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Inequitable Changes to Time Spent in Urban Nature during COVID-19: A Case Study of Seattle, WA with Asian, Black, Latino, and White Residents

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Abstract: The COVID-19 pandemic has impacted everyone in urban areas. Some of these impacts in the United States have negatively affected People of Color more than their White counterparts. Using Seattle, Washington as a case study, we investigated whether inequitable effects appear in residents' interactions with urban nature (such as urban green space). Using a 48-question instrument, 300 residents were surveyed, equally divided across four racial/ethnic groups: Asian, Black and African American, Latino/a/x, and White. Results showed that during the span of about 6 months after the onset of the pandemic, Black and Latino residents experienced a significant loss of time in urban nature, while Asian and White residents did not. The implications of these findings, including inequities in the potential buffering effects of urban nature against COVID-19 and the future of urban nature conservation, are discussed. Multiple variables were tested for association with the changes to time spent in urban nature, including themes of exclusion from urban nature spaces found throughout the existing literature. Findings show that decreases in time spent in urban nature among Black and Latino residents may be associated with their feeling as though they did not belong in urban nature. We provide recommendations based on these findings for how government agencies can promote more equitable access to urban nature during the pandemic and beyond. The results of this study have implications that extend beyond the US and are relevant to the international scholarly literature of inequities and urban nature interaction during the COVID-19 pandemic.

Keywords: urban nature; green space; equity; sense of belonging; COVID-19; BIPOC



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1. Introduction

This research lies at the intersection of three large conditions that are restructuring human lives and social systems. The first is recent: the COVID-19 pandemic. The second, and here we speak about the United States specifically, is the longstanding structural racism within society that continues to harm People of Color¹. The third is the increasing diminishment of nature on this planet, and in the lives of people. Because interacting with nature can help people physically and psychologically, it seems plausible that being in nature can buffer some of the pandemic's negative effects. Yet, if so, and given existing structural racism, it is also plausible that People of Color have not equally benefited from this potential.

Examining this disparity is the motivation for this study. During COVID-19, People of Color in US cities have experienced more negative outcomes (compared with the White population), with a higher likelihood of COVID-19 infection, poorer COVID-19 outcomes, higher stress and anxiety levels, and larger unemployment rates [1–6]. Thus, in this study we investigated whether the amount of time residents of Seattle, Washington spent in urban nature changed after 6 months of the pandemic, and if so, how those changes varied across

four racial/ethnic groups: Asian, Black and African American, Hispanic and Latino/a/x, and White^{2 3 4}.

1.1. *The Importance of Assessing Race/Ethnicity When Investigating Urban Nature Visitation*

One of the reasons why there may be inequities by race/ethnicity in changes in nature access during the pandemic is because of the history of racism in the US, which has led to historical differences in perceptions and use of urban nature. Roberts et al. [11] described how current environmental racism reflects racist policies in the past and how many historic policies were tied to the natural landscape. For example, after enslaved people in the US were declared free, former slave-owners “employed” freed Black Americans and sold them farm equipment, livestock, and other necessities in advance. Under sharecropping contracts, the Black workers were to pay the farm owners a share of their crop yield to pay for those assets making the accumulation of wealth extremely challenging [11]. This is just one way in which the relationship between Black Americans and the natural landscape has been intertwined with racism throughout US history.

Today, Black Americans’ relationship with nature continues to be shaped by historic racism. Finney [12] showed, for example, how urban parks were historically often places for acts of racism, and how these places can convey racist sentiments for some Black individuals. Natural landscapes can be associated with lynchings, slavery, segregation policies, and events of conflict and violence [12–14]. By contrast, for many White individuals more “wild” or “untouched” nature harkens to a “simpler time” before industrialization and represents a nostalgic longing for the past [12,14]⁵.

The deep history of racism intertwining with the natural world is reflected in the racism in natural spaces that continues today [16]. A recent example of racism in urban nature spaces that made national headlines occurred in Central Park, New York. In May 2020, a White woman called the police on a Black man who was birdwatching in the park because the man had asked the woman to leash her dog in accordance with the law [17]. As Newsome [18] writes: “For far too long, Black people in the United States have been shown that outdoor exploration activities are not for us, whether it be because the way the media chooses to present who is the ‘outdoorsy type’ or the racism experienced by Black people when we do explore the outdoors, as we saw recently in Central Park.”

As demonstrated in multiple studies, racial/ethnic inequities in access to urban nature appear in a multiplicity of ways: For one, White neighborhoods typically contain a higher density of urban nature areas compared with neighborhoods consisting primarily of People of Color due to redlining and other discriminatory housing practices [19–23]. Second, the quality of urban nature is generally lower in Communities of Color [24]. Third, the upkeep of urban nature is generally lower in Communities of Color [25,26]. Fourth, social barriers to urban nature accessibility for people in Communities of Color can exist at the personal, institutional, or systemic level. These barriers include lack of multilingual signage, safety concerns, lack of free time, transportation limitations, cultural expectations and norms, and historically segregated park design [19,27,28].

1.2. *Effects of COVID-19 on Urban Nature Access Disaggregated by Race/Ethnicity*

If measured as a homogenous group, some literature suggests that urban residents have increased their urban nature use during the pandemic [29]. For example, in a survey of land managers of urban parks across 12 US cities, 83% reported an increase in visitation to the spaces they manage [30].

However, when disaggregating residents by race/ethnicity, the emerging studies show conflicting results. Larson et al. [31], for example, found that Black and Hispanic (compared with White) residents of cities across North Carolina, USA, experienced a greater decrease in urban nature visitation 6 months after the start of the COVID-19 pandemic. Similarly, a study of New York City residents found that Black and Native American participants were more likely to experience a decrease in urban nature visitation during COVID-19 compared with Asian and White participants [32]. By contrast, other studies have found that People

of Color living in cities actually increased their time spent in urban nature during the COVID-19 pandemic. Pipitone and Jović [33], for example, found that non-White New York City residents increased their frequency of urban nature visitation during the first lockdown in New York City and again about 4 months after the pandemic started. Thus, to date, the research is not clear on the effects of the pandemic on nature interaction when disaggregating by race.

We sought to understand the nuances between racial/ethnic groups in terms of the changes to urban nature during the pandemic. To perform this, we disaggregated results by race/ethnicity rather than collapsed participants into White and non-White groups. This study sought to help clarify the existing literature by means of an opening that we saw when reviewing the (above) literature on race/ethnicity and urban nature visitation. Namely, it appeared to us that one overarching construct that might help explain differences in nature access by racial/ethnic group is what we call *sense of belonging in urban nature*.

1.3. Sense of Belonging in Urban Nature

We mentioned earlier the incident of a White woman calling the police on a Black man who was birdwatching in Central Park. As Roberts writes [28], this example carries forward a long history of racism that existed at the time when Central Park was built in the 1850's, when the park became an urban oasis for White people with privilege, and largely excluded People of Color. Roberts [28] writes that it is not just Central Park where this exclusion continues to occur, but in many urban parks and green spaces nationwide. The empirical literature supports this proposition (e.g., Hoover and Lim [16], Joassart-Marcelli [34], and Wolch et al. [35]). For example, Byrne [36] conducted focus groups with Latina women living in Los Angeles, California, near an urban national park. Most participants in this study expressed feeling 'out of place' and/or 'unwelcome' there. One Latina woman expressed worry that a resident would call the sheriff if they saw a Latino in a part of the park that was too close to the White neighborhoods.

Thus, it may be the case that inequities in sense of belonging may play a large role in differences in urban nature visitation across racial/ethnic groups. To date, however, most assessments of sense of belonging have been on people's perceptions of their place within a broader community or social group. Hagerty et al. [37], for example, described belongingness as perceiving oneself as a part of, and integral to, the collective whole. Hagerty and Patusky [38] went on to develop the Sense of Belonging Instrument (SOBI), which includes items with imagery evoking social alienation. One example is an item that reads: "I feel like a square peg trying to fit into a round hole".

Other lines of investigation that touch on sense of belonging are studies that focus on sense of place and place attachment. Sense of place is an overarching construct that describes one's feelings towards a place [39]. Place attachment, a subset of sense of place, more specifically refers to the positive connection between an individual and a specific place [40]. Peters et al. [41] used the idea of place attachment to better understand whether urban parks encourage social cohesion within a neighborhood. The study, which took place in the Netherlands, found that establishing an attachment to urban nature was associated with increased social cohesion amongst non-Western Dutch immigrants.

