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Trail use and recreational physical activity behavior of trail users and non-users during COVID-19 restrictions in Colorado Springs, Colorado

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Abstract

Physical activity (PA) is an important health behavior that was impacted for many by the public health response to the COVID-19 pandemic. In many places, indoor recreational facilities were required to close; however, many outdoor spaces like trails were available for recreational use. The purpose of this study was to examine the use of a mixed-use trail before, during, and after COVID-19 restrictions in a large Colorado city and explore if recreational PA behavior differed between trail users and non-users during those periods. Trail user counts on a mixed-use trail were extracted for 2019 and 2020 from continuous-count data. Trail use habits and recreational PA behavior from before, during, and after restrictions were collected via a retrospective internet survey (N=183). Minutes per week of walking, moderate-to-vigorous PA and total PA were calculated from survey responses. Trail use data were analyzed with a two-way ANOVA and PA data were analyzed with a two-way repeated measures ANOVA. Trail use (average count/day) during COVID-19 restrictions was greater than before by 178 users and after by 96 users. During restrictions, trail users reported 153.5 more minutes of total PA per week than non-users. These results suggest the importance of maintaining accessible outdoor infrastructure for promoting positive PA behaviors in general, and especially in a pandemic situation.

Keywords: health behavior; outdoor recreation, COVID-19, trail use, physical activity

Regular physical activity (PA) is beneficial to overall health and well-being (Powell et al., 2019). For example, PA has been shown to reduce risk of cardiovascular diseases and diabetes (Wahid et al., 2016) as well as certain cancers (Moore et al., 2016). There are also positive associations of PA to mental health outcomes such as reduced depression (R. L. White et al., 2017). Yet, globally, only about 25% of the adult population obtain recommended amounts of PA activity, which causes a 20-30% risk of increased death (World Health Organization, 2020).

Shortly after COVID-19 was declared a global pandemic in March of 2020, responses to mitigate the spread of the respiratory virus altered life as usual for many people (World Health Organization, 2021). Restrictions and closures that were the result of these efforts may have impacted PA behavior (Besenyi et al., 2021; Fearnbach et al., 2021). The public health response varied by location but many communities implemented "Stay at Home" (SAH) policies that limited social gatherings and where people could travel, do business, or recreate (Ritchie et al., 2020). These policies typically stated that people were not to leave their homes except for what was deemed a necessary activity, such as getting groceries or commuting to work. Schools were closed or transitioned to remote environments and many "non-essential" places of business were forced to either close or reduce their in-person workforce, which left people out of work or working from home. Indoor recreational facilities such as gyms and group exercise facilities were included in the closures (Ritchie et al., 2020).

Surveillance of PA behavior at the onset of the pandemic indicated that movement decreased globally (Ammar et al., 2020; Tison et al., 2020). Location-specific studies showed changes to PA behavior during restriction periods. For example, smartphone app data in the United Kingdom indicated PA decreased during restrictions (McCarthy et al., 2020), and self-reported PA also decreased in a sample in Spain (Castañeda-Babarro et al., 2020). However, evidence also pointed to an increase in outdoor activity. For example, bike share ridership in South Korea increased (Park et al., 2020) and a collection of trail counters in the United States noted increased user counts during restriction periods (Rails to Trails Conservancy, n.d.).

Although some locations restricted outdoor PA (Michelini et al., 2021; Volenec et al., 2021), an increase in outdoor activity may have been a natural way to cope with the stresses of the pandemic. Initial evidence collected at the onset of the COVID-19 pandemic indicated that spending time in the natural environment was important to people during restrictions (Fisher & Grima, 2020; Lesser & Nienhuis, 2020). Time spent in nature is positively associated with health and well-being, including mental health and vitality (van den Berg et al., 2016; M. P. White et al., 2019). Anxiety, depression, and feelings of frustration, which were not uncommon during the pandemic, may be reduced by being active in nature (Christiana et al., 2021). Spending time in nature is also associated with the likelihood of meeting recommended PA guidelines (Flowers et al., 2016).

