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Exercise and stress levels associated with a visit to Tallgrass Prairie National Preserve

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Abstract

Tallgrass Prairie National Preserve (TAPR) is a rural protected natural area in Kansas, United States. This parcel of public land provides visitors from varying areas with opportunities to experience a remaining collective of the tallgrass prairie ecosystem that once spanned large areas of North America. TAPR also provides visitors with opportunities to engage in nature-based experiences while also executing active pursuits. The researchers examined the effects of visiting TAPR on individuals' stress and activity levels during fall 2016. Electronic surveys and accelerometers were used to quantify individual stress levels and exercise. Participants ($n = 239$) traveled an average of 138 km to visit TAPR and spent an average of 143.7 minutes at the park, with an average of 68.1 minutes in moderate to vigorous exercise. A large majority of visitors (88.3%) also reported feeling less stressed than usual while at the park. The results suggest visiting natural areas have the potential to reduce stress and promote exercise, both well-known factors contributing to individual well-being. The results of this case study also convey the significance that accessible natural areas can have regarding opportunities of people to spend time in public lands and their reception of the benefits (e.g., mental, emotional, and physical) gained from the natural experience(s).

Keywords: healthy parks, visitor use, wellness

Introduction

Exercise is associated with a decreased risk of chronic disease, improved mood, higher quality of life, and better physical and cognitive function (Hillman, Orsega-Smith et al. 2004, 232–256; Penedo and Dahn 2005, 189–193; Warburton, Nicol, and Bredin 2006, 801–809; Erickson, and Kramer 2008, 58–65). To achieve health benefits from exercise, adults must engage in > 150 minutes of moderate-intensity or > 75 minutes of vigorous-intensity activity per week

(USDHHS 2018). Unfortunately, most adults in the United States (US) do not meet these guidelines. In fact, only half of US adults engage in sufficient aerobic activity, while 26.3% of adults report doing no exercise at all (CDC 2013). These high levels of inactivity have remained stable despite intervention efforts to promote exercise (ODPHP 2016). Regular engagement in exercise can produce short- and long-term attributes that positively influence the lives of individuals and

initiate beneficial habits (e.g., consistent exercise and/or a nutritious diet), especially during the formative stages of life (Macera, Hootman, and Snieszek 2003, 122). The implementation of positive habits can enhance the well-being of individuals, increase frequency of activity, and reduce negative health impacts across all ages (Sothorn et al. 1999, 271–272).

US National Park Service (NPS) locations are a potentially overlooked resource for promoting exercise. There are 422 units managed by NPS that collectively form the national park system. Examples of these units include national battlefields, national historical parks, national memorials, national preserves, and national parks, among other designations (NPS 2020). These locations provide an outlet for individuals to exploit the benefits that spending time outdoors in NPS locations can provide (e.g., mental, physical, and emotional) (Cohen et al. 2007, 509; James et al. 2016, 1344). Thus, NPS locations could provide resources for individuals to increase their exercise levels and acquire the associated attributes (e.g., stress reduction) (Sothorn et al. 1999, 271–272).

NPS locations generally provide a range of activity-based opportunities for visitors to exploit. Activities including hiking, climbing, and kayaking, for example, can enhance visitors' exercise while exploring nature. Some activities are associated with specific NPS locations (e.g., kayaking and climbing), but hiking or walking outdoors is a common activity available to many visitors in most NPS units. Frequent visitation to these locations could reduce visitors' sedentary trends and foster connections with the outdoors (Sothorn et al. 1999, 271–272). Moreover, if exposure to natural settings is increased, individuals can experience the positive aspects of nature from immersion (e.g., mental clarity and a reduction in depression) and potentially strengthen their bond with the outdoors (Bedimo-Rung, Mowen, and Cohen 2005, 159). Previous research has determined the notable impact that distance (e.g., increased or decreased) to natural areas can potentially have on the well-being of visitors (e.g., mental health) due to the degree of accessibility and exposure, the enhanced level of physical health that individuals who are closer to higher levels of accessible natural outlets (e.g., trail densities) display, and the additional benefits (e.g., socialization) that are introduced when individuals have a significant level of access to nature-based experiences (Rosenberger, Bergerson, and Kline

2009, 8–20; Sturm and Cohen 2014, 19–24; Wolf and Wohlfart 2014, 89–103). Collectively, these studies are a reflection of the varying and diverse benefits that can come to individuals who spend time accessing nature-based opportunities. The studies also convey the integral importance these attributes can have within the overall satisfaction and quality of one's life (Rosenberger, Bergerson, and Kline 2009, 8–20; Sturm and Cohen 2014, 19–24; Wolf and Wohlfart 2014, 89–103; Wood et al. 2017, 63–71).