The literature on People of Color's feelings of exclusion from urban nature spaces shows a relationship between three dimensions: The self, the social, and nature. Sense of belonging, as it is currently characterized in the literature, largely centers around one's place within society, capturing the self and the social dimensions, and lacks the relationship to nature dimension. Sense of place and place attachment both focus on the relationship between the individual and nature, but do not include a larger social dimension. A sense of belonging in urban nature measurement has the potential to bridge the self, the social, and nature to understand the intricate relationships between these dimensions. For our purposes, the limitation with the existing bodies of literature related to belongingness is that they do not focus directly enough on experiences of exclusion, especially those due to a historical legacy of racism, in the context of urban nature.

Jennings et al. [42] described how addressing one instantiation of environmental injustice is not sufficient to tackle systemic environmental racism. In the case of urban nature, seeking to address inequitable feelings of belonging alone cannot deal with the deep history of racism in the US that has fed into today's exclusion of People of Color from urban nature spaces. Nonetheless, we view sense of belonging in urban nature as a significant theme seen throughout the environmental justice literature worthy of investigation.

One study that made a substantial contribution to this concept is from Pipitone and Jović [33]. They measured participants' sense of belonging in urban green space before and during the COVID-19 pandemic through a single 4-point ordinal scale question (with response options of "very strong", "somewhat strong", "somewhat weak", "very weak", and "I don't know") adapted from Rugel et al. [43] which reads "How would you describe your sense of belonging to local parks or urban green space?" This study found no significant difference in sense of belonging between White and non-White participants before COVID-19. Four months into the pandemic, White participants' sense of belonging was marginally significantly higher than that of non-White participants [33].

To the best of our knowledge, there is no existing scale or multi-item measurement that directly assesses sense of belonging in urban nature. Thus, this study sought to initiate the creation of such a measurement, and then to use it in our present investigation.

1.4. The Present Investigation

In this study, we investigated whether there were inequitable effects during the early period of COVID-19 in terms of the experience of urban nature across four racial/ethnic groups residing in Seattle, Washington: Asian, Black, Latino, and White. More specifically we sought:

1. To assess the frequencies of urban nature interactions before and during COVID-19 across the four racial/ethnic groups;
2. To test for differences in average change in frequency of urban nature interaction before and during COVID-19 across the four racial/ethnic groups;
3. To test whether there were inequitable effects of COVID-19 on the frequency of urban nature interaction before and during COVID-19, and to test for a significant effect of three variables: perceived coronavirus threat, perceived quality of nearby urban nature, and sense of belonging in urban nature, controlling for age, gender, income, and pre-pandemic frequency of urban nature interaction;
4. To gather themes of exclusion from urban nature among People of Color in the US to develop an exploratory new measure for sense of belonging in urban nature, and to employ the measure across the four racial/ethnic groups;
5. To characterize the types of urban nature interaction that residents engaged in before and during the pandemic to add depth to discussions of urban nature interaction.

2. Materials and Methods

2.1. Study Site

Seattle is located in the state of Washington in the Pacific Northwest of the United States. Seattle has a population of 737,015 [44]. Of Seattle's population, 67.3% identifies as White, 15.4% Asian, 7.3% Black or African American, 6.7% Hispanic or Latino (of any race), 0.5% American Indian and Alaska Native, and 0.3% Native Hawaiian and other Pacific Islander. Those who identify as some other race constitute 0.3% of the Seattle population and those who identify as two or more races constitute 6.9%. The median household income of Seattle is USD 92,263 [44].

Williams et al. [45] found Seattle to have less inequity in urban nature access compared with other major cities in the US including Atlanta, GA; Baltimore, MD; Detroit, MI; and Los Angeles, CA. Nonetheless, inequities in urban nature are prevalent. In Seattle, the amount of urban canopy cover in a given census tract is inversely correlated with the proportion of People of Color living in the census tract [46].

Seattle has a long history of racial segregation that has shaped the city. From 1910 to 1960, many Seattle housing property deeds contained clauses that explicitly prohibited People of Color or other discriminated communities from renting or buying the property. By the 1920's, certain areas of what were called the Central District and Chinatown were the only "open neighborhoods" available to People of Color [47]. Today, Seattle's Central District and International District (formerly Chinatown) are composed of 35.5% and 66.8% non-White residents, respectively. Both the Central District and International District have significant gaps in urban nature accessibility [48].

2.2. Participant Recruitment

Participants were primarily recruited online via the social media platforms Facebook and Instagram (both owned by the company Meta). Pay-per-click Facebook and Instagram ads were run by study researchers. These ads provided a short description of the study, advertised participant compensation, and provided a link to the study's eligibility questionnaire. These ads resulted in about 108,939 'impressions' (the number of times the ad is seen by a user. Users may have seen the ad more than one time). Ads were shown to Facebook and Instagram users aged 18 and over. Ads were dispersed equally to users residing within a 10-mile radius of downtown Seattle, encompassing the entire city of Seattle.

A Facebook post with identical information to the ad was shared in various community Facebook Groups. The posts were shared in general Seattle groups (such as 'Mt. Baker Neighborhood, Seattle' and 'Beacon Hill Social Club'), as well as in Facebook groups for Seattle residents of a specific race/ethnicity (such as 'Seattle Latinx Pride' and 'Families of Color Seattle'). The study description and eligibility questionnaire link were also distributed by study researchers to personal and professional connections via email to reach more potential participants. Although we do not know the exact reach of the free Facebook ads or emails, we may reasonably assume the reach of the paid Facebook ads far surpassed the reach achieved through free Facebook posts and email sharing.

Due to the recruitment method, participants were primarily drawn from Facebook and Instagram users, introducing a bias and excluding those who do not use those social media sites. Despite this drawback, Facebook advertising has become a common research recruitment technique and has been shown to result in fairly representative samples [49]. Reagan et al. [50] conducted a review of 18 studies that implemented Facebook advertising and free Facebook posts as recruitment techniques. Many of the included studies focused on sampling vulnerable populations. Reagan et al. concluded that Facebook and Instagram ads were effective recruitment methods stating, "... paid ads may increase the likelihood of reaching the target population and maximizing sample accrual."

Individuals interested in participating in the study were directed to an eligibility questionnaire hosted on Qualtrics where they provided responses used to determine eligibility. Prior to beginning the eligibility questionnaire, participants viewed a consent form and provided acknowledgement of consent. To be eligible for participation, individuals must reside within Seattle city limits, have lived in the same residence since at least fall 2019, be at least 18 years of age, be able to read and write English, and identify as Asian, Black or African American, Hispanic or Latino, or White. Individuals who identified as any other race/ethnicity or more than one race/ethnicity were not eligible. Eligible participants received a link to take the main survey after completing the eligibility questionnaire. Participants who completed the main survey received a USD 10 Amazon gift card via email. This study was approved by the University's Institutional Review Board (IRB ID: STUDY00011290).

2.3. Data Collection

Data collection began in January of 2021 and concluded March 2021. A quota sampling technique was used to achieve an equal number of participants in each of the four included racial/ethnic groups (Asian, Black, Latino, and White). After receiving 75 responses from White participants, White participant recruitment ceased and the survey was modified

so that only Asian, Black, and Latino individuals were eligible. Similarly, after 75 Asian responses were collected, Asian participant recruitment closed. A total of 78 responses from Latino individuals and 80 responses from Black individuals were received before the survey fully closed. A total of 75 participant responses were randomly sampled from each of these two groups to achieve an equal sample size between the four racial/ethnic groups. It was important for this study to strive for equal representation of the included four racial/ethnic groups. Equal representation, something that is not common among urban nature studies, allows for comparisons between racial/ethnic groups to be made with more confidence, enabling the results to speak to any urban nature inequities that are found.