Because PA and spending time in nature are both important behaviors for a healthy lifestyle and can be complimentary (Christiana et al., 2021; Pasanen et al., 2014; Thompson Coon et al., 2011), it is probably not a surprise that PA advocates promoted outdoor, nature-based PA at the onset of the pandemic when restrictions were most severe (e.g., staying at least 6 feet from others; avoiding places with poor ventilation). The outdoors was an available space for this distancing and airflow. The American College of Sports Medicine (ACSM) published various resources on staying active and included outdoor activity (ACSM, 2020). The Centers for Disease Control and Prevention (CDC) also included outdoor activity in their call to actions related to PA (CDC, 2021b) during restrictions. PA advocates also emphasized the importance of ensuring that parks and green spaces were available specifically for mental and physical health benefits (Slater et al., 2020). Given that COVID-19 restrictions altered daily routines, likely increasing negative mental health outcomes such as anxiety and depression, the need for PA and outdoor recreation during COVID-19 restrictions was perhaps even more important than before (Vindegaard & Benros, 2020; Violant-Holz et al., 2020).

Engaging in outdoor PA can be achieved by making use of trails. There is a small body of evidence that those who use trails participate in more PA than non-users (Troped et al., 2005). Additionally, trail users have been shown to have greater self-reported well-being (Smiley et al., 2020). However, little is known about changes in PA behavior among trail users and non-users during the COVID-19 restrictions. Therefore, we examined the following two research questions related to trail use in a location that named outdoor PA a "Necessary Activity" during the peak of restrictions (Colorado Department of Public Health and Environment (CDPHE), 2020).

- How did traffic volumes on a mixed-use urban trail change during the SAH restrictions?
- Did the SAH restrictions impact recreational PA behavior differently in users and non-users of this trail?

Methods

Study Location

Colorado is one of the most active states in the U.S. with nearly 60% of the adult population meeting the National Physical Activity Guidelines for Adults, whereas only about 55% of the population meets this standard (CDC, 2021a). Colorado Springs is a city (2019 pop 464,871) in Colorado where 77% of the population is within a 10-minute walk to a park (*ParkScore*, n.d.). The Pikes Peak Greenway Trail (henceforth referred to as the Greenway Trail) is a mixed-use urban trail just west of downtown Colorado Springs that parallels a prominent creek

watershed. The section of the Greenway Trail that has a pedestrian and bicycle traffic counter traverses Monument Valley Park, a 153.4-acre urban park (Figure 1).

Figure 1. Location of trail counter along the Pikes Peak Greenway Trail in Colorado Springs, Colorado.

Data Collection

Trail Counter Data

We gathered trail use data via a permanently installed trail traffic counter located on the Greenway Trail. The counter is a bi-directional passive infrared sensor (Multi, Eco-Counter, Montreal, Canada) that measures pedestrian and bicycle traffic counts in up to 15-minute increments. The City of Colorado Springs provided access to the counter system data for this study. We extracted hourly and daily count data from January 1, 2019 - December 31, 2020 into an Excel spreadsheet (date/time and total count) for descriptive analysis.

Physical Activity Behavior Survey

We designed an online survey to collect information about PA behavior, Greenway Trail use, and demographics of adult residents of Colorado Springs, CO, ages 18-65. This age range was chosen to align with the Physical Activity Guidelines for Adults (Powell et al., 2019).

The survey consisted of three sections. The first section inquired about PA behavior using a modified version of the International Physical Activity Questionnaire (IPAQ), which has been previously validated for use in assessing PA behavior (Craig et al., 2003). We asked respondents to retrospectively report on their walking, moderate, and vigorous PA behavior (typical days per week and typical duration per day) before the Colorado SAH restrictions (before March 26, 2020), during the SAH restrictions (March 26 - May 1, 2020), and in the 7 days prior to completing the survey. These periods are referred to in this study as 'before,' 'during,' and 'after,' restrictions, respectively.

In the second section of the survey, we asked respondents to report on their use of the Greenway Trail. The first question of this section asked if respondents had ever used the Greenway Trail (yes or no). If respondents selected 'no' this section of the survey was skipped. If respondents selected "yes" they were directed to a set of questions asking about their use of the Greenway Trail including duration, frequency, and typical mode of use (e.g., walking, running, bicycling). Questions were framed to ask about use of the trail as it related to before, during, and after restrictions as outlined above. These questions were adapted from existing examples of trail use surveys (American Trails, n.d.) and similar urban trail use surveys have been shown to have reasonable reliability and validity (Spruijt-Metz et al., 2010).