Time in nature can provide the element of physical engagement and the associated benefits that have been found to come from outdoor activities, but the inclusion of social and mental engagement are also attributes that should be considered (Sturm and Cohen 2014, 19–24; Wolf and Wohlfart 2014, 89–103; Wood et al. 2017, 63–71). The existence of increased socialization can not only satisfy the interaction-based desires of individuals but could be influential in increasing the probability or occurrence of visitation due to a positive association between communal activities and nature-based experiences. During these moments, visitors are able to engage in a shared experience with other individuals and conjoin the elements of conversation and physical engagement through exploring the natural setting where the gathering is taking place (Wolf and Wohlfart 2014, 89–103). If these experiences are positive, those involved may be more likely to increase visitation due to their desire to consistently engage in those situations. Thus, the reception of social benefits can contribute to not only the introduction of physical and mental benefits due to the diverse engagements (e.g., interactions with natural characteristics and other people who are present), but potentially enhance the connection that individuals maintain towards nature due to their continual immersions within these significant contexts (Sturm and Cohen 2014, 19–24; Wolf and Wohlfart 2014, 89–103; Wood et al. 2017, 63–71).

The attributes that can be gained by an individual when time is spent in nature is significant to their health and overall well-being, but can also produce changes in attitudes and values and correspondingly the natural settings with which they engage. Specifically, the level of connection or significance that an individual holds towards a natural environment could have an immense impact on their level of resonance with and responsibility for protecting the location and

the organisms that inhabit it. This potential increase in the level of concern that an individual maintains toward a natural area can result in better stewardship. Stewardship involves the elements of obligation that one has regarding the natural world and how it is managed. When an individual experiences the development of a stewardship ethic within themselves concerning the natural areas they engage with, it can foster the progression of a lasting connection with nature and a long-term desire to engage in pro-environmental or environmentally conscious behaviors (Brown and Mitchell 2000, 70–79). Additionally, the element of stewardship can be enhanced based on the social aspect that occurs when those who share a similar resonance with nature gather. Similar to the group-based or communal activities that individuals can engage in when spending time in nature, the collective unification that can come from shared stewardship ventures can potentially result in even more pro-environmental behaviors by members of the group.

Based on the range of benefits that can come from progressing the connections that individuals maintain towards the natural world, and the desire they have to spend time within its dynamic landscapes, the assurance of equitable access to these locations is integral in improving the health of individuals and natural areas alike. Specifically, the reduction of potential inhibitors that could impede the potential for individuals to engage in these significant experiences is imperative. For these shifts to occur in NPS locations, efforts to increase accessibility to natural settings, will likely be needed. Various sociodemographic and accessibility factors can influence the amount of available resources that individuals can bring to this process. Factors related to money and to distance from the natural area can compound to establish a series of inhibitors that impede individuals from getting equitable access to NPS locations. An example includes the financial costs that are generally associated with visitation to NPS locations, such as costs associated with travel (e.g., gas prices or lodging) and time spent within these sites (e.g., entrance or amenity fees; Johnson and Suits 1983, 21–24).

In addition, the distance between an individual's residence and their desired NPS location can either be an advantage or a barrier to accessibility (Johnson and Suits 1983, 21–24). No matter where they are situated,

all NPS locations must do what is necessary to provide equal opportunities for all individuals, no matter their sociodemographic status, to gain access in an equitable manner (Tarrant and Cordell 1999, 18–23).

Based on these collective elements, in the present study we aimed to evaluate the influence that park visitation could have on individual well-being, and specifically assess NPS locations as potential outlets to engage in exercise. Although using visitor/participant-reported data is a common way to gauge activity and stress levels, we also incorporated the novel element of fitting participants with accelerometers that provide objective data to pair with the more subjective surveys. Specifically, our objectives were to:

1. Assess the impact that time spent at TAPR had on their exercise.
2. Examine changes in stress levels of visitors in comparison to those exhibited in their daily life.