2.4. Participant Characteristics

The sample consisted of 300 participants with 75 participants in each racial/ethnic group (Asian, Black, Latino, and White). It is worth noting that participants declared their race as part of this survey but were not asked to share any information about their cultural background, which may impact one's urban nature interaction habits. Participants indicated their total household income via income categories. The median annual household income category for the sample was USD 75,000–USD 99,000, encompassing the Seattle median of USD 92,263 [44]. There were slightly more females (56%) than males (42%) in the sample. Participants provided their age according to age categories, with the median age category being 25–34 years of age. This is just under the median Seattle age of 34.7 years of age [44].

2.5. Survey Instrument

A 25-minute survey consisting of 48 multiple-choice, Likert scale, and open-ended questions was administered to participants. This online survey was hosted on Qualtrics. The survey sought to capture changes in urban nature visitation 6 months into the pandemic as well as evaluate participants' urban nature perceptions and values. The following definition of urban nature was provided to participants before and throughout the survey: "Urban nature refers to parks, green areas, open spaces, and places with water, vegetation, and/or animals within the city of Seattle. Urban nature does not include things you may pass by briefly, such as trees along a sidewalk. Nature elements which one may pass by briefly, such as urban street trees, were not included as urban nature for this study to place more emphasis on urban nature spaces one may intentionally seek to spend time in."

To understand how participants' urban nature use changed during the COVID-19 pandemic, a set of questions was provided twice within the survey. The first time, participants were asked to reflect to their experiences in fall 2019 (before the COVID-19 pandemic). Participants were then provided the same set of questions and asked to respond according to their recent experiences in fall 2020 (about 6 months into the COVID-19 pandemic). Fall was chosen as the reference period for both before the pandemic and during the pandemic. One reason for this was to reduce variability that may be due to different levels of outdoor activity throughout the year. The second time point was positioned 6 months into the COVID-19 pandemic in an attempt to accurately represent how the pandemic may affect urban residents long term. The immediate changes to urban nature interaction during the early months of the COVID-19 pandemic may be more extreme or different than those changes seen further into the pandemic. With future disruptive events possibly affecting urban life for extended periods of time, a moderately long time span of 6 months may be most appropriate when assessing the impacts of the event.

2.6. Measures

The key measurements and scales included in this survey are below:

Types of Urban Nature Interaction: To attain some specificity in Seattle residents' urban nature interactions, this survey asked about the types of urban nature activities participants engaged in. Participants were provided a list of 20 common activities in urban

nature such as walking a dog and having a picnic. They were asked to indicate all urban nature activities which they had enacted in fall 2019 and fall 2020. These data draw upon Interaction Pattern Theory, a way of characterizing the meaningful and instantiated ways in which people interact with nature [51–54]. These data were collected to add more depth to our understanding of how urban nature interaction changed during the pandemic, if at all. Although we consider these data exploratory, they allow for greater nuance when considering how resiliency might be increased in urban communities.

Frequency of Urban Nature Interaction: Within this group of pre- and during COVID-19 questions, participants were asked about how frequently they spent time in urban nature in fall 2019 and fall 2020. This question read: “Over the course of fall [2019 or 2020], how frequently did you spend time in or around urban nature?” Participants responded to this multiple-choice question with how many days per week, on average, they spent time in or around urban nature in fall 2019 (before the pandemic) and fall 2020 (about 6 months into the pandemic). Multiple-choice response options included: “Less than once per month”, “1–3 times per month”, “Once per week”, “2–3 days per week”, “4–5 days per week”, “6 days per week”, and “Daily”. These responses were converted to days per month. The average of each response option was used (e.g., “Less than once per month” was replaced with 0 days per month, “2–3 days per week” was replaced with 10 days per month, and “Daily” was replaced with 28 days per month).

Urban Nature Conservation Values: A single Likert scale question was used to measure participants’ perceived level of importance of urban nature conservation to test for association with sense of belonging in urban nature. One’s urban nature conservation values were assessed through the question: “How important to you is the protection of urban nature?” The 5-point Likert question response options ranged from not at all important (1) to very important (5).

Perceived Coronavirus Threat Questionnaire (short): Three measures were explored as possible explanatory variables for the differences in the effects of COVID-19 on urban nature interaction frequency. The first was the short version of the Perceived Coronavirus Threat Questionnaire, developed and validated by Conway et al. [55]. This scale is used to assess the level of which participants were fearful of the COVID-19 virus. This measure was included as spending time in urban nature may mean being in close proximity to other people. During the COVID-19 pandemic, this may motivate city residents to spend less time in urban nature. This shortened scale was modified from a 7-point Likert scale to a 5-point Likert scale ranging from not at all true of me (1) to very true of me (5). The scale includes three items which read: “Thinking about the coronavirus (COVID-19) makes me feel threatened.”; “I am afraid of the Coronavirus (COVID-19).”; “I am stressed around other people because I worry I’ll catch the coronavirus (COVID-19).” Cronbach’s alpha for the Perceived Coronavirus Threat Questionnaire in this study was 0.74.

Perceived Green Space Quality Scale: The second measure explored as a possible explanatory variable for the differences in the effects of COVID-19 on urban nature interaction frequency was the Perceived Greenspace Quality Scale [56]. As previously noted, urban nature quality is a key dimension of accessibility, and can provide insight into why an urban nature spot might not be visited. This scale was adapted by replacing the term “greenspace” with “urban nature”. The 10-point Likert scale was converted to a 5-point Likert scale ranging from completely disagree (1) to completely agree (5). Examples of items in this scale include: “My neighborhood has safe urban nature spots.”; “My neighborhood has well-maintained urban nature spots.”; “My neighborhood has beautiful urban nature spots.” Cronbach’s alpha for the Perceived Greenspace Quality Scale in this study was 0.84.

Sense of Belonging in Urban Nature Questionnaire: The third measure we sought to explore as a possible independent variable for changes in frequency of urban nature interaction was sense of belonging in urban nature. No existing measurement fit the requirements for this measure, so an exploratory questionnaire was developed for this study. This measure, which we call the Sense of Belonging in Urban Nature Questionnaire, was intended to better understand experiences of inequity in urban nature, specifically as it

relates to one's sense of belonging. Each of the six items in this questionnaire correspond to a larger overall theme of inequity distilled from the existing literature. (See Table 1 for all items and corresponding literature). Participants responded to each item on a 5-point Likert scale ranging from completely disagree (5) to completely agree (1). Internal reliability of this questionnaire was high (Cronbach's $\alpha = 0.84$); however, this questionnaire remains unvalidated. The Sense of Belonging in Urban Nature Questionnaire is composed of six themes that characterize six racial/ethnic inequities in the pursuit of characterizing one facet of environmental racism. White people (of any nationality) form the majority in the US and do not, for the most part, face racial discrimination or racial inequities in the US, and by extension, in urban nature spaces. It is for this reason that the sources for the Sense of Belonging in Urban Nature Questionnaire are all grounded in the experiences of People of Color in the US.

Table 1. The Sense of Belonging in Urban Nature Questionnaire.

Theme	Item
Ease of Access [22,36,57–62]	"It is not easy for me to get to a park or other urban nature spot near my home."
Safety [13,25,36,60,61,63,64]	"When in an urban nature spot near my residence, I fear for my own safety or the safety of others around me."
Feeling Out of Place [25,36,64,65]	"I feel out of place in the urban nature spots I visit."
Unwelcomeness [13,36,61]	"I feel unwelcome by others when in urban nature."
Institutional Acceptance [13,26,28,36,65]	"I feel uncomfortable when I see a park management employee when in urban nature."
Different Ways of Interacting with Nature Acceptance [13,36,66–68]	"I feel that the way I use urban nature is unwelcome or unaccepted by other visitors."