The third section of the survey asked respondents to report on demographic information, including age, gender, race/ethnicity, average household income,

employment status, level of education, self-reported health status, and zip code. The survey was approved by the University of Colorado Colorado Springs Institutional Review Board (2021-041) and made available via the Qualtrics platform from October 1, 2020, through March 1, 2021. We collected a total of 215 survey responses and after review against inclusion criteria, 183 responses remained for analysis (Odell et al., 2023).

Measures

Trail Counts

To ensure we only included typical use counts in our analysis, we examined a local running club's website for events in 2019 and 2020 that had courses passing by the counter. Three dates in 2019 were excluded and one in 2020, as two events did not take place in 2020 due to COVID-19. Additionally, Tuesdays were excluded for both years due to a weekly 'running club' that significantly increases trail volume. Another review of the data was done after events were excluded, and after controlling for seasonal variation, no outliers were found.

We categorized the 2020 traffic count data with respect to COVID-19 restrictions for Colorado in the before, during, and after restriction periods. The count data from 2019 was categorized by corresponding time periods, but because trail use varies by day of the week (e.g., weekday versus weekend day), the comparable 'during' period was March 28, 2019 – May 3, 2019.

Physical Activity Behavior

To fully understand PA behavior, we created additional variables to quantify minutes of typical weekly PA for each activity type (walking, moderate, and vigorous) in each period. These 'minutes per week' variables were created by multiplying the number of days reported for each activity by the minimum value of the range reported for that activity (Odell et al., 2023). Moderate and vigorous PA minutes were combined for analysis and is henceforth referred to as MVPA. Total PA for each respondent was calculated by adding the minutes per week of walking and MVPA.

We determined if respondents increased, decreased, or made no change to PA by comparing minutes of PA of each activity type in the before period to the during period. Respondents with more PA during restrictions were coded as increased, those with less as decreased, and those with no difference as no change.

Statistical Analysis

The statistical software used for all analyses was JASP version 0.11.0.0. Alpha for all analyses in the study was set at .05.

Trail Counts

For our analysis, year and period were the independent variables and average daily use count was the dependent variable. We analyzed differences in average daily use across periods with a two-way (period*year) analysis of variance (ANOVA) utilizing period (before, during, and after) as the three-level primary factor and year (2019 and 2020) as two-level between-subjects factor. We report post hoc analysis p-values with the Tukey correction.

Physical Activity Behavior

For the PA analysis, the independent variables were the period and trail user status (yes/no), and the dependent variables were the minutes per week of total PA, walking, and MVPA. We performed two-way repeated measures ANOVAs to examine differences in types of PA behavior (walking, MVPA, total PA) based on trail user status. The primary factor was the three-level period (before, during, and after) and the between-subjects factor was the dichotomous trail use 'yes/no' variable. The Greenhouse-Geisser correction was used in cases where a violation of sphericity occurred. For these data we report post hoc analysis p-values with the Holm correction to account for multiple comparisons.

Results

Greenway Trail Use During COVID-19 Restrictions

The results of the two-way ANOVA analysis of the traffic counter on the Greenway Trail showed overall trail use between 2019 and 2020 are not statistically different. There were, however, statistically significant interaction effects across year and time periods, $F(2, 616) = 8.42$, $p < .001$, $\eta_p^2 = .027$. Post hoc comparisons revealed that trail use (average total count per day) during restrictions in 2020 ($M = 768$, $SD = 318$) is greater than trail use before ($M = 590$, $SD = 325$), $p < .001$, and after ($M = 672$, $SD = 252$), $p = .005$. There were no statistical differences across 2019 periods. Additionally, trail use during restrictions were an average of 206 counts per day higher, 95% Confidence Interval (CI) [10, 403], in 2020 than trail use in the comparable period of 2019, $p = .033$. The average daily trail use counts in each period can be seen in Figure 2. Descriptive results of hourly count data are shown in supplemental figures S1 and S2.

