

Correlates of trail usage for physical activities in rural Appalachia, USA

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Abstract

Introduction: Physical inactivity is associated with several negative consequences. Trails in USA have been seen as useful part of build environment in facilitating physical activities for all people. Understanding of the role of sociodemographic and environmental aspects with trail usage can guide interventional plan for trails in Berea, USA.

Purpose: This study aims to examine the correlates of trail usage for physical activities in rural Appalachia.

Methods: It is a cross-sectional research design. Data for three years, 2017, 2018 and 2019 was collected. Parametric test including t-test was applied to observe differences in physical activities minutes per week for gender and analysis for variance for ethnicity, education, income, and overall health. Independent median test was used in observing difference with year and simple regression for age.

Results: Physical activities on trails were found associated with education and overall health for winter ($P < 0.05$). Age was found associated with more physical activity per week during winter. Physical activities were not found different with gender, ethnicity, and income during summer and winter ($P > 0.05$) in the same year while comparing between three year from 2017 to 2019, physical activities per minute were found significantly different for both seasons ($P < 0.05$).

Conclusion: Findings suggest that winter and age are positively associated with physical activities in Berea trails. Education and overall health also have impact on this behavior. Findings of this study may be very useful in developing promotional activities for younger people and summer time.

KEY WORDS: Appalachia; physical activity; public health; trails.

Riassunto

Introduzione: La sedentarietà è associata a diverse conseguenze negative. Le piste negli USA sono state considerate come una parte utile dell'ambiente per facilitare l'attività fisica in tutte le persone. Comprendere il ruolo degli aspetti sociodemografici ed ambientali sull'uso dei sentieri può guidare piani di intervento per i sentieri in Berea, USA.

Proposta: Questo studio ha l'obiettivo di esaminare i correlati di uso dei sentieri per attività fisica nella rurale Appalachia.

Metodi: Lo studio ha un disegno di ricerca di tipo trasversale. Sono stati raccolti dati dal 2017 al 2019. Test parametrici tra cui il t-test sono stati applicati per osservare le differenze in minuti di attività fisica per settimana per genere e l'analisi della varianza per origine etnica, educazione, reddito e stato di salute complessivo. Il test della mediana per campioni indipendenti è stato usato per osservare la differenza con l'anno e la regressione semplice per l'età.

Results: Le attività motorie sulle piste sono state associate con l'educazione e lo stato di salute complessivo in inverno ($P < 0.05$). L'età è risultata essere associata con un maggior livello di attività motorie durante l'inverno. Le attività motorie non sono risultate differenti rispetto al sesso, etnia, e reddito sia in estate che in inverno ($P > 0.05$) nello stesso anno, mentre comparando i dati tra i 3 anni dal 2017 al 2019, è stato scoperto che le attività motorie per minuto sono risultate significativamente differenti in entrambe le stagioni ($P < 0.05$).

Conclusioni: I risultati suggeriscono che la stagione invernale e l'età sono positivamente associati con le attività motorie sulle piste della Berea. L'educazione e lo stato di salute complessivo hanno anche esercitato una certa influenza su questo comportamento. I risultati di questo studio possono essere molto utili per sviluppare attività di promozione della salute nei giovani e nella stagione estiva.

TAKE-HOME MESSAGE

In Appalachia, USA physical activities on trails were found associated with age, education and overall health during winter.

Competing interests - none declared.

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Cite this article as: Summers A, Lakhan R, Hackbert P. Correlates of trail usage for physical activities in rural Appalachia, USA. J Health Soc Sci. 2020;5(3):317-330

DOI 10.19204/2020/cr115

Received: 29/01/2020

Accepted: 07/03/2020

Published Online: 15/05/2020

INTRODUCTION

Physical built environment plays an important role in increasing walking, running, jogging, and cycling activities [1]. In the next two decades, the number of Americans with Cardiovascular Diseases (CVD) will rise to 131.2 million – 45 percent of the total U.S. population – with costs expected to reach \$1.1 trillion [2]. Physical inactivity has been found to be a greater risk for multiple diseases and chronic conditions [3]. Approximately 35 percent of mortality from coronary artery disease is attributable to physical inactivity in USA [4]. According to the Appalachian Regional Commission (ARC), heart disease mortality rate for rural Appalachian counties is 234 per 100,000 population, which is 27 percent higher than the rate of 184 per 100,000 for the Region's large metro counties, and 34 percent higher than the national rate [5]. People in rural Appalachian region experience a higher burden of chronic diseases [6]. The ARC is a 205,000-square-mile region from southern New York to northern Mississippi that follows the spine of the Appalachian Mountains. The Region includes all of West Virginia and parts of 12 other states: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia. Forty-two percent of the Region's population is rural, compared with 20 percent of the USA population. Two Appalachian states in Central Appalachia – West Virginia and Kentucky are among the top five states most likely to have residents who do not participate in physical activities [5, 6]. Physical activity increases endurance, builds muscular strength, helps to control blood lipid abnormalities, diabetics, and obesity and improves quality of life and survival rates [7]. Research suggests that rural residents have higher rates of poverty, fewer community resources, less access to preventive services and health care, greater geographic dispersion, and more transportation challenges (e.g., lack of public transit, greater travel distance) than urban residents. Rural residents are less likely to meet physical activity recommendations [8]. These