Methods

Study area. Tallgrass Prairie National Preserve (TAPR) is a unit of the national park system managed by NPS that provides a natural area for visitors to observe biodiversity, use approximately 64 km of hiking trails, and receive other intrinsic and extrinsic benefits without payment of an entrance fee. TAPR trails provide opportunities for visitors to explore the site while engaging in a moderately difficult level of exercise (NPS 2018). TAPR is near Strong City, Kansas, US—a rural area characterized by tallgrass prairie landscapes and cattle grazing (Figure 1). TAPR encompasses approximately 4,409 ha and is a remnant of the estimated 68,800,000 ha of tallgrass prairie that used to exist in North America. This site was established in 1996 and provides habitats for various wildlife populations. TAPR also has diverse flora and fauna species representing a dynamic native tallgrass ecosystem (NPS 2018). Additionally, TAPR provides a place for public recreation and exercise in a rural area dominated by private landholdings (the state of Kansas is 97% private land) (FWS n.d.).

Procedures. The researchers collected data in fall 2016 for eight days (one Friday, three Saturdays, and four Sundays) at TAPR. Therefore, this study may not reflect use and visitation for other seasons of the year. Two data collection days aligned with special events at the research site, so the activities in which visitors

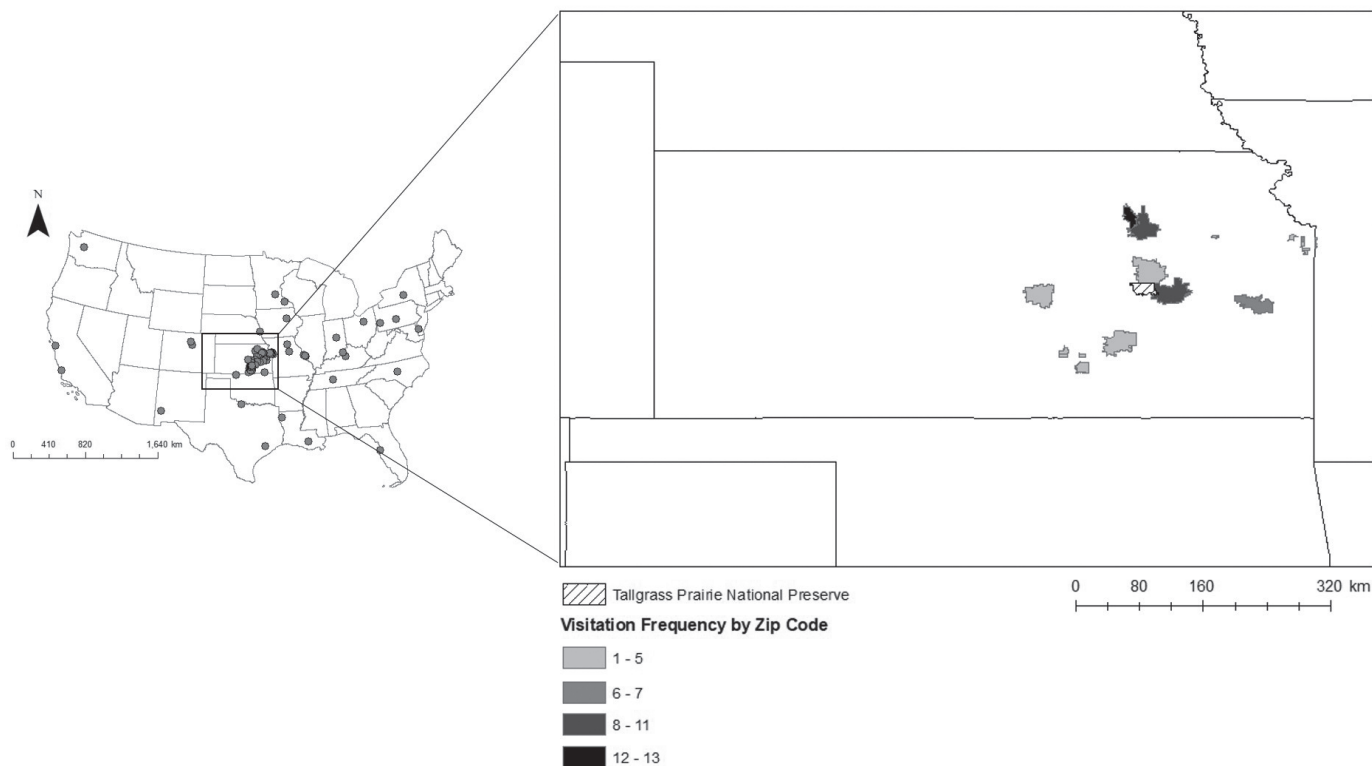


FIGURE 1. The zip code of residence for visitors to Tallgrass Prairie National Preserve (TAPR), Kansas, US, during fall 2016 (gray circles). The frequency of visits to TAPR in relation to zip codes in Kansas and Missouri are highlighted in the side panel.

engaged on these days may have differed from typical activities. The researchers included these events to capitalize on visitation and the opportunity to obtain a representative sample size.

On each day, the researchers surveyed visitors to TAPR from 9:00 a.m. to 5:00 p.m. outside of the visitor center. The researchers approached all visitors upon their arrival, explained the study purpose, and asked if they would be willing to wear an accelerometer (Actigraph GT3X) during their visit. Accelerometers recorded the number of steps and continuous “activity counts” summed across each minute, where greater activity counts reflect greater amounts and intensities of exercise by the wearer (e.g., running; Freedson, Melanson, and Sirard 1998, 777–781). The researchers recorded the exact times participants wore accelerometers and excluded any recorded activity outside of the specified wear time from analyses. Data were collected and analyzed using the software ActiLife 6.0.

The requirement for written informed consent for visitor participation was waived; consent was implied when an individual agreed to wear the device. The

researchers helped participants affix the accelerometer over their left hip using a waist-worn belt and noted the time when each participant began use of the device. Visitors were instructed to go ahead with their planned activities and return the accelerometer before exiting the park. When participants returned the accelerometer, the researchers noted the time visitors stopped wearing the device and asked them to complete an electronic survey on a handheld tablet. The survey included questions regarding sociodemographics, visitation reasons, exercise, and stress. All methods were approved by a University Institutional Review Board.