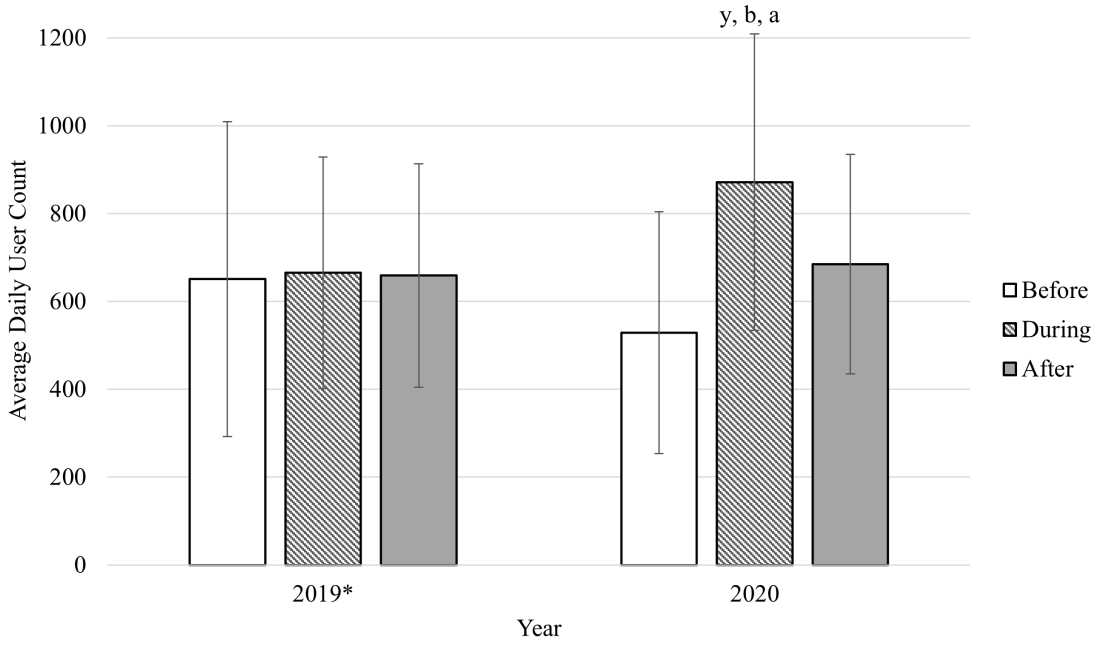

Figure 2. Average daily trail user counts in 2019* and 2020 for each period.
*Before, during, and after periods for 2019 refer to the matched dates in 2020.
y - Result is significantly different than the same period in 2019.
b - Result is significantly different than the Before period of the same year.
a - Result is significantly different than the After period of the same year.
All significant findings are at the 0.05 threshold.

Physical Activity Behavior

Respondent Demographics

The demographics of trail users and non-users showed differences across several categories, as for example, trail users tended to be older with a mean age of 48.8 years compared to 41.8 years for non-users. The complete demographic results are reported in Table 1. For comparison, as of 2019 U. S Census estimates, Colorado Springs was 49.9% female, 67.3% White, the median household income was approximately $70,500, and 40.2% have a bachelor's degree or higher.

Table 1. Demographics of respondents by trail use status.

Used Greenway Trail Ever?	Yes (*n* = 131)	No (*n* = 52)
Age (M ± SD)	48.8 ± 11.6	41.8 ± 14.2
Gender		
Female	55.0%	66.7%
Male	43.5%	26.9%
Non-binary/other/ prefer not to say	1.6%	5.8%
Race/ethnicity		
White	90.1%	73.1%
All others	8.9%	26.9%
Highest Education Level		
Less than 4-year degree	8.4%	28.8%
4-year degree or higher	91.6%	71.2%
Annual Household Income[a]		
Less than $70,000	29.4%	35.5%
$70,000 or higher	70.6%	64.7%
Employment Status		
Employed before SAH		
No	13.7%	11.5%
Yes	86.3%	88.5%
Employed during SAH		
No	32.8%	23.1%
Yes	67.2%	76.9%
Employed after SAH		

	No	29.8%	17.3%
	Yes	70.2%	82.7%
Self-Rated Health			
	Good or Excellent	95.3%	75.9%
	Average/Poor/Very Poor	4.7%	24.1%

[a] 'Yes' $n = 126$, 'No' $n = 51$.

Changes in Physical Activity Behavior

We examined how PA behavior changed by activity type (walking, MVPA, and total PA) and trail user-status. Figure 3 presents the percentage of respondents who decreased, did not change, and increased PA during restrictions by each activity type for trail users and non-users.