factors are likely to affect Appalachian heart health [9, 10]. Promotion of physical activities can be very useful in reducing risk of several chronic disease and in improving overall health. Underserved populations, including racial/ethnic minorities, and individuals with low socioeconomic status are less likely to engage in sufficient physical activity and are thus at increased risk of morbidity and mortality [11]. Public health interventions including investments in biking and walking in transportation infrastructure; increase and improve recreational spaces in communities; and reduce sedentary work environments.

Built environments, trail systems, enhance rural physical activities

Built environment plays an important role in addressing such needs and can contribute strong influence on active living and positive health outcomes [12, 13]. Gordon-Larsen et al., (2006) found that residential proximity to recreation facilities, access to publically accessible walking and cycling parks, and trails through green space were associated with higher levels of physical activity and better health outcomes [14]. Multi use trails increased walking and cycling [15]. Rural Appalachia experiences poorly designed environment conducive for physical activities. Appalachian cities and government policies must drive change at the local level to promote healthy Appalachian communities. Policies could include creating community gardens, developing local food markets, assuring food pantries carry items of high nutritional value, educating food stamp recipients about good nutrition, addressing build environmental concerns, developing small-scale interventions in grocery stores, creating school and workplace policies to address families and encouraging physical activities [16]. Environmental justice and recreation also aim to promote equitable access to infrastructure like trails, and the corresponding health and economic outcomes in underserved areas [17, 18]. Research examining the impact of new infrastructure to support physical activity has shown some favorable health outcomes [19]. Cross-sectional studies have shown signifi-

cant increase in physical activities among trail users compared to non-users [20]. Recent studies have found trail systems very effective in increasing physical activities and reducing related morbidity and mortality [21]. Recently, modifying the built environment by the adoption of a loop trail, improved increases in usage and physical activity across transportation modes [19]. There is evidence to suggest that rural residents may be more willing to travel farther distances to access parks and trails and thus, proximity to these resources may not be as important in rural compared to urban settings [22, 23]. If smaller trails in rural communities are connected, than they can play an important role in attracting more people for walking, running, and biking.

The Kentucky Trail Town Program

The state-wide Kentucky Trail Town program, launched by the Kentucky Department of Travel, Office of Adventure Tourism (KYT OAT) in 2012 provides certification for communities located in geographically advantageous areas to capitalize on adventure tourism through a systematic trail-based community economic development model. Trails trail systems and greenway development have increased over the last 30 years in urban, rural, and suburban areas [18]. Trails are proven highly valued assets, and use studies have provided evidenced health-related benefits [24, 25]. Within the Appalachia Region small towns and rural communities near major bicycling routes and hiking trails have adopted the concept of 'trail towns' since late 1980 to prevent population loss, secure economic opportunities, and overcome health epidemics [26]. Analysis of survey data along a 16-mile bicycle-walking trail in Georgia reported increase in exercise and enjoyment for women [27]. Urban trails on health impact calculation on six chronic diseases and mortality outcomes on regular trail use prevented 36 hospitalizations due to chronic diseases and 182 premature deaths per 100,000 trail users and year, worth \$2,1 million in avoided treatment costs [28].