Demographics. Participants reported their gender, age, race, education, total household income, and zip code. Additionally, they reported their visitation history to TAPR and the reason(s) for their visit.

Exercise during visit. Each minute participants wore an accelerometer was classified either as “sedentary” (< 100 activity counts recorded/minute), “light intensity” (100–1951 activity counts recorded/minute), or “moderate to vigorous intensity” (MVPA) (> 1952 activity counts recorded/minute; Freedson, Melanson,

and Sirard 1998, 777–781). Additionally, the researchers quantified the number of steps taken by participants wearing accelerometers.

Typical exercise. At the end of their park visit, visitors completed the Godin Leisure-Time Exercise Questionnaire to self-report their current frequency of engaging in “strenuous” (e.g., running), “moderate” (e.g., easy bicycling or swimming), and “light” (e.g., bowling or golf) leisure-time exercise for at least 15-minute sessions during a typical week (Godin and Shephard 1985, 141–146). The use of the term “exercise” within this research is based on the implementation of the Godin scale, in contrast to the use of the more recent term “physical activity.” The researchers summed the weighted totals of strenuous (number of sessions multiplied by 9) and moderate (number of sessions multiplied by 5) exercise and classified individuals as “active” (MVPA score ≥ 24) or “inactive” (MVPA score < 24). Weights are based on validated scoring instructions for measuring exercise, and our MVPA threshold corresponds with individuals engaging in 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity exercise per week (Godin and Shephard 1985, 141–146; Cohen and Williamson 1988, 31–67; Godin 2011, 18–22).

Stress during visit. To assess participants’ stress level during their visit (e.g., “compared to other days, my stress level today was very low”), the researchers posed four questions. Participants responded on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The researchers calculated a summary score by averaging the responses to the four questions for each visitor. Internal consistency of the scale was acceptable ($\alpha = 0.81$) (Vaske 2008, 121–171).

Typical stress. To assess typical stress, participants responded to a four-item version of the Perceived Stress Scale (Cohen and Williamson 1988, 31–67). The participants reported the extent to which they feel capable of handling stressful or difficult situations. Participants responded on a 5-point Likert scale ranging from 1 (never) to 5 (very often), with higher scores indicating higher perceived stress. Internal consistency of the scale was acceptable ($\alpha = 0.75$) and summed individual scores ranged from 4–20 (e.g., answers to the four questions corresponded to all values of 1 or 5). The researchers aggregated the scale and classified individuals scoring < 8 (median) as “low

stress” and individuals scoring > 8 as “high stress” based on the current sample.