The six themes of racial/ethnic inequities that form the Sense of Belonging in Urban Nature Questionnaire were identified through a literature review of social barriers to urban nature use among People of Color in the US and the resulting feelings of exclusion. The themes included in the sense of belonging measurement are by no means the only ways in which Communities of Color feel excluded from urban nature. Nor are they likely uniform for experiences across all Communities of Color. The themes of inequity included in the exploratory Sense of Belonging in Urban Nature Questionnaire are intended to characterize broad ways in which exclusion presents. The sense of belonging inequity themes are Ease of Access, Safety, Feeling Out of Place, Unwelcomeness, Institutional Acceptance, and Different Ways of Interacting with Nature Acceptance. See Table 1 for source literature for each theme. Descriptions of these inequity themes are below:

- **Ease of Access:** this theme characterizes difficulties in spending time in urban nature due to socioeconomic inequities including proximity to nearby urban nature, poor quality of nearby urban nature, lack of free time, and transportation limitations;
- **Safety:** one is less likely to feel a sense of belonging in urban nature if spending time in urban nature poses a risk to personal safety or the safety of others;
- **Feeling Out of Place:** This theme seeks to capture feelings of not belonging or fitting in within the landscape. There are several factors that may lead to one feeling out of place in urban nature spaces. Some include having very limited representation of People of Color in nature spaces, cultural expectations and norms, and being the only Person of Color in an urban nature space;
- **Unwelcomeness:** Feelings of not belonging in urban nature can arise from external exclusion from those in the White majority. Overt and covert messages from White individuals in urban nature spaces can send a clear message of unwelcomeness to People of Color in the space;
- **Institutional Acceptance:** If People of Color are not accepted in urban nature on an institutional level, urban nature spaces and management practices reflect that. People of Color may feel that urban nature areas were not created for them, with the design catering to typically Eurocentric ways of interacting with urban nature. People of

Color also experience conflicts with those who manage urban nature spaces due to their presence in these spaces;

- **Different Ways of Interacting with Nature Acceptance:** People of Color may feel that the way they use urban nature is not deemed acceptable or welcome by others.

2.7. Analysis

Participants' frequencies of urban nature interaction in fall 2019 (before COVID-19) and fall 2020 (6 months into COVID-19) were first compared between racial/ethnic groups. The Kruskal–Wallis non-parametric equivalent to ANOVA was conducted to test whether any pair(s) of racial/ethnic groups had significantly different frequencies of urban nature interaction in fall 2019. The Kruskal–Wallis test uses ranked data points to test for differences in the mean rank of each group in the independent variable. Dunn's test for stochastic dominance, a common post-hoc test following the Kruskal–Wallis test, was then used to identify which pair(s) of racial/ethnic groups significantly differed in frequency of urban nature interaction in fall 2019. The "dunnTest()" function in R was used with the specification that the comparisons were one-sided. One-sided post-hoc tests allow for the results to speak of directionality. The Bonferroni method was used to adjust the p -values of this post-hoc test to reduce the familywise error rate associated with multiple testing. The same process was then conducted to compare groups' 2020 frequencies.

We used two linear regression analyses to test whether sense of belonging was significantly associated with 2019 frequency of urban nature interaction and/or 2020 urban nature interaction. Control variables were included in each regression model for race/ethnicity, age, gender, and income.

To test whether a given racial/ethnic group experienced a significant change in frequency of urban nature interaction, the average 2019 and 2020 frequencies were first calculated for each group. One-tailed paired sample t -tests were then conducted within each racial/ethnic group to compare their 2019 and 2020 average frequencies. Although the distributions for 2019 and 2020 reported frequencies of urban nature interaction are mildly non-normal, the sample size (300 total, 75 participants in each racial/ethnic group) is large enough to justify the use of Student's t -test. The tests were directional because each group's 2020 average frequency was observed, descriptively, to be either greater or less than their 2019 frequency. Control variables such as age, gender, and income were not included in these tests since the "before" and "during" data were for the same set of participants. If these t -tests were significant, it meant the racial/ethnic group experienced a significant increase or decrease (depending on the directionality of the test) in frequency of urban nature interaction from fall 2019 to fall 2020.

We then tested whether the COVID-19 pandemic impacted the frequency of urban nature interaction differently across racial/ethnic groups. The Kruskal–Wallis test was conducted to test whether the observed changes in frequency were different across racial/ethnic groups. Given that this test was significant, one or more pairs of racial/ethnic groups experienced significantly different effects of COVID-19 on their frequency of urban nature interaction. Dunn's test for stochastic dominance was then used to identify which pair(s) of racial/ethnic groups significantly differed in observed change to frequency of urban nature interaction. A one-sided Dunn's test was used for post-hoc comparisons in order to speak about directionality of significant differences. The Bonferroni method was used to adjust the p -values of this post-hoc test.

A stepwise regression analysis was conducted to test whether perceived coronavirus threat, perceived urban nature quality, or sense of belonging in urban nature can partially explain differences in the effects of COVID-19 on frequency of urban nature interaction. The automated stepwise regression analysis was chosen because we were interested in testing which variable(s), of the several that were of interest, significantly contributed to the inequities in change in frequency of urban nature interaction. Control variables (age, gender, income, and pre-pandemic frequency) were introduced to better isolate the effects of racial/ethnic inequities. Age data were converted from categorical responses to integers

by taking the average of the multiple response options for age (e.g., 18–24 years of age was replaced with 21). Average annual income categories were similarly replaced with the average for that response category and rounded to the nearest whole dollar (e.g., USD 50,000 to USD 74,999 was replaced with 62500). Less than USD 25,000 was replaced with 24999 and USD 200,000 or more was replaced with 200000. Pre-pandemic frequency of urban nature interaction was included as a control variable as those with a high 2019 (pre-pandemic) frequency have the potential for a larger decrease in average days per month than those with a lower 2019 frequency (and vice versa for those who start with a low 2019 frequency). Perceived coronavirus threat, perceived quality of urban nature, and sense of belonging variables were added to a regression formula with the control variables. The dependent variable of this regression formula was change in frequency of urban nature interaction. A forward and backward variable selection process was automated using the “step()” command in R to select a formula-based linear regression model based on the Akaike Information Criterion (See Table 2 for the automated variable selection steps). This stepwise regression analysis removes any independent variables which do not significantly contribute to partially predicting the outcome variable for the specified sample. Both control and explanatory variables were permitted to be removed in this process. The “step()” function returns the regression formula that includes the independent variables which produce the lowest Akaike Information Criterion (AIC). The AIC value was used to compare regression models with different independent variables and indicate which set of variables best predict the outcome for that specific data set. This means that if another sample were tested in the same way, a different combination of independent variables may be returned by the stepwise analysis.

Table 2. The automated stepwise variable selection process.

Step	Variable Removed	Df	Deviance	Resid. Df	Resid. Dev	AIC
0	NA	NA	NA	287	12,408.43	1142.71
1	Gender	3	58.69	290	12,467.13	1138.12
2	Income	1	0.05	291	12,467.17	1136.12
3	Perceived coronavirus threat	1	3.17	292	12,470.34	1134.20
4	Perceived urban nature quality	1	13.56	293	12,483.90	1132.52

We used Kruskal–Wallis tests to observe whether sense of belonging in urban nature, perceived quality of nearby urban nature, level of importance of nearby urban nature conservation, and perceived COVID-19 threat level significantly varied across racial/ethnic groups. If the Kruskal–Wallis test was significant, we then used Dunn’s test for stochastic dominance to identify which pair(s) of racial/ethnic groups significantly differed. A one-sided Dunn’s test was used for post-hoc comparisons in order to speak about directionality of significant differences. The Bonferroni method was used to adjust the *p*-values of these post-hoc tests.

The association between the level of importance one assigns to urban nature conservation and their sense of belonging in urban nature was explored using a linear regression model. Importance of urban nature conservation was regressed onto several control variables (race/ethnicity, age, gender, and income) and responses to the Sense of Belonging in Urban Nature Questionnaire. The covariate *p* values were used to assess whether sense of belonging significantly predicted urban nature conservation values.

To analyze the types of urban nature interactions participants engaged in, frequencies of occurrence for each activity in fall 2019 and fall 2020 were descriptively compared. Comparisons were made for the entire sample as well as within each racial/ethnic group. Since this data are exploratory and was collected via two ‘check all that apply’ questions, the authors found descriptive analysis to be sufficient in this case.

We analyzed all data in RStudio version 1.4.1103. Statistical significance was $\alpha = 0.05$ for all inferential analyses.

3. Results

3.1. Frequencies of Urban Nature Interaction before and during COVID-19

In fall 2019 (before the COVID-19 pandemic), White participants spent time in or around urban nature most frequently with an average of 11.20 days per month (SD = 8.43) (see Table 3). This was followed by Black (M = 8.32, SD = 6.50) and Latino participants (M = 7.65, SD = 6.40). White participants did not spend time in urban nature significantly more frequently than Black (adjusted $p = 0.584$) or Latino participants (adjusted $p = 0.064$) during this time. Average frequency of urban nature interaction for Asian participants (M = 7.81) was significantly lower than that of White participants (M = 7.81, adjusted $p = 0.004$).