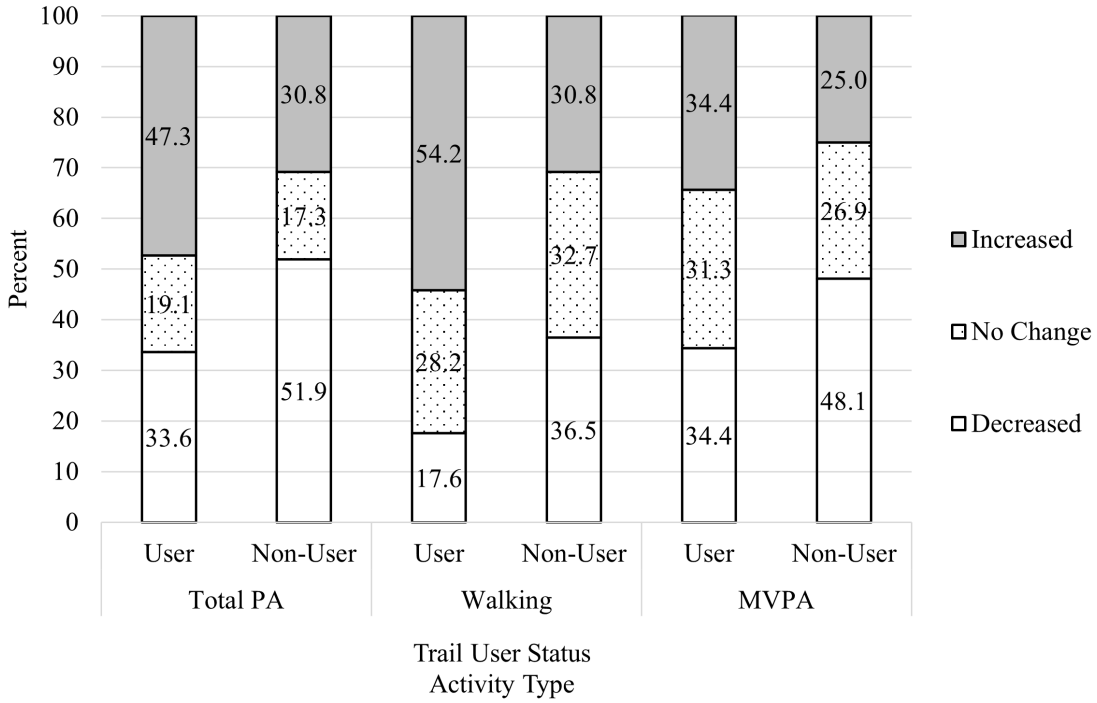

Figure 3. Percent change in PA activity types during restrictions by trail user status.

To explore the changes in amounts of activity across periods and user-type, we first examined total PA. The results of the two-way ANOVA for total PA showed a significant difference in total PA between trail users and non-users, $F(1, 181) = 7.43$, $p = .007$, $\eta_p^2 = .039$. Trail users averaged 102.1 more minutes, 95% CI [28.2, 176.0], of total PA than non-users across all periods. There was also a significant (period*user type) interaction effect ($F(2, 362) = 4.11$, $p = .017$, $\eta_p^2 = .022$). Post hoc analysis revealed that trail users reported 153.5 minutes more of total PA per week during restrictions, 95% CI [28.3, 278.7], than non-users, $p = .005$, $d = .27$.

We also examined changes in minutes per week of walking and MVPA across periods and trail user-type. The two-way repeated measures ANOVA for walking minutes showed a significant interaction effect, $F(1.83, 331.91) = 11.05$, $p < .001$, $\eta_p^2 = .058$. The post hoc analysis indicated that trail users increased walking by 50.8 minutes per week during restrictions compared to before, 95% CI [23.91, 77.61], $p < .001$, $d = .41$. Trail users also decreased their walking minutes after restrictions by 34.3 minutes per week from during restrictions, 95% CI [7.50, 61.20], $p = .003$, $d = .28$. Non-users did not have a statistically significant difference in walking minutes across time periods. The two-way ANOVA for MVPA showed statistically significant differences between trail user types, $F(1, 181) = 12.66$, $p < .001$, $\eta_p^2 = .065$. Trail users averaged 100.9 more minutes of MVPA, 95% CI [44.96, 156.91] than non-trail users across all periods. There were no significant interaction effects (all $p > .05$) for MVPA. The weekly minutes of each activity and trail user-status are shown in Figure 4.