Data analysis. The researchers used descriptive statistics to determine the average length of a visit to TAPR as well as the average time (in minutes) spent in sedentary, light, and MVPA activity. Also, the researchers used independent sample t-tests (SPSS version 25) to determine whether total time spent in these categories during a visit differed between (1) men and women, (2) visitors above and below 50 years of age, (3) individuals who engaged in regular exercise compared to inactive individuals, and (4) individuals who reported low and high levels of perceived stress. Additionally, the researchers compared frequency distributions to examine the number of visitors who reported feeling less stressed than usual during their visit to TAPR. The researchers used a Kolmogorov-Smirnov test (SPSS version 25) to test for differences between the distributions based on time spent in the park. This test was chosen due to the power of the statistical analysis and because it is a robust test of the distribution of the data (especially with smaller sample sizes; Lilliefors 1967, 399–402). The researchers assessed how variation in time spent at TAPR compared among the visitors’ answers. Based on the mean value of 143.7 minutes for time spent at TAPR, visitors were categorized as spending above (> 143.7 minutes) or below (< 143.7 minutes) this determined point. Additionally, these two groups were found to be normally distributed. The Kolmogorov-Smirnov revealed a normal distribution for those that spent < 143.7 minutes ($p > 0.05$) or > 143.7 minutes ($p > 0.05$) at TAPR.

Results

Demographics. The researchers approached 325 visitors and 239 agreed to participate (73% response rate). Of these, 222 visitors completed a survey; a single non-response was recorded for this cross-sectional study. Out of 221 visitors who provided a response, most were female ($n = 128$). The remainder of visitors indicated they were male ($n = 92$) or other ($n = 1$; Table 1). Average respondent age was 54.5 years (range = 18–78 years). Most visitors had a four-year collegiate degree ($n = 87$) or a graduate or professional degree ($n = 83$). The predominant race was white (90.8%). Most visitors reported a pre-tax total household income $> \$100,000$. Although participants were primarily white and highly educated, they represented the current

TABLE 1. Descriptive statistics regarding exercise and stress levels of visitors to Tallgrass Prairie National Preserve (TAPR), Kansas, US, in fall 2016.

Gender	
Male	92 (41.4%)
Female	128 (57.7%)
Age	54.5 (14.8)
Race: White	207 (90.8%)
Education	
High school graduate	12 (5.4%)
Some college	28 (12.7%)
Two-year degree	9 (4.1%)
College graduate	87 (39.4%)
Graduate or professional degree	83 (37.6%)
Income	
<\$50,000	54 (24.9%)
\$50,000–\$100,000	67 (30.8%)
>\$100,000	69 (31.8%)
Do not wish to answer	27 (12.4%)
First time visitor	74 (35.6%)
Length of visit (minutes)	143.7 (62.2)
Reasons for visiting	
To spend time outdoors	149 (24.8%)
To spend time with family/friends	145 (24.1%)
To be active	114 (19.0%)
To learn more about the history of the area	84 (14.0%)
To learn more about animal life in the area	44 (7.3%)
To learn more about plant life in the area	43 (7.2%)
Other	22 (3.7%)

sociodemographics of Kansas residents (86.5% white; USCB 2018).

Visitation. Of the respondents, 64.4% (n = 134) reported previous visitation to TAPR and 35.6% (n = 74) were first-time visitors. Most participants were from Kansas and Missouri (n = 181), with 76.7% of visitors traveling < 2 hours to TAPR (Figure 1). The average distance traveled to TAPR was 138 km. The primary reason(s) for visiting TAPR was to spend time outdoors (n = 149), to spend time with family/friends (n = 145), and to be active (n = 114). “Other” reasons (n = 22) included special events that were taking place at the park on data collection days. Approximately 52.7% of the visitors were visiting with one other person, 9.5% were alone, and 37.8% were in groups of > 3 (group size = 1–18).

