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The Association of Natural Elements With Physical Activity Intensity During Trail Use by Older Adults

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Background: Public health efforts to promote trail use among older adults could be an effective strategy for increasing physical activity among older adults. However, research is needed to better understand factors that influence older adults' use of trails. ***Purpose:*** To examine the association between variations in natural elements (ie, season, weather, temperature) and older adults' overall trail use and physical activity intensity during trail use. ***Methods:*** A rail-trail in South Carolina was systematically evaluated (2006–2009) using The System for Observing Play and Recreation in Communities. ***Results:*** The majority (74.2%) of the 1053 older trail users observed were walking; 25.9% were observed in vigorous activity. Older adults were most often observed using the trail in the spring (40.1%), sunny weather (76.8%), and moderate temperatures (56.2%). Significant differences in activity type by natural element variables were identified. ***Conclusions:*** When promoting trail use among older adults, natural elements should be considered.

Keywords: season, weather, exercise

The benefits of regular physical activity for older adults have been well documented.[1] Regular physical activity among older adults has been associated with improved outcomes with regards to cardiovascular disease, diabetes, cancer, weight control, cognitive function, mental health problems, such as anxiety and depression, and all-cause mortality.[1] Many older adults, however, are not regularly active.[2,3] Nationwide, 61.0% of adults 65 years and over are not meeting national physical activity recommendations.[2] Clearly public health efforts are needed to promote increases in physical activity among older adults.

Promoting changes in physical activity behavior among older adults is challenging. Efforts to change behavior may be most effective when an ecological approach, which may focus on public policy and physical environments in addition to frequently used behavior modification strategies, is used.[4,5] The Community Preventive Services Task Force recommends the creation of, or enhanced access to, places for physical activity as an effective method for increasing physical activity and improving individuals' physical fitness.[6] One such example is the creation of greenway trails.[7–10] In an examination of activity behaviors in 25 parks, Reed and colleagues found that greenway trails were the most frequently used activity setting.[11] Additional research suggests that persons who use trails for physical activity are more likely to meet the national physical activity recommendations than those who rarely or never use trails for physical activity.[12]

In 2005, the Mary Black Foundation, located in Spartanburg County in South Carolina, funded a 2-mile urban rail-trail conversion project. This paved greenway trail serves as a key connector between the downtown business district and more rural parts of the county, and is located between 2 historic residential neighborhoods which include individuals with diverse socioeconomic and demographic characteristics.[13] Reed and colleagues[13] recently examined usage patterns of the Spartanburg trail using objective measures. Among other findings, the results showed that older adults were less likely to use the trail than adults. Specifically, of 3317 trail users, only 16% of trail users were older adults. Other studies using subjective measures have also identified an inverse association between age and trail use.[14] The findings from these studies highlight a need for greater promotion of trail use among older adult populations. However, before efforts to promote trail use among older adults can be effective, further research is needed to better understand factors that influence older adults' use of trails.

Previous studies indicate that season, weather, and temperature variations influence physical activity behavior.[15,16] For example, adults report less physical activity during winter months,[16–18] and objective counts of adults using trails show trail use increases in warmer temperatures and decreases in colder temperatures suggesting seasonal changes.[19] Matthews and colleagues[20] also found that 6% of the variance in physical activity levels over 12 months were explained by seasonal effects. Older adults physical activity behavior may be especially influenced

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by seasonality because of reductions in thermal tolerance with age, which may be largely due to chronic diseases and a sedentary lifestyle rather than age itself.[1,21] In addition, older adults have specifically reported both inclement weather and extreme temperatures as barriers to engaging in regular physical activity.[22–24] Researchers have called for additional studies examining associations between physical activity behavior and natural elements, such as season, weather, and temperature.[10,15] However, no studies to date have examined the associations between older adults' use of an outdoor greenway trail and these natural elements. Given the notable lack of information, the purpose of this study was to examine the relationships between season, weather, and temperature and 1) overall trail use and 2) physical activity intensity during trail use by older adults.