Table 3. Average measurement values across racial/ethnic groups.

	Measurement Average (SD)			
	Asian	Black	Latino	White
2019 Frequency ¹	7.81 (8.21)	8.32 (6.50)	7.65 (6.40)	11.20 (8.43)
2020 Frequency	7.09 (8.47)	4.56 (6.24)	5.55 (7.12)	12.35 (8.99)
Change in Frequency (δ) ²	−0.72, −9.22% (8.08)	−3.76, −45.19% (6.42)	−2.12, −27.71% (6.75)	1.15, +10.27% (8.56)
Perceived Coronavirus Threat (Low: 3, High: 15)	12.15 (2.08)	12.88 (1.70)	12.25 (1.99)	11.87 (2.61)
Perceived Urban Nature Quality (Low: 6, High: 30)	24.07 (4.09)	21.76 (4.78)	22.31 (4.15)	24.61 (4.99)
Sense of Belonging in Urban Nature (Low: 6, High: 30)	23.24 (4.62)	18.56 (4.75)	20.12 (5.21)	25.31 (4.41)
Level of Importance of Urban Nature Conservation (Low: 1, High: 5)	4.80 (0.40)	4.44 (0.78)	4.64 (0.63)	4.97 (0.16)

¹ All frequency values are provided in average number of days per month. ² The bolded Change in Frequency values indicate that the racial/ethnic group experienced a significant change in frequency from fall 2019 to fall 2020.

About 6 months after the start of the pandemic (in fall 2020), White participants still had the most frequent urban nature interaction with an average frequency of 12.35 days per month (SD = 8.99). Asian participants had the next most frequent urban nature use with an average of 7.09 days per month (SD = 8.47). This was followed by Latino participants (M = 5.55, SD = 7.12) and Black participants (M = 4.56, SD = 6.24). About 6 months after the pandemic began, the average frequency of urban nature interaction among White participants was significantly higher than that of Asian (adjusted $p < 0.01$), Latino (adjusted $p < 0.001$), and Black participants (adjusted $p < 0.001$). The Asian, Latino, and Black frequencies did not significantly differ from each other.

3.2. Average Change in Frequency of Urban Nature Interaction

This study investigated whether each racial/ethnic group experienced a change in frequency of urban nature interaction from before the pandemic to during the pandemic. There was no significant difference in the frequency of urban nature interaction for White and Asian participants from fall 2019 to fall 2020. Latino and Black participants, however, experienced a significant decrease in frequency of urban nature interaction 6 months into the COVID-19 pandemic (see Figure 1).

White participants experienced **no significant change** in average days per month spent in urban nature from fall 2019 to fall 2020 ($\delta = 1.15$; $p = 0.125$; $H_0: \delta \not\leq 0$; 95%CI_{low}: −0.50).

Asian participants experienced **no significant change** in average days per month spent in urban nature from fall 2019 to fall 2020 ($\delta = -0.72$; $p = 0.222$; $H_0: \delta \not\leq 0$; 95%CI_{high}: 0.84).

Latino participants experienced a **significant decrease** in average days per month spent in urban nature from fall 2019 to fall 2020 ($\delta = -2.12$; $p < 0.004$; $H_a: \delta \leq 0$; 95%CI_{high}: −0.81).

Black participants experienced a **significant decrease** in average days per month spent in urban nature from fall 2019 to fall 2020 ($\delta = -3.76$; $p < 0.001$; $H_a: \delta \leq 0$; 95%CI_{high}: -2.53).

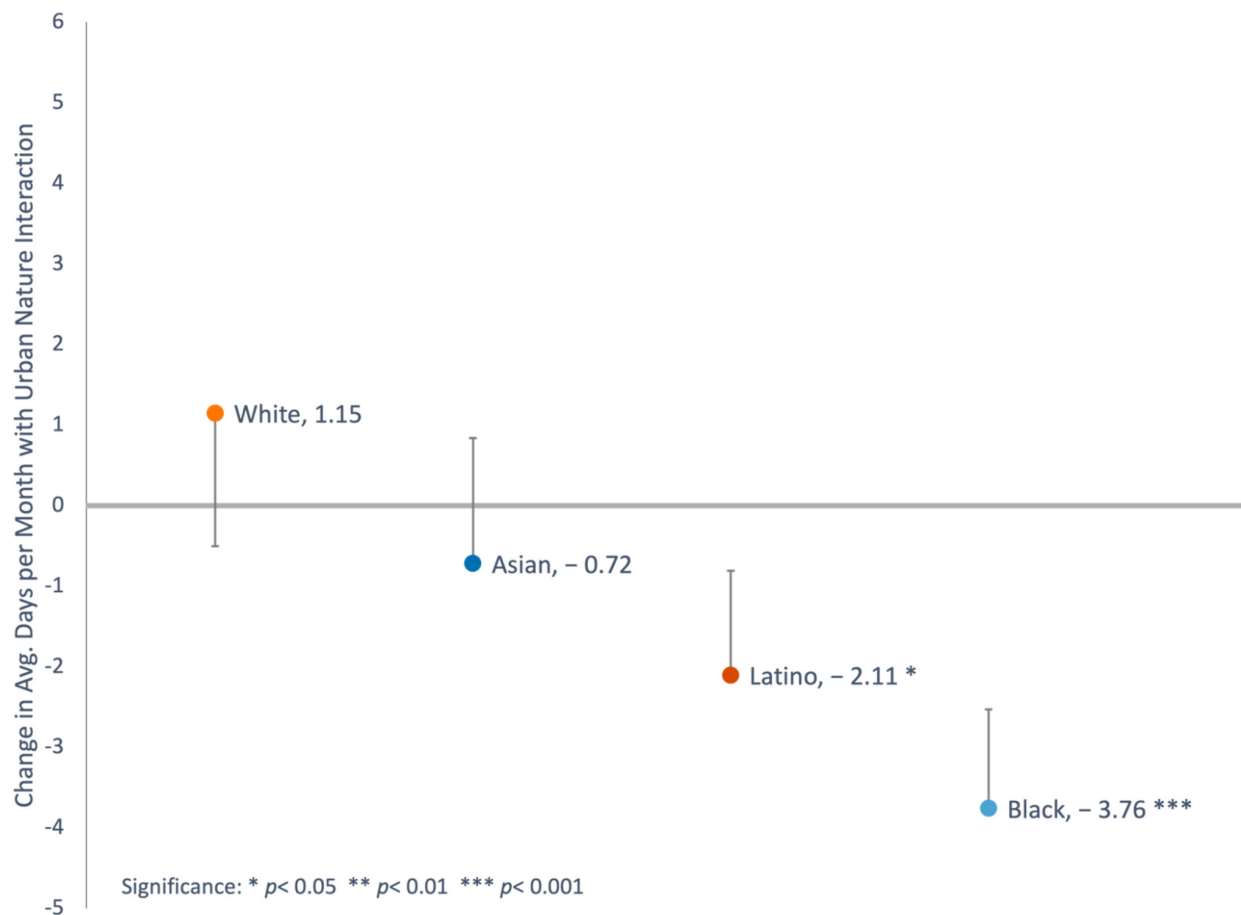


Figure 1. Change to average frequency of urban nature interaction among each racial/ethnic group.

To test whether COVID-19 impacted frequency of urban nature interaction significantly unequally amongst racial/ethnic groups, changes to frequency of urban nature interaction were compared across racial/ethnic groups. The Kruskal–Wallis non-parametric equivalent to ANOVA was used. This test was significant ($p < 0.001$), meaning the COVID-19 pandemic did not impact frequency of urban nature interaction equally across racial/ethnic groups.

Black participants were impacted to a greater degree than White participants (adjusted $p < 0.001$). Latino participants were impacted to a greater degree than White participants (adjusted $p = 0.009$). Black participants' frequency of urban nature interaction was also impacted significantly more than that of Asian participants (adjusted $p = 0.009$). No other pairings of racial/ethnic groups significantly differed in change to frequency of urban nature interaction.