Exercise and stress. On average, visitors spent 143.7 minutes at the park (range: 31.7–295.7 minutes; Table 1). Visitors spent an average of 68.1 minutes in MVPA (47.4% of the visit), 43.3 minutes sedentary

(30.1% of the visit), and 32.3 minutes in light activity (22.5% of the visit; Table 2). Men and visitors < 50 years spent more time in MVPA than women and visitors > 50 years of age, respectively, but these differences were not statistically different (Table 2). Regularly active individuals engaged in significantly more MVPA during their visit than individuals not currently meeting exercise guidelines, but inactive individuals still averaged 60.4 minutes of MVPA while at TAPR. In total, 73.2% of visitors accumulated the recommended 30 minutes of daily MVPA during their visit. Additionally, visitors averaged 8,135 steps during their visit, which composed 81.4% of the recommended 10,000 steps per day.

Visitors reported completing three sessions of moderate or light exercise during a typical week. Based on this, an increase in the level of exercise completed by TAPR visitors was found during this study in comparison to their general routines (Table 3). On average, visitors reported feeling less stressed during their visit compared to other days (M = 5.4; range

TABLE 2. Mean results (and standard deviation) of visitors' exercise and stress levels while visiting Tallgrass Prairie National Preserve (TAPR), Kansas, US, in fall 2016.

	All n = 239	Men n = 88	Women n = 126	Age < 50 n = 76	Age > 50 n = 139	Active n = 116	Inactive n = 101	Low stress n = 114	High stress n = 106
Sedentary	43.3 (34.2)	40.7 (32.7)	44.8 (34.7)	43.0 (33.3)	43.7 (34.4)	45.0 (34.4)	41.8 (33.3)	43.0 (34.3)	43.7 (33.5)
Light	32.3 (19.6)	30.8 (20.4)	33.4 (19.6)	30.8 (17.9)	33.3 (20.9)	33.2 (20.6)	31.4 (18.9)	32.9 (19.6)	31.8 (20.1)
MVPA	68.1 (50.4)	77.6 (51.9)	63.9 (50.0)	73.4 (48.2)	67.5 (52.3)	76.9* (49.3)	60.4 (51.3)	72.1 (51.9)	66.4 (49.9)
Steps	8135 (5327)	8846 (5237)	7942 (5462)	8404 (4955)	8280 (5571)	9096* (5067)	7345 (5529)	8627 (5429)	7947 (5282)

MVPA: Moderate to vigorous intensity. *Significant difference between groups. All of the significant values were evaluated at the 0.05 level of significance testing.

TABLE 3. Visitors' self-reported responses to questions about their exercise and stress levels in relation to their visit to Tallgrass Prairie National Preserve (TAPR), Kansas, US, in fall 2016.

	Strongly disagree	Disagree	Slightly disagree	Neither agree or disagree	Slightly agree	Agree	Strongly agree	Mean	SD
<i>Exercise Items</i>									
I was more physically active during my visit today than on a regular day	8.2%	15.5%	8.2%	13.2%	18.3%	22.4%	14.2%	4.4	1.9
I walked more today than I usually walk	4.8%	18.8%	12.1%	6.3%	19.8%	23.2%	15.0%	4.5	1.9
During my visit today, I engaged in more physical movement than usual	3.8%	20.7%	10.3%	11.3%	17.4%	22.5%	14.1%	4.4	1.9
Today, I moved around more than most days	5.6%	18.7%	10.3%	15.4%	14.0%	20.1%	15.9%	4.4	1.9
<i>Stress-related Items</i>									
During my visit today, I experienced a lot less stress than usual	1.9%	3.7%	3.3%	13.6%	19.2%	39.3%	19.2%	5.4	1.4
When I visited Tallgrass Prairie National Preserve today, I felt my stress level decline tremendously	1.4%	4.3%	1.9%	14.8%	27.1%	33.8%	16.7%	5.3	1.3
Compared to other days, my stress level today was very low	1.9%	5.6%	4.7%	12.6%	23.7%	33.0%	18.6%	5.2	1.5
Today, my stress was much less than most days of the week	0.5%	3.8%	2.8%	13.7%	17.5%	37.0%	24.6%	5.5	1.3

= 1–7). Notably, approximately 88.3% of all visitors reported that they experienced less stress than usual. This percentage increased to 91.6% when examining only individuals who typically report high stress.