Methods

The 2-mile rail-trail in Spartanburg County was systematically evaluated over 4 years. Findings from the current study are from spring 2006 to fall 2009. The trail was observed for 7 days during each season (ie, winter, spring, summer, fall). All observations were within a 2-week range of the original data collection points. For example, if measures were obtained February 14 to 21 in the winter of 2006, then the observation periods during subsequent winters were within 2 weeks of the original date.

The System for Observing Play and Recreation in Communities (SOPARC)[25] was used to assess rail-trail user demographics and behaviors, as well as to record variations in season, weather, and temperature. Previous studies have provided evidence for both the validity[26,27] (established through heart rate monitoring) and reliability[25,28,29] (interobserver agreement) of determining physical activity behavior using SOPARC.

Undergraduate students were trained as rail-trail observers. Details about the training process are provided elsewhere.[13] Interrater reliability of all trained trail observers was assessed before participating in the current study. Each observer was asked to identify the gender, age, and race/ethnicity of a person and the physical activity behavior shown in 75 pictures of diverse persons performing a variety of physical activity behaviors. Test-retest correlation coefficients were greater than $r = .90$ for each variable for all observers. The lead investigator also performed quality assessment checks with all trained observers on the trail.

Momentary time sampling techniques were used to observe and record data about trail use. This method has been shown to yield valid behavioral samples when measures of persistent behaviors (eg, physical activity) are taken at regular, frequent intervals. In this study, observations were taken in the morning (7:30 AM), noon (12:30 PM), afternoon (3:30 PM), and evening (6:00 PM). Observations were made for 10 minutes at 6 different access points along the trail. During each scan, the physical activity level of individuals using the trail was coded as sedentary (ie, lying down, sitting, or standing), walking (ie, individuals are walking at a casual pace), or engaging in vigorous-intensity physical activity (ie, individuals are engaged in activity more vigorous than ordinary walk, such as jogging).[25] Separate scans were made to determine demographic characteristics.

The season, weather, and temperature were recorded during each observation period. For the purpose of this study, season was defined as the natural periods in which the year is divided, including fall, winter, spring, and summer. The categories are based upon the Northern hemisphere experience of fall being in September to November, winter falling in December to February, spring falling in March to May, and summer falling in June to August. Weather is defined as meteorological conditions, such as winds, clouds, sunlight, and precipitation. The categories included partly sunny/sunny (hereafter called 'sunny'), partly cloudy/cloudy (hereafter called 'cloudy'), and misting/raining (hereafter called 'rainy'). Temperature was divided into 3 categories based on the Fahrenheit scale: low (60°F or less), moderate (61–80°F), and high (81°F or greater). Temperature was obtained using portable thermometers.

Only observations of older adults using the trail were examined in this study. In this study, older adults were defined as persons age 60 and older according to SOPARC protocol.[25] The study was approved by the University of South Carolina and Furman University Institutional Review Boards.

Data Analysis

Descriptive and inferential statistics were calculated using SAS, version 9.1. Frequency distributions were used to summarize the majority of the data. Logistic regression models were used to assess differences in physical activity behavior by season, weather, and temperature. Due to the small number of individuals observed engaging in sedentary behavior while using the trail (n = 37), observations of these individuals were not included in the analyses, resulting in a 2-category physical activity intensity variable: walking versus vigorous-intensity physical activity. Gender, ethnicity, and time of day were controlled for in all analyses.

Results

There were 1053 observations of older adults engaging in physical activity on the trail over 16 quarterly observation periods from 2006–2009.

Overall Trail Use

As shown in Table 1, older adult trail users were mostly White (80.5%) and male (53.7%) The majority (74.2%) of older trail users were observed walking, and 25.9% were observed in vigorous activity.