3.3. Independent Variables for the Inequitable Effects of COVID-19

With the observed disparate outcomes in frequency of urban nature interaction during COVID-19, we tested whether perceived coronavirus threat, perceived quality of nearby urban nature, and/or sense of belonging in urban nature at least partially contribute to this disparity. Based on an automated stepwise variable selection, it was determined that the combination of race/ethnicity, age, pre-pandemic frequency of urban nature interaction, and sense of belonging best predict the changes to frequency of urban nature interaction of this study's sample (AIC = 1132.52). To attain the smallest AIC value, perceived coronavirus threat, perceived quality of nearby urban nature, gender, and income variables were removed from the regression formula. This result shows that the effects of COVID-19

on frequency of urban nature interaction are associated with sense of belonging in urban nature, pre-pandemic frequency of urban nature interaction, race/ethnicity, and age. This regression shows that participants with a lower sense of belonging in urban nature lost more time in urban nature during COVID-19. It is important to note here that neither race/ethnicity, age, pre-pandemic frequency, sense of belonging, nor the combination of these variables can fully explain the changes to frequency of urban nature interaction. However, it is of interest to see which of the included variables in this study best fit the outcome data.

With sense of belonging in urban nature significantly contributing to changes in frequency of urban nature interaction from 2019 to 2020, we tested whether sense of belonging was significantly associated with either 2019 frequency of urban nature interaction or 2020 frequency of urban nature interaction. Sense of belonging in urban nature did not significantly predict frequency of urban nature interaction in fall 2019 ($p = 0.211$) but predicted frequency of urban nature interaction in fall 2020 ($p = 0.001$).

3.4. Sense of Belonging in Urban Nature

White participants descriptively responded with the highest sense of belonging in urban nature ($M = 25.31$, $SD = 4.4$) followed by Asian ($M = 23.24$, $SD = 4.62$), Latino ($M = 20.12$, $SD = 5.21$), and Black participants ($M = 18.56$, $SD = 4.75$) (see Figure 2, Table 3). A Kruskal–Wallis test shows disparities in sense of belonging in urban nature across racial/ethnic groups ($p < 0.001$). White participants had a significantly higher sense of belonging in urban nature than that of Latino (adjusted $p < 0.001$) and Black participants (adjusted $p < 0.001$). Sense of belonging among Asian participants was significantly higher than that of Latino (adjusted $p < 0.002$) and Black (adjusted $p < 0.001$) participants.



Figure 2. Average sense of belonging in urban nature for each racial/ethnic group.

Using a linear regression with control variables for race/ethnicity, age, gender, and income, sense of belonging in urban nature was found to significantly predict participants' reported importance of urban nature conservation ($p = 0.02$). Participants with a higher sense of belonging in urban nature put a higher level of importance on urban nature conservation.

3.5. Perceived Quality, COVID-19 Threat Level, and Importance of Urban Nature Conservation

A Kruskal–Wallis test revealed that at least one pair of racial/ethnic groups significantly differed in their level of importance of nearby urban nature conservation ($p < 0.001$). Dunn’s test shows that the average response to the Perceived Coronavirus Threat Questionnaire among Black residents ($M = 4.44$, $SD = 0.78$) was significantly lower than that of Asian residents ($M = 4.80$, adjusted $p = 0.0034$) and White residents ($M = 4.97$, adjusted $p < 0.001$) (see Table 3).

We found significant differences between at least one pair of racial/ethnic groups in terms of perceived quality of nearby urban nature ($p < 0.001$). Black participants scored significantly lower on the Perceived Green Space Quality Scale ($M = 21.76$, $SD = 4.78$) compared with both Asian ($M = 24.07$, adjusted $p = 0.007$) and White participants ($M = 24.61$, adjusted $p < 0.001$). Latino participants also scored significantly lower ($M = 22.31$, $SD = 4.15$) than both Asian (adjusted $p = 0.03$) and White participants (adjusted $p < 0.001$) (see Table 3).

No significant differences in perceived coronavirus threat were observed between racial/ethnic groups.

3.6. Types of Urban Nature Interactions

Prior to the pandemic, participants of this sample descriptively took walks with other people more frequently than they took walks alone. Six months into the pandemic, participants more frequently took walks alone than took walks with other people (see Table 4 for descriptive frequencies of each activity before and during the pandemic). This pattern holds true descriptively within each racial group except for Latino and White participants. Latino participants more frequently took walks alone before the pandemic. White participants more frequently took walks with other people during the pandemic.

Table 4. Types of urban nature interaction before and during the COVID-19 pandemic.

Urban Nature Interaction ¹	Frequency (%)									
	<i>n</i> = 300		Asian (<i>n</i> = 75)		Black (<i>n</i> = 75)		Latino (<i>n</i> = 75)		White (<i>n</i> = 75)	
	Before	During	Before	During	Before	During	Before	During	Before	During
Took a walk with other people	194 (65)	137 (46)	53 (71)	38 (51)	37 (49)	15 (20)	40 (53)	24 (32)	64 (85)	60 (80)
Took a walk alone	179 (60)	164 (55)	51 (68)	47 (63)	26 (35)	24 (32)	44 (44)	36 (48)	58 (77)	57 (76)
Sat in nature	155 (52)	116 (39)	38 (51)	30 (40)	24 (32)	18 (24)	40 (53)	24 (32)	53 (71)	44 (59)
Enjoyed the stillness and quietness of nature	153 (51)	129 (43)	39 (53)	29 (39)	28 (37)	21 (28)	40 (53)	35 (47)	46 (61)	44 (59)
Watched the sunrise or sunset	137 (46)	108 (36)	32 (43)	14 (19)	14 (15)	20 (27)	36 (48)	26 (35)	55 (73)	48 (64)
Looked out at a large view of water	135 (45)	112 (37)	41 (55)	34 (45)	9 (12)	8 (11)	32 (43)	20 (27)	53 (71)	50 (67)
Ran or jogged	129 (43)	72 (24)	34 (45)	19 (25)	30 (40)	12 (16)	37 (49)	17 (23)	28 (37)	24 (32)
Looked out at a large view of the city	97 (32)	77 (26)	31 (41)	24 (32)	4 (5)	1 (1)	19 (25)	13 (17)	43 (57)	39 (52)
Had a picnic	94 (31)	57 (19)	27 (36)	18 (24)	9 (12)	1 (1)	23 (31)	13 (17)	35 (47)	25 (33)
Looked at wildlife	84 (28)	71 (24)	23 (31)	13 (17)	5 (7)	2 (3)	14 (19)	10 (13)	42 (56)	46 (61)
Rode a bike	83 (28)	62 (21)	16 (21)	11 (15)	11 (15)	6 (8)	21 (28)	15 (20)	35 (47)	30 (40)
Walked a dog	65 (22)	67 (23)	13 (17)	14 (19)	11 (15)	11 (15)	19 (25)	18 (24)	22 (29)	24 (32)
Tended to a garden	57 (19)	60 (20)	10 (13)	12 (16)	7 (9)	6 (8)	11 (15)	11 (15)	28 (37)	31 (41)
Played a sport	53 (18)	19 (6)	20 (27)	8 (11)	11 (15)	3 (4)	13 (17)	3 (4)	9 (12)	5 (7)
Watched my children play	49 (16)	36 (12)	13 (17)	9 (12)	17 (23)	11 (15)	10 (13)	9 (12)	9 (12)	7 (9)
Used a water vessel such as a kayak, canoe, paddle board, or sailboat	44 (15)	30 (10)	6 (8)	7 (9)	3 (4)	1 (1)	10 (13)	2 (3)	25 (33)	20 (27)
Collected berries, nuts, mushrooms, greens, or other edible items	44 (15)	29 (10)	11 (15)	8 (11)	4 (5)	1 (1)	8 (11)	3 (4)	21 (28)	17 (23)
Swam or submerged in water	37 (12)	24 (8)	5 (7)	5 (7)	4 (5)	2 (3)	9 (12)	3 (4)	19 (25)	14 (19)
Rode a skateboard or scooter	18 (6)	12 (12)	3 (4)	1 (1)	3 (4)	0 (0)	4 (5)	5 (7)	8 (11)	6 (8)
Volunteered with an organization outside	14 (5)	5 (2)	4 (5)	0 (0)	0 (0)	1 (1)	4 (5)	0 (0)	6 (8)	4 (5)
Other	5 (2)	5 (2)	0 (0)	1 (1)	0 (0)	1 (1)	0 (0)	0 (0)	5 (7)	3 (4)

¹ The above types of interaction were presented to participants in a “choose all that apply” question. They were asked to indicate all that they had enacted at each time point.