Discussion

Our results revealed that participants reported feeling less stressed than usual while visiting TAPR and highlights the potential health benefits of visiting an NPS location. Overall, the sample engaged in a substantial amount of exercise, and there were few significant differences between various subgroups of TAPR visitors. Although the groups who could be considered “at-risk” (e.g., inactive individuals, highly stressed individuals, etc.) did engage in slightly less MVPA during their visits than their counterparts, all

the subgroups still accumulated at least one hour of MVPA on average. These data suggest NPS locations can promote healthy behaviors in all individuals regardless of their gender, age, or typical behaviors. Our results suggest that the experiential benefits of natural locations could benefit visitors, especially those who could experience negative health situations or are dealing with inhibiting sociodemographic or socioeconomic factors (Eberhardt and Pamuk 2004, 1682–1683; Smith, Humphreys, and Wilson 2008, 56–66).

Interaction with nature enhances mental, physical, and emotional attributes that can influence an individual's well-being (Maller et al. 2005, 45–49; Bartley et al. 2019, 293–299). Benefits involving mental clarity, stress

reduction, self-enrichment, and an increased feeling of satisfaction can result from exposure to nature (Maller et al. 2005, 45–49; James et al. 2016, 1344). Accessibility to parks such as TAPR, is fundamental for providing equal opportunities for individuals to exploit the intrinsic and/or extrinsic benefits of being in nature (Weinstein, Przybylski, and Ryan 2009, 1315–1316). Indeed, proximity to an NPS location or other natural area (e.g., state park, local park, and etc.) is a significant factor that influences an individual's ability to access natural areas (Bedimo-Rung, Mowen, and Cohen 2005, 159; Veitch et al. 2013, 107–111).

Depending upon an individual's resources and their distance to the nearest NPS location, both positive and negative factors could affect their feasibility to access a nature-based experience (Weinstein, Przybylski, and Ryan 2009, 1315–1316; Bedimo-Rung, Mowen, and Cohen 2005, 159). NPS locations throughout the US represent numerous resources that can be used for nature-based experiences (e.g., physical exercise), but the existence of barriers to these visits can also be immense. In this respect, geographic location or sociodemographic influences introduce higher risks for negative health occurrences for individuals, such as non-residents in comparison to residents, due to density and perceived demand (Eberhardt and Pamuk 2004, 1682–1683; Smith, Humphreys, and Wilson 2008, 56–66). As a result, park planners should account for population density when considering where to site a new natural protected area (Veitch et al. 2013, 107–111). Not doing so could contribute to the negative impacts that occur to individuals who do not have adequate access to natural spaces (Bedimo-Rung, Mowen, and Cohen 2005, 159). These impacts include negative influences on mental health, the heightened occurrence of diseases, the increased level of chronic health impairments, and an increased mortality risk (Eberhardt and Pamuk 2004, 1682–1683).

Additional factors that could influence the health of individuals include access to healthcare services, urban sprawl, and sociodemographic influences (Eberhardt and Pamuk 2004, 1682–1683). The increase of infrastructure associated with urban sprawl diminishes the opportunity for individuals to access wilderness non-use values (e.g., clean water and air), which decline along with a reduction in natural areas. Wilderness non-use values are secondary attributes that are increased based on an individual's opportunity

to access natural settings, such as NPS locations. These elements can positively influence visitors' lives, for example by encouraging an increased level of exercise (Porter and Tarrant 2005, 108–112; Jackson, Porter, and Tarrant 2018, 96–97). Sociodemographic factors, such as total household income and occupation, could dictate if individuals can move closer to natural areas (Eberhardt and Pamuk 2004, 1682–1683). Depending upon residency, income could influence an individual's accessibility to natural areas and resulting exercise benefits (Parks, Housemann, and Brownson 2003, 29).

Enhanced natural area access, specifically at NPS locations, could reduce negative factors that impact the well-being of individuals (Eberhardt and Pamuk 2004, 1682–1683; Maller et al. 2005, 45–49). The distance between an individual's residence and the nearest NPS location could be the deciding and integral factor in their choice to spend time in nature at all or else find a closer alternative. People who live closer to an NPS location often experience an enhanced presence of natural amenities (Veitch et al. 2013, 107–111). Accessible NPS locations, such as TAPR, are key to activating the causal chain (e.g., increased exercise levels, reduced stress level, enhanced levels of socialization, and improved mental state) that comes from spending time in nature. These benefits, in addition to the fostering of connections to nature, are a minor reflection of the immense impact that time in nature could have on the life of an individual (Eberhardt and Pamuk 2004, 1682–1683; Smith, Humphreys, and Wilson 2008, 56–66; Veitch et al. 2013, 107–111).