Findings listed in Table 1 illustrate rail-trail usage by older adults during each of the 4 years data were collected, the 4 seasons, different weather conditions, varying temperatures, and different time periods during the

Table 1 Older Adults Observed Using a South Carolina Rail-Trail by Seasonality and Demographic Variables, 2006–2009

	Older adults observed using the trail					
	Total (n = 1053)		Walking (n = 781, 74.2%)		Vigorous (n = 272, 25.8%)	
Variables	*f*	(%)	*f*	(%)	*f*	(%)
Season						
Fall	221	(21.0)	167	(21.4)	54	(19.9)
Winter	296	(28.1)	245	(31.4)	51	(18.8)
Spring	422	(40.1)	273	(35.0)	149	(54.8)
Summer	114	(10.8)	96	(12.2)	18	(6.6)
Temperature[a]						
Low	289	(28.9)	231	(31.1)	58	(22.5)
Moderate	562	(56.2)	409	(55.1)	153	(59.3)
High	149	(14.9)	102	(13.7)	47	(18.2)
Weather						
Party sunny/sunny	783	(76.8)	613	(81.2)	170	(64.4)
Partly cloudy/cloudy	195	(19.1)	125	(16.6)	70	(26.5)
Misting/rain	41	(4.1)	17	(2.3)	24	(9.1)
Time period						
Morning	309	(29.3)	230	(29.5)	79	(29.0)
Noon	208	(19.8)	154	(19.7)	54	(19.9)
Afternoon	302	(28.7)	240	(30.7)	62	(22.8)
Evening	234	(22.2)	157	(20.1)	77	(28.3)
Year						
2006	204	(18.7)	144	(18.4)	54	(22.3)
2007	181	(16.6)	142	(18.2)	30	(12.4)
2008	386	(35.4)	285	(36.5)	89	(36.8)
2009	318	(29.2)	209	(26.8)	99	(40.9)
Gender						
Female	488	(46.3)	440	(56.3)	48	(17.6)
Male	565	(53.7)	341	(43.7)	224	(82.4)
Ethnicity						
White	848	(80.5)	603	(77.2)	245	(90.1)
Non-White	205	(19.5)	178	(22.8)	27	(9.9)

[a] Low = 60°F or less; moderate = 61–80°F; High = 81°F or greater.

Abbreviations: *f* = frequency.

Note. Because of some missing data, the total number of responses for each variable category may not add up to the total number of observations listed.

day. Overall older adults were most often observed using the rail-trail in the spring (40.1%), when the weather was sunny (76.8%), and when the temperature was moderate (56.2%). Older adults most often were observed engaging in walking in the morning or afternoon, and vigorous activity in the morning or evening.

Physical Activity Intensity During Trail Use

A comparison of walking versus engaging in vigorous activity while using the trail by season, weather, and temperature adjusting for gender, ethnicity, and time of day is shown in Table 2. The odds of older adults being observed walking were lower during the spring, fall and winter as compared with summer. The odds of observing older adults walking were higher when the weather was sunny compared with rainy. The odds of observing older adults walking were also higher when temperatures were low (≤60 degrees) compared with high (≥81 degrees).

According to the inverse of the relationships described above and shown in Table 2, the odds of observing older adults engaging in vigorous activity were greater in the fall, winter, and spring compared with summer. The odds of observing older adults engaging in vigorous activity were also more likely in rainy weather compared with sunny weather. Finally, the odds of observing older

Table 2 Full Model[a]: Walking (as Compared With Vigorous-Intensity Activity) on a South Carolina Rail-Trail by Weather, Season, and Temperature, 2006–2009 (n = 1053)

	Walking versus vigorous activity		
Variable[b]	**OR**	**95% CI**	***P***
Season			<.0001
Fall	0.27	(0.13, 0.57)	
Winter	0.46	(0.21, 1.00)	
Spring	0.20	(0.10, 0.39)	
[Summer]	[1.00]		
Weather			<.001
Sunny	3.32	(1.51, 7.27)	
Cloudy	1.73	(0.77, 3.92)	
[Rainy]	[1.00]		
Temperature[c]			.038
Low	2.42	(1.22, 4.79)	
Moderate	1.55	(0.91, 2.64)	
[High]	[1.00]		

[a] Adjusted for gender, ethnicity, and time period.

[b] Reference category shown in brackets.