4. Discussion

In the last decade, the research has increasingly shown that accessing and interacting with nature is important for people's physical and mental wellbeing (see, e.g., Bratman et al. [69]; Frumkin et al. [70] for comprehensive reviews). Nature experience is linked, for example, to improved immune functioning, reduced diabetes, lower blood pressure, better eyesight, improved postoperative recovery, and reduced mortality; and to increased positive affect, improved manageability of life tasks, and decreases in mental distress. Thus, during the beginnings of a pandemic, during a time of enormous uncertainty and hardship on individuals, communities, and social systems, it seems to us *prima facie* obvious that it would be good if all people can access nature, and thereby potentially buffer some of the negative physical and mental outcomes caused by the pandemic.

With People of Color in the US being affected more acutely by COVID-19 than the White population [1–6], it is reasonable to believe they stand to gain the most from urban nature interaction. Yet, the COVID-19 pandemic may be disproportionately impacting People of Color's urban nature interaction just as it has disproportionately affected People of Color in many other dimensions.

Within this framing, and with an equity focus, we investigated residents' change in frequency of nature access during the first 6 months of the pandemic across four racial/ethnic populations in Seattle, WA. We found that Black and Latino Seattle residents experienced a significant decrease in their frequency of urban nature interaction while Asian and White residents experienced no change. This is not to say, however, that Asian Seattle residents in other ways were not disproportionately affected by the pandemic during this time; they were. For example, hate crimes against Asian Seattle residents increased 56% from 2019 to 2020 [71].

Among the various studies that have investigated differences across racial/ethnic groups in urban nature interaction before and during the pandemic, the results of this study support People of Color spending less time in urban nature after the onset of the pandemic. Our results specifically align with those of Larson et al. [31], who found that Black and Hispanic urban residents across cities of North Carolina have experienced a decrease in urban park use during the COVID-19 pandemic.

What might have contributed to the inequitable outcomes in urban nature interaction for Black and Latino residents? This study sought to uniquely approach this question through the lens of belongingness. Across the environmental justice literature, there are repeated themes of People of Color feeling excluded from urban nature spaces (see Table 1). This novel study seeks to examine the role of belongingness in urban nature inequities by developing an exploratory Sense of Belonging questionnaire. Results found sense of belonging in urban nature to be significantly associated with participants' changes in frequency of urban nature interaction during COVID-19; specifically, those with a lower sense of belonging (Black and Latino residents) experienced a greater loss of time in urban nature, while those with a higher sense of belonging (Asian and White residents) experienced no change.

While sense of belonging in urban nature was found to significantly contribute to change in frequency of urban nature interaction, perceived coronavirus threat and perceived urban nature quality did not. In terms of peoples' wariness around COVID-19, it may be the case that after 6 months of the pandemic people became less afraid of catching the virus and so were comfortable in situations where they may be in closer proximity to others. Especially when considering the reduced risk of infection in open air, people may have been more willing to take risks to spend time in urban nature. It may also be that since Seattle's urban nature spaces are relatively spacious people felt comfortable spending time in urban nature regardless of their perceived COVID-19 threat level.

It is not clear why perceived urban nature quality was not associated with changes to frequency of urban nature interaction. We may hypothesize that perhaps the pandemic had little effect on residents' perceptions of the quality of nearby urban nature, and so it did not affect whether people increased or decreased their time spent in urban nature.

In addition to sense of belonging in urban nature, age and race/ethnicity were significantly associated with changes to frequency of urban nature interaction. Race/ethnicity being a significant variable is expected as we saw from previous results that racial/ethnic groups experienced different effects on their time spent in urban nature during the first 6 months of the pandemic. It is less clear what the relationship between age and change in frequency of urban nature interaction during the pandemic is. The regression formula resulting from the stepwise variable selection process suggest that those older in age experienced less of a decrease in time spent in urban nature and were more likely to experience no change. Further research is needed to investigate the role of age in changes to urban nature interaction during the COVID-19 pandemic.

Other demographic variables, including gender and income, were not significantly associated with changes to frequency of urban nature interaction during the COVID-19 pandemic. Given the existing literature, one might have expected that income would be a significant independent variable. The fact that both income and gender were not, suggests that the inequitable changes in frequency of urban nature interaction may be more closely tied to racial/ethnic inequities than income or gender inequities.

While sense of belonging in urban nature was significantly associated with frequency of urban nature interaction in fall 2020 (during COVID-19), it was not associated with pre-pandemic frequency of urban nature interaction. This finding, combined with the fact that sense of belonging was significantly associated with change in frequency of urban nature interaction from 2019 to 2020, suggests that there may be some interplay between sense of belonging in urban nature and the COVID-19 pandemic that has affected urban nature interaction. It may be the case that COVID-19 exacerbated the exclusion of Black and Latino residents from public spaces. For example, Hoover and Lim [16] described how in New York City there were more police present in urban parks during COVID-19 to enforce social distancing between visitors. This increased police presence likely heightened the exclusion of Black individuals from those urban nature spaces [16].

In the coming years, as COVID-19 either abates or becomes endemic, an open and important question is whether Black and Latino urban residents experience a rise in urban nature visitation or return to their pre-pandemic frequencies of urban nature interaction. Given the existing racial/ethnic disparities in urban nature, and urban environments in general, as well as the disproportional impacts that COVID-19 has had on Black and Latino communities, it seems possible that Black and Latino urban nature interaction will not fully recover. With results of this study showing that sense of belonging is associated with loss of time in urban nature, sense of belonging in urban nature may have decreased among Black and Latino residents during the pandemic. This may lead to a cycle, wherein a lower sense of belonging leads to less frequent urban nature interaction, which leads to lower sense of belonging. If less frequent urban nature interaction observed during the COVID-19 pandemic becomes a new normal, urban nature conservation values, and nature conservation values as a whole, may decrease over time. These implications are further discussed below.

Some evidence has shown that meaningful experiences in nature may be associated with strong conservation values [72,73]. For those living in dense cities, the most readily available nature that one may experience is urban nature. It is therefore plausible that increasing access to urban nature may increase urban nature conservation values. Conversely, if decreases in urban nature interaction among Black and Latino communities are maintained or continue post-pandemic, urban nature conservation values may decrease among Black and Latino populations. With urban populations expected to continue to increase and the degradation of the natural world persisting, it may become imperative to foster strong nature conservation values among those living in the city. For urban residents who may have limited experiences in more rural nature, meaningful experiences in urban nature can act as a bridge towards becoming interested in the conservation of larger nature areas.

Our results additionally show that participants with a higher sense of belonging in urban nature reported a higher level of importance of urban nature protection. This finding,

combined with sense of belonging being associated with changes in frequency of urban nature during the pandemic, provide some support for increased nature interaction being associated with stronger conservation values. Furthermore, these results suggest it is worth continuing investigations of sense of belonging in urban nature to provide evidence of whether efforts to increase sense of belonging in urban nature, in addition to having meaningful experiences in urban nature, would have impacts on conservation values.

Limitations

Achieving equal representation of the included racial/ethnic groups of this study allowed for comparisons between groups to be made with higher confidence. This study excluded several racial/ethnic groups including American Indian, Alaska Native, Native Hawaiian, and Pacific Islander individuals. Those who identified as belonging to more than one racial/ethnic group were also not eligible for participation. Research that includes and appropriately represents these racial/ethnic groups is of importance in future research given that these racial/ethnic groups are frequently underrepresented or not represented at all.

Although recruiting participants for research studies through social media ads has become fairly common, it introduces a bias in that it allows only for those with internet connection, an internet-capable device, and a social media profile to participate.