The City of Berea Trails

Researchers and authors carried out advocacy with the Berea city government connecting existing trails and the promotion of the Daniel Boone Trace Trail (DBTT), which traversed the city. Coinciding with existing research, researchers expected that trail connection would add value to the built environment in the small towns and rural communities effective in increasing physical activities. It is essential to know the effect of connected trails and information of contributing social and environmental factors to develop appropriate strategic plans to promote physical activities in rural areas. Berea, is a small town with a population of 14,000 persons located in Madison County, a transitional county within the Appalachian Regional Commission, which has a median family income no greater than 67 percent of the U.S. average and a poverty rate of 150 percent of the U.S. average or greater. Civic leaders had develop a series of in-town multi-use trails approximately at the same time as the Kentucky Trail Town certification process began. One bicycle-and-pedestrian route included a segment from the center of town out 1.75 miles to the Artisan Center near interstate I-75. Another paved one-mile multi-use trail segment starts at the municipal building, runs along Brushy Fork Creek, and crosses over where Silver Creek and Brushy Fork intersect at the Stephenson Bridge (SB). This segment, identified as the John B. Stephenson Trail for 1 mile. A third paved 0.87-mile multi-use segments extend from Short Line Pike road at the Blue Lick Road past the Berea Arena Theater ending at the Pinnacles at Indian Fort Mountain parking lot. This segment is called the Indian Fort Mountain Trail. Before the Kentucky Trail Town certification, there were unconnected trail segments. The Kentucky Trail Town certification mobilized community advocates and community-based advocates to map the original Daniel Boone Trace Trail marking the footsteps of Daniel Boone and his ax men, walked along this path in 1775 through the City of Berea. Researchers, with several colleagues and supporters initiated advocacy in 2014 with the Kentucky Trail

Town certification process and certification was secured in 2015 [25]. The construction and completion of the bicycle-and-pedestrian 0.87-mile segment at the end of the John B. Stephenson Trail to the Indian Fort Mountain Trail on September 7, 2019 connecting the three segments into a 3.2-mile multi-use trail starting at the municipal building, past the Berea Arena Theater ending at the Pinnacles at Indian Fort Mountain parking lot. As a result of the advocacy of the researchers, the City of Berea completed the middle 1.2 segment on September 7, 2019 [25]. The City of Berea, a Kentucky Trail Town, hosts two U.S. Bicycle Routes. USBR 76, originally designated in 1982 provides cyclists with multiple connected route options across the state of Kentucky and USBR 21, the Daniel Boone Trace Trail. All routes are designed to take advantage of low-traffic routes, allowing scenic and comfortable cross-state ride. Many studies have been shown benefits and impacts of multi-use bicycle- pedestrians paved routes and trails [28–31]. The objective of this study was to examine the correlates of trail usage for physical activities in rural Appalachia. This baseline data would also serve in evaluating the effectiveness of connected trails and the physical activities and associated health impact.

METHODS

Study area and setting

Berea is adjacent to a metro area in eastern Kentucky best known for its art festivals, historic restaurants and buildings, and as the home to Berea College, a private liberal arts college, distinctive among post-secondary institutions for providing free education to students. Berea college have been the first college in the Southern United States to be coeducational and racially integrated. Berea College charges no tuition; every admitted student is provided the equivalent of a four-year scholarship. Because of its unique and social approach, this college has been instrumental in promoting tourism in this area. The town is located in the middle of three major cities:

Cincinnati 100 miles in north, Lexington 50 miles north, and Knoxville about 130 miles in south.

The Daniel Boone Trace Trail (DBTT) route is part of a National Bicycle Route (USBR 21) developed in collaboration with the Adventure Cycling Association and approved by both the State of Kentucky Bicycle and Pedestrians Program Coordinator in Frankfort Kentucky and American Association of State Highway and Transportation Officials (AASHTO). All U.S. Bicycle Routes are designated and approved AASHTO. The 265-mile route connects the Ohio River in Mason County, Kentucky, through the heart of the Bluegrass Region, through Berea, and to the edge of the Cumberland Gap in Tennessee. Completing the 265-mile route ranks Kentucky as one of the top five states with the most miles on the U.S. Bicycle Route System. The study area encompassed 3.2 miles of the 265-mile trail, as shown in Figure 1. The methods used to develop results in this paper can help to explain only the Daniel Boone Trace Trail.

The DBTT segment within Berea serves as the trail route for this research. The starting point of the 3.2-miles has a trailhead, a parking lot, and hosts runners, walkers, and cyclists of all ages. The first one-mile segment is pleasantly shaded along the intersection of two historical creeks, the Brushy Fork and Silver Creek. A bridge hosts the historical landmark of Daniel Boone's crossing. At the end of the newly connected trail is the parking lot for the famous Pinnacle Trails of Indian Fort Mountain. This end of the trail has a freshly constructed Berea College Forestry center completed in 2017, with restrooms, and visitor center. Persons parking here have a shaded one-mile multi-use trail segment along forested slightly rolling hills that hosts a creek crossing back towards the center of town. The trail segment has two entry points of two family home subdivisions as well as parking lots at both ends. The family home subdivision segments have no shade or water. Families are observed with young children in strollers and riding bicycles along this rolling