[c] Low = 60°F or less; moderate = 61–80°F; High = 81°F or greater.

adults engaging in vigorous activity were greater when temperatures were high compared with when temperatures were low.

Discussion

Due to the stark decline in physical activity with aging, public health efforts are needed to increase physical activity among older adults. One potential strategy may be to promote the use of trails.[6] However, previous studies indicate that weather and climate conditions may influence outdoor physical activity behavior including the use of trails.[10,15,16] This is the first study to investigate the association between older adults' overall trail use and physical activity intensity during trail use with season, weather, and temperature using objective measures.

Overall Trail Use

Older rail-trail users in this study were mostly White males and mostly engaged in walking while on the trail. Only 26% of older adults observed using the trail were performing vigorous physical activity (eg, jogging, biking). Research suggests that rest spots, such as benches along trails, might facilitate walking among older adults.[30] There are amenities, such as benches, along the trail examined in this study that could also accommodate sedentary behavior. However, very few older adults in this study were observed engaging in sedentary behavior, such as sitting or standing. Walking has consistently been identified as a preferred type of physical activity by older adults.[24,31] The results of this and previous studies[31,32] suggest efforts to increase older adults' use of trails may be most effective if walking is the type of physical activity promoted. Mild-to-moderate intensity activities, such as walking, can provide significant health benefits with fewer risks as compared with vigorous activity.[33]

Older adults were most often observed using the rail-trail in the spring (40.1%), when the weather was sunny (76.8%), and when the temperature was moderate (56.2%). This is consistent with previous findings that adults are less active during winter months,[16–18,34] prefer being active when the weather is sunny,[35] and that identify extreme temperatures as a perceived barrier to physical activity among older adults.[22–24] Public health professionals' planning efforts to promote initiation of trail use among older adults who do not currently use the trail may be most successful if programs begin in the spring and/or when the temperature is moderate. This supports Merrill and colleagues[16] recommendation to tailor choices for physical activity by season and climate.

Physical Activity Intensity During Trail Use

There were several significant differences in the type of physical activity older adults were observed engaging in by season, weather, and temperature. The odds of observing older adults walking on the trail rather than engaging in vigorous activity were highest in the summer compared with other seasons, when the weather was not rainy, and when the temperature was low rather than high. On the

other hand, the odds of observing older adults engaging in vigorous activity rather than walking were higher in the fall, winter, and spring rather than summer, when weather was rainy, and when the temperatures were high. Thus, older adults were observed walking in weather conditions (sunny, moderate temperatures) traditionally viewed as more favorable,[22–24,35] whereas, those observed engaging in vigorous physical activity were more often observed in conditions (eg, high temperatures, rainy) traditionally viewed as less favorable.[22–24,35] It may be that older adults who typically engage in vigorous activity are more committed to being physically active and/or structured exercise and likely to use the trail despite less desirable weather conditions. Additional research is needed to further examine differences in physical activity type by season and weather conditions.

There are limitations to this study. First, a cross-sectional study in a southeastern county may have limited generalizability. The majority of older adults observed were White limiting generalizability of the findings to similar populations. In addition, causal inferences about the associations between older adults' trail use and natural elements cannot be made due to the cross-sectional nature of the data. However, the valid and reliable objective measures used, large number of users observed, and multiple seasons of data collection lend strength to the findings.

The results of this study provide several potential implications for research and practice. Consistent with findings from previous studies, more older adults were observed using the trail (particularly those observed walking) when weather conditions were favorable. Additional research is needed to examine if older adults find alternative locations to be active, such as indoor settings, when the weather is less favorable. Professionals promoting trail use among older adults might consider providing suggestions for alternative activities when weather conditions are less favorable to limit their negative impact on older adults' regular physical activity. Persons promoting trail use may also contemplate environmental changes, such as shaded rest spots and water fountains along the trail, to maintain use by older adults when temperatures are high. Further, providing information about safely engaging in physical activity on the trail during adverse weather conditions could be beneficial for older individuals who use the trail despite less optimal weather conditions, such as those observed engaging in vigorous activity on the trail in this study.

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