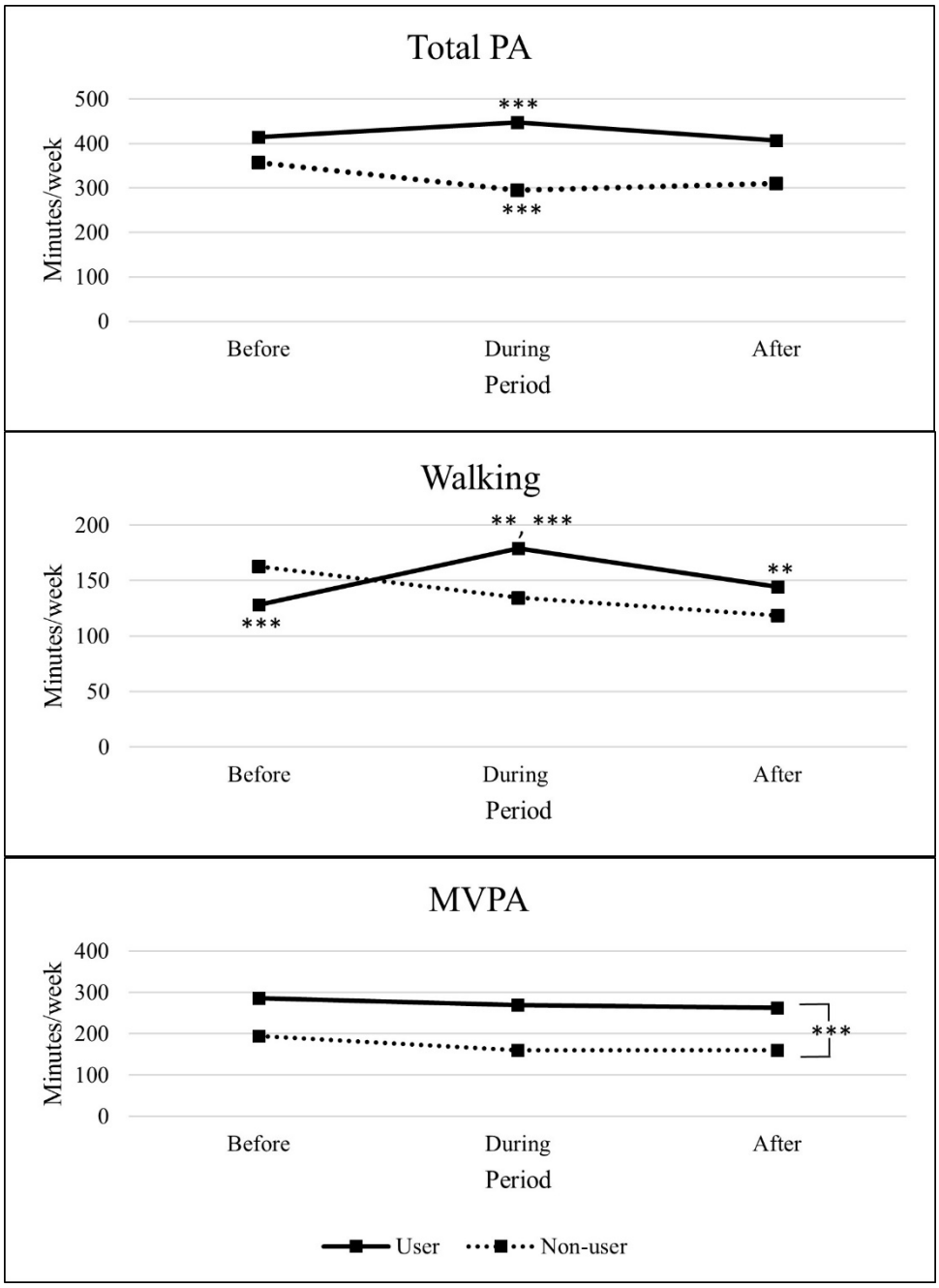

Figure 4. Average weekly minutes of PA in each period by trail user status.
Data with the same designation are statistically different from each other at the stated levels:
*$p < .05$. **$p < .01$. ***$p < .001$.

