion, additional opportunities lie in considering the suite of recreation opportunities, a broader sample, as well as automating data collection and analysis. In terms of locales, we focused on trails within or close to urban areas, but the entire suite of outdoor recreation venues are of interest across the recreation opportunity spectrum and wildland-urban interface (Mateer et al., 2021). In terms of recreation activities, we focused on trail visitors, but a broader sample that includes other outdoor activities (including even higher-risk activities such as rock climbing or white-water rafting) might provide additional insights. As our sample excluded the risk-averse population not engaging in trail-related recreation, engaging entire communities or visitorships to understand their risk perceptions and behaviors would allow risk segmentation (Priporas, Vassiliadis, Bellou, & Andronikidis, 2014), tailored messaging (Tsaksis & Schneider, 2021) to improve communication about appropriate behaviors, and enhance trust (van Riper et al., 2016). Real-time information in terms of density has influenced other COVID-19 related behaviors (Adam, Werner, Wendt, & Benlian, 2020) and perhaps adding information about distancing and masking compliance would further direct behaviors. Our project did not include compounding risks or constraints related to race-ethnicity, crime or discrimination (Schneider, Shinew, & Fernandez, 2014). For example, due to framing of the COVID-19 in the United States, physical safety concerns emerged among Asian Americans and, as such, anecdotal evidence reveals they did not recreate outdoors and were constrained from the much-needed mental and physical benefits of outdoors (Tavernise & Oppel, 2020). Given the already constrained nature of non-dominant racial and ethnic groups in the United States and their increasing population, addressing these constraints and additional risks are both a necessity and opportunity. Methodologically, automating observation and analysis, through visitor-related photographs or onsite camera systems (Hoeben et al., 2021) with computer-generated coding can potentially reduce error and afford greater attention to the entire scene, perhaps illuminating other influences on CDC-compliant behaviors. As public health crises will be a part of the future and as mask mandates evolve, additional research is imperative to continue to protect visitors in the natural settings that afford exercise and mental respite. While limited to observation, this research provides a strong foundation to build from for safe visitor use and management.

CRediT authorship contribution statement

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