This study's definition of urban nature did not include natural elements one may experience briefly, such as street trees, or experience from ones' residence, such as nature window views. The intent of excluding these types of nature was to focus on urban nature spaces one may intentionally visit to experience slightly "larger" urban nature. However, we recognize that there is a large body of literature examining the human benefits of urban street trees (e.g., Mullaney et al. [74], Seamans [75], and Taylor et al. [76]) and window nature views (e.g., Kahn et al. [77], Kaplan [78], Taylor et al. [79], and Ulrich [80]), as well as characterizing racial inequities in the accessibility of these types of nature within the US (e.g., Flocks et al. [81], Landry and Chakraborty [82], Li et al. [83]). Inequities in accessibility to urban street trees and window views of nature during the pandemic may be associated with changes in frequency of urban nature interaction. It may be the case that those who benefit from accessibility to urban street trees and nature window views, more often those who are wealthy and White, might not have been as inclined to visit what our study defined urban nature spaces during COVID-19. Additionally, although we observed inequities in changes to urban nature interaction over the course of the first 6 months of the pandemic, this study does not fully capture inequities in the buffering effects of nature during the pandemic, as benefits may have been gained by urban residents from types of nature not included in our definition of urban nature (e.g., street trees and nature window views).

The Perceived Green Space Quality scale and the Sense of Belonging in Urban Nature Questionnaire were provided at a single time point approximately 6 months into the pandemic. The responses to these measurements were used alongside data that pertained to both 6 months into the pandemic and fall 2019, before the COVID-19 pandemic. From fall 2019 to fall 2020 there may have been changes to both perceived quality of nearby urban nature and sense of belonging, and these changes may have been inequitably distributed across racial/ethnic groups. Urban parks in predominantly Black neighborhoods tend to be smaller in area [25]. During the pandemic, this may have meant those smaller parks were more densely crowded. Due to COVID-19 precautions, one may consider more dense parks to be of lower quality. This is one way in which the pandemic may have inequitably affected the quality of urban nature in predominantly non-White neighborhoods. Sense of belonging may have also been impacted to various degrees across racial/ethnic groups. With the rise of anti-Asian American and Pacific Islanders (AAPI) violent attacks during the pandemic, as have occurred in urban parks across the US [66], urban nature spaces may have become less welcoming for Asian residents 6 months into the pandemic.

Two other limitations are worth noting: First, when participants took the survey in winter 2020, they were asked to recall their experiences in fall 2019 and respond to certain

questions accordingly. The pre-pandemic data are therefore not as reliable as it would have been had this been a longitudinal study with two data collection periods. Second, the Sense of Belonging in Urban Nature Questionnaire developed for this study, while achieving high internal reliability, remains unvalidated. Further exploratory and confirmatory factor analyses would be needed to validate this questionnaire.

5. Conclusions

Increasing access to urban nature among Black and Latino Seattle residents may narrow inequities in who benefits from urban nature, including during times of major disruption such as a global pandemic. Addressing the inequitable distribution of urban nature benefits is sometimes discussed as one way to increase resiliency of predominantly non-White neighborhoods [84]. However, the goal of increased resiliency, in some ways, places the responsibility of recovering from disruptive events on Communities of Color and does not address the underlying issues that lead to inequities in how Communities of Color are affected by such events in the first place [85]. In the field of ecology, there exists the concept of resilient and resistant plant species. Resilient plants are able to quickly “bounce back” from damage such as being trampled. Resistant species, on the other hand, are more impervious to trauma in the first place [86]. Mapping these terms onto inequities in the effects of disruptive events among Communities of Color, it may be more beneficial to address resilience and resistance among Communities of Color. Increasing urban nature access may be one way of doing that. If a community already benefits from interacting with accessible urban nature, they may be less prone to significant damages when major disruptive events occur.

How may resistance and resilience among urban Communities of Color be strengthened to decrease the inequitable effects of future disruptive events? This study supports that addressing inequitable access to urban nature and sense of belonging in urban nature may be ways of doing so. Everyone in a city should feel equally welcomed in their city’s urban nature regardless of race and ethnicity. Thus, the six themes identified across the existing literature that compose the Sense of Belonging in Urban Nature Questionnaire, Ease of Access, Safety, Feeling Out of Place, Unwelcomeness, Institutional Acceptance, and Different Ways of Interacting with Nature Acceptance, may be entry points for city governments to begin to increase sense of belongingness among minoritized groups. Examples of actions that city government agencies can take to target the inequity themes of the Sense of Belonging in Urban Nature Questionnaire include:

- Direct urban parks budget to urban nature spaces predominantly serving People of Color to increase Ease of Access, Safety, and Institutional Acceptance of urban nature spaces near People of Color;
- Organize urban nature programming, specifically for Black or Latino urban residents, to improve representation and increase belongingness in urban nature among Black and Latino communities;
- Present urban nature information on signage and online in multiple languages to increase urban nature accessibility;
- Increase representation of People of Color on urban park signage and websites;
- Improve racial/ethnic diversity of people hired into city government, especially departments which oversee urban nature areas (such as Parks and Recreation departments).

Examining how urban residents interact with nature prior to and during a major disruptive event (such as the COVID-19 pandemic) may also be of aid in assessing the potentially inequitable types of nature that different racial/ethnic groups have access to and reimagining urban centers to be more sustainable, resilient, and resistant in the face of future disruptive events. This study conducted exploratory investigations into the types of interactions participants engaged in prior to the pandemic and during the pandemic (presented in Table 4). In different parks in different locations, there should be equity, for example, in how the parks allow people to sit in nature, have a picnic, engage in sports, run or jog, ride a bike, walk a dog, sit, watch a sunset, watch one’s children play, look out on a

water view or a city view, tend to a garden, and/or simply enjoy the quietness of nature. This list is part of a larger approach to urban design, Interaction Pattern Design, that seeks to maximize ways for people not only to access nature, but to interact with that they access so that the interactions are engaging, meaningful, and self-reinforcing [46–49].

This list in Table 4 of interactions with nature can provide some insights for how to better design urban nature for future pandemics and for increasing density. For example, prior to the pandemic, Seattle residents took walks with other people more frequently than they took walks alone. Six months into the pandemic, residents took walks alone more frequently than with other people. This is likely due to social distancing mandates and attempts to limit risk of contracting COVID-19. Thus, wide walking trails may be increasingly important to implement. They not only allow for social distancing during times of a pandemic but create the urban nature infrastructure that plans for what, in most urban areas, will be increasing population density.

The results of this study may have larger international relevance in places that experience discrimination based on race, ethnicity, and other dimensions such as religion. Regardless of whether these societal inequities are similar to those of Seattle, WA, or the US, the general conclusions and implications may remain: that minoritized or vulnerable populations may be suffering more in terms of urban nature interaction during the pandemic, and that these inequities may have significant effects on minoritized populations both during the pandemic and moving forward. While the discussions and recommendations included in this paper are directed towards Seattle, WA, the same principles may be applied to other US and international locations where certain populations have lost more time in urban nature during the pandemic than others.

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Notes

- ¹ We recognize that the terms “People of Color” and “Communities of Color” can homogenize the experiences of different racial/ethnic groups. Terms such as Black, Indigenous, and People of Color (BIPOC) are used to highlight the shared experiences of colonization among Black and Indigenous communities. However, this study’s sample does not include indigenous people, therefore we chose to use People of Color and Communities of Color throughout this paper. Additionally, we acknowledge that within each racial/ethnic group included in this study, there is great variability in cultural norms and expectations, upbringing, etc.
- ² Throughout this paper, ‘Black or African American’ is shortened to ‘Black’.
- ³ Latinx and Latiné have been used as alternatives to Latino in efforts to be more gender inclusive [7,8]. We recognize that there are people who oppose the use of each of the terms Latino, Latinx, and Latiné within the Hispanic and Latino community [9,10].

We also recognize the issue with researchers, often outside the Hispanic and Latino community, imposing Western norms and altering the way that Hispanic and Latino individuals identify themselves and their community [9,10]. Here, Latino/a/x is used to be inclusive of those within the community who identify as Latino or Latina, and those who wish to use an ungendered term. Latino/a/x is shortened to Latino throughout this paper.

4 Urban nature in the case of this study refers to parks, green areas, and places with water, vegetation, and/or animals within a city.

5 This White perception of “untouched” nature erases the existence of Indigenous peoples of North America that molded the North American landscape through burning and silvicultural practices for at least 20,000 years before European colonization [15].

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