Discussion

Our study sought to explore trail use and recreational PA behavior of trail users and non-users during and after COVID-19 restrictions. We found that trail use increased during restrictions and returned to pre-pandemic levels after the restrictions. We also identified that trail users and non-users changed PA behavior differently during restrictions, leading to a significant difference in total PA during the restriction period.

Greenway Trail Use

The Greenway Trail counter recorded more traffic during restrictions than before or after. This data is consistent with trail count increases seen during restriction periods in other locations (Derks et al., 2020; Doubleday et al., 2021; Rails to Trails Conservancy, n.d.). For example, the Rails to Trails Conservancy's network of over 30 counters in the U.S. had a nearly 200% increase in trail use across the U.S. during the initial restriction period in mid-late March 2020. [Note: The Greenway Trail counter is a part of the Rails to Trails counter network.] However, not all trail counters reported increases in

use, and the difference can possibly be attributed to trail location (i.e., urban or rural) as well as how the restrictions were defined in that area (Doubleday et al., 2021).

Because the Greenway Trail traverses an urban park, it is also useful to compare our results to studies that measured park use during restrictions. Park and green space visitation were typically seen to increase (Geng et al., 2020; Venter et al., 2020), and green spaces and natural areas were perceived to be of higher value during the pandemic (Fisher & Grima, 2020). Recent examination of park use during restrictions indicated that increases may to be related to people already using the parks (Larson et al., 2021). Local context for park use is also an important consideration, as not all parks saw an increase in use during restrictions. For example, the number of visits to green space declined in the UK during restrictions, a location with stricter movement constraints (Burnett et al., 2021). A study of 97 counties in the western United States found that while park visitations on average increased about 20%, park visitations did not increase across all regions or demographics (Rice & Pan, 2021), and a study conducted in North Carolina identified socioeconomic status as negatively correlated to park use (Larson et al., 2021). Despite these differences, studies still found access to green space important for both mental and physical benefits during the pandemic. For example, although some urban locations experienced a decrease in park use, there was an increase in use of other urban green spaces (e.g., tree-lined streets) and these spaces were used for mental breaks and exercise (Ugolini et al., 2020). Our findings demonstrating increased trail use during restrictions are consistent with the studies mentioned above where COVID-19 restrictions were less constrained. The study location, Colorado Springs, CO, was in a state that named outdoor PA as a necessary activity and therefore policy makers recognized the importance of utilizing outdoor recreational space to sustain physical and mental wellness during the pandemic. Together, these strategies for mitigating virus spread while supporting overall health may have benefitted many members of the community – particularly those who already participated in outdoor recreational activity prior to the onset of the pandemic.

Greenway Trail use returned to typical levels after restrictions. One possible explanation is that once the most stringent measures were relaxed and businesses (including indoor recreational facilities) gradually reopened, the 'extra' time that was being spent in nature was no longer available, and people returned to their pre-pandemic routines. Our findings are similar to data reported by Doubleday et al. (2021) from Seattle, where post-restriction trail count data tended to return to pre-restrictions levels. In contrast, data from Norway suggest increased visits to green space post restrictions is being maintained (Venter et al., 2021), which would warrant further investigation on why some locations may be able to maintain higher user or visitation levels after COVID-19 restrictions and others not.

Physical Activity Behavior of Trail Users and Non-Users

To our knowledge, this is the first study to examine PA behavior of trail users and non-users during COVID-19 restrictions. We found that Greenway trail users participated in 153 more minutes per week of total PA during restrictions, and users were more likely to maintain or increase total PA during restrictions than non-users. The non-user population in this study was slightly younger, less white, had poorer self-rated health, fewer 4-year college degrees, and a higher rate of employment during restrictions. These differences between trail users and non-users are similar to those found by Smiley et al. (2020) in a pre-COVID study in Indiana and may partially explain this variation in PA behavior. It is possible the non-users were more likely to be working in essential businesses without flexible schedules or the ability to work from home, both being factors allowing for increased PA during restrictions (Besenyi et al., 2021; Fearnbach et al., 2021; Mel & Stenson, 2021). While we didn't assess where the respondents got their PA, it is also possible that non-users in our study may not have had the same access as trail users. This is an important consideration as it has been shown that proximity to trail access is correlated with trail usage (Starnes et al., 2011).