The establishment of public natural areas closer to centers of population is significant when considered against the current dispersion of accessible natural areas and the inhibitors that could reduce the likelihood of visitation by individuals (e.g., travel costs, time required for travel, and sociodemographic and socioeconomic factors). More accessible natural areas closer to more people would increase the motivation to spend time in nature and engage in regular exercise. Additionally, this would also encourage more people to use an NPS location as an exercise venue—one that produces additional experiential benefits. Increased time in nature, exercise, socialization, communal-based activities, and overall state of being or mood are examples of the overall rewards that could come to

all individuals from enhanced access and exposure to public lands (Eberhardt and Pamuk 2004, 1682–1683; Moody et al. 2004, 438–443; Smith, Humphreys, and Wilson 2008, 56–66; Weinstein, Przybylski, and Ryan 2009, 1315–1316; Veitch et al. 2013, 107–111).

In addition to the equitable provision of nature-based experiences and resources, the perception that visitors have regarding NPS locations as places to engage in exercise could influence the exercise itself. Often, exercise is associated with using indoor facilities that provide ways to engage in individual-based routines or classes with numerous attendees (Learmonth et al. 2013, 81–88). Encouraging people to exercise at NPS locations could increase their levels of exercise and time spent in nature (Maller et al. 2005, 45–49). Similar to indoor facilities, NPS locations also provide opportunities for engagement in community-based activities and collectively can enhance the well-being of those involved (Payne and Schaumleffel 2008, 116–135). Potential methods to assist with perspective shifts could include offering park-based opportunities, such as outreach events. Group-based guided hikes, collective trail runs, yoga sessions during the sunrise or sunset time periods, or theme-based gatherings (e.g., topics focused on the historical or cultural significance of the site) are examples of events that could assist in encouraging visitors to perceive NPS locations as accessible places for exercise and opportunities to engage with others (NPS 2018). These methods could be applied not only at TAPR, but at a variety of NPS locations and other natural areas. Additionally, the incorporation of these methods could assist in encouraging the establishment of more protected natural areas in less-populated regions (Veitch et al. 2013, 107–111).

Limitations

As is the case with most studies of this kind, there were limitations that may have influenced the collection and analysis of the data (Vaske 2008, 121–171). First, participants were aware that their exercise was being measured during their visit, so it is possible they modified their behavior as a result. Second, all the data (excluding the accelerometer data) were self-reported, thus visitors may have over- or underestimated their exercise and/or their stress levels. Lastly, this was a cross-sectional study that took place during only one season of the year. While an appropriate and representative sample was acquired, the study may not

be representative of seasonal differences of use within TAPR.

Conclusion

The integration of visitor surveys with accelerometer use provides a beneficial approach to investigating exercise and stress levels of visitors to a natural area (Bartley et al. 2019, 293–299). This study also found that NPS locations can be beneficial in fostering the connection that individuals feel towards nature. By highlighting the myriad of opportunities to acquire intrinsic and extrinsic (e.g., wilderness non-use values) benefits from the natural world, NPS could help make positive alterations to the well-being of its visitors (Porter and Tarrant 2005, 108–112; Weinstein, Przybylski, and Ryan 2009, 1315–1316; Jackson, Porter, and Tarrant 2018, 96–97). This, in conjunction with more NPS locations better distributed among urban and rural populations and a focus on potential sociodemographic factors that impede accessibility, serve as opportunities to increase individuals' exercise and reduce the negative impacts resulting from inactivity and stress (Eberhardt and Pamuk 2004, 1682–1683; Moody et al. 2004, 438–443; Smith, Humphreys, and Wilson 2008, 56–66; Weinstein, Przybylski, and Ryan 2009, 1315–1316; Veitch et al. 2013, 107–111). Due to patterns of population distribution and inequities in income and other resources, people often experience unequitable access to protected natural areas (Veitch et al. 2013, 107–111). Creating more of them for all people to access would be significant in positively influencing their daily habits and their overall well-being.

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