Another important finding is that more non-trail users decreased their total PA than increased, whereas more trail users increased their total PA compared to decreased. Our results of trail users being more active are consistent with Smiley et al.'s (2020) finding that trail users tend to be more active in general. Trail users participated in more MVPA than non-users across all periods, and it was changes in walking behavior that drove the difference in total PA between groups during restrictions. This is important as it relates to existing PA routines. For example, a study of fitness facility users and non-users reported that facility users only maintained total PA during restrictions, but the non-users of facilities increased total PA (Beattie et al., 2021). This could suggest some groups have increased adaptability based on existing routines. Trail users may have not had the same daily disruptions during restrictions related to PA behavior as non-users.

If trail users already had a PA routine, especially related to outdoor infrastructure, they may have been better able to plan for PA during restrictions (Maertl et al., 2021). Additionally, trail users may already appreciate the benefits of being in nature. During the pandemic, people expressed an increased desire to be outside for exercise and to connect with nature (Fisher & Grima, 2020; Mel & Stenson, 2021; Ugolini et al., 2020). Getting outside may have helped people cope with feelings of isolation and the unknowns of the pandemic, as it has also been reported that PA and time spent outdoors during restrictions was associated with fewer symptoms of anxiety and depression (Young et al., 2021). Therefore, during the unknown and stressful situation of the pandemic, trail users may have been more likely to utilize the "tools" of outdoor spaces and PA.

These findings reinforce the need for equitable access to green spaces and opportunities for recreational PA.

Limitations and Strengths

While the findings herein present unique look at trail use and PA behavior during the pandemic, there are limitations to our study. It is known that retrospective, self-reported responses are subject to recall error. Due to study time constraints, this method was the most practical way to collect the desired information from individuals, and the self-report format used was via a validated instrument. Selection bias may have been introduced by the internet delivery format to those with greater access to the internet; however, an in-person survey format was not feasible during the pandemic. Additional selection bias to a population that tends to be more active and use trails could have been introduced by the convenience and snowball sampling methods. While the results cannot be generalized beyond the study population due to the limited geographic extent, our study does present a look at a population under one set of COVID-19 restrictions. Moreover, only one trail was examined, and the study sample is relatively small and is not fully representative of the Colorado Springs population.

There are a few strengths of this study to note. One is that it combines subjective self-reported data with objective trail counter data for a more comprehensive view of PA behavior across COVID-19 restriction periods. Another strength is that the structure of the survey allowed for a novel look at PA behavior in trail users compared to non-users. This study's data is such that it can add to the growing body of research related to trail and green space use during the COVID-19 pandemic and PA.

Implications

Associated with our findings are practice and research implications. As our results showed increased trail use during COVID-19 restrictions, it would be important for policymakers to consider access to outdoor recreational spaces such as trails to support physical and mental health during pandemic situations. However, with increased use, practitioners would need to account for potential increased maintenance needs. As we found increased use was not sustained in all cases, more research is warranted to better understand why some locations were able to maintain increased use and others not. Moreover, we found trail users had more positive PA behavior during restrictions than non-users, and that there were demographic differences between users and non-users. Local policymakers should explore policies to ensure equitable access to trails and outdoor recreational opportunities in their jurisdictions. Furthermore, additional research is needed to understand behavior differences between trail users and non-users in challenging times.

Conclusions

Our finding that trail use increased during the COVID-19 restrictions combined with the finding that trail-users participated in more PA during restrictions suggests that outdoor trails may be associated with positive recreational PA behavior during uncertain times. Circumstances such as a pandemic where indoor recreational facilities close may push more people outside or cause more frequent use of outdoor infrastructure by existing users. Our results point to the valuable nature of outdoor infrastructure as a community resource in general and when PA options are limited. Accessible outdoor trails could play a role in improving adult PA behavior, and further investigation into demographic and trail access differences is warranted.

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Conflict of interest statement

The authors report there are no competing interests to declare.

Author Contributions

Conceptualization, Formal Analysis, Writing – Original Draft, N.E.O. Reviewing and Editing, Supervision, J.A.L., Methodology, J.A.L and N.E.O.

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Informed Consent and Ethical Approval

Informed consent was obtained by all individual participants included in this study. The University's Institutional Review Board approved this study (#2021-041). All procedures performed in studies involving human participants were in accordance

with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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