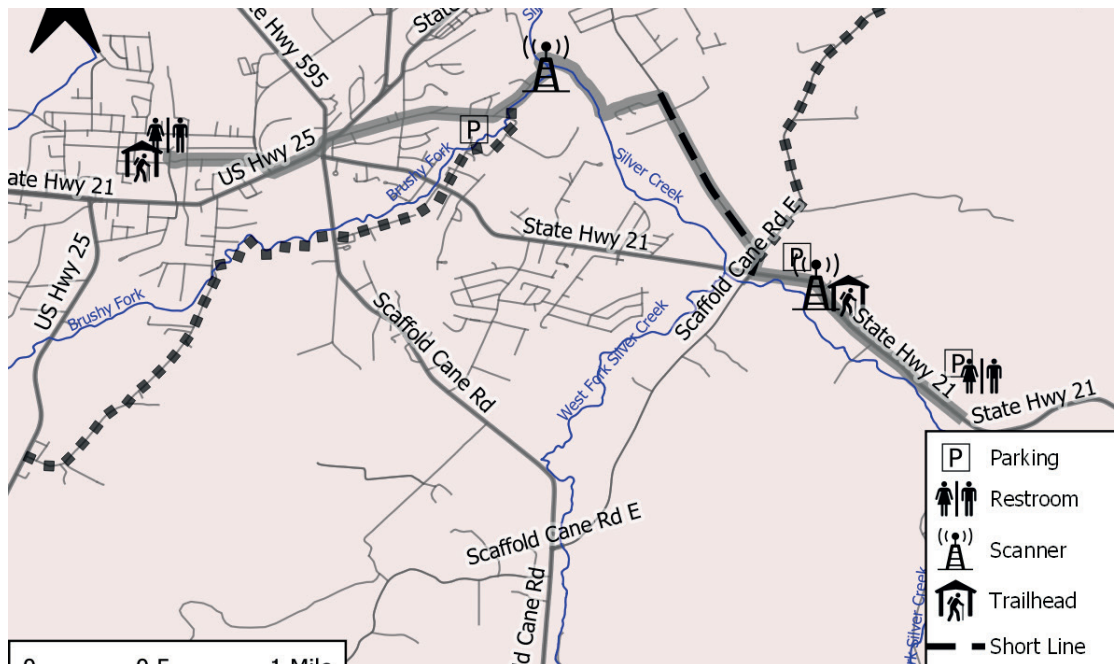


Figure 1. Trail Map of Berea Trail Town. Stevenson Bridge and Arena Theater trails are indicated by the ‘Scanner’ on the Existing Trails.

hill on this section of the trail segment. In summary, the 3.2-mile trail has a parking lot at both ends, one with restrooms and visitor center and one without. Figure 1 shows the trail segments and location of the intercept survey points.

Study instruments and variables

This long-term project used a reliable and valid intercept survey used to capture the behavioral effects of connecting two segments replicating the ‘rails to trails conversion [29]. Two questions regarding physical activity participation were added to the American Tobacco Trail survey. First, how many days of the week do you participate in 30 minutes or more of moderately vigorous physical activity. Second, if you were not able to access the trail, how likely were you to participate in another form of physical activity [21]. This 18-question survey asks demographic information, as well as tourist and economic impact questions. A combination of Berea College and Eastern Kentucky University faculty and students collected the data. Data was collected by Berea College and Eastern Kentucky University faculty and trained students and members of the Trail Town Committee. Sur-

vey was conducted during the daylight hours (8:00 a.m. to 8:00 p.m.) for 12 consecutive hours on two weekdays and two weekends in the months of May, June, and July during 2017, 2018 and 2019. Visible signs were posted along the trail alerted trail users of the survey requesting users to stop and complete the survey. Manual hand counts determined trail usage as well. In addition, infrared sensors counted the number of users during the study period from July 2016- 2018. Origin, destination, and round-trip data from surveys were analyzed in tandem with the hand counts to determine the mode of trail use, consistency, and non-participation rates.

Statistical analysis

Physical activity minutes per week overall and also in two seasons, summer and winter were used as dependent variables. Age, gender, education, ethnicity, income, and overall health were used as an independent variable. A difference in physical activities with gender was assessed with an independent t-test. Analysis of variance (ANOVA) was applied in assessing the difference in physical activity minutes per week for overall, summer, and winter with education, ethnicity, income, and

overall health. Independent samples median test was used to observe a difference in physical activities for three years 2017, 2018 and 2019. The $P < 0.05$ was considered significant for t and f statistics. Simple regression was applied to assess the association between physical activities minutes in summer and winter with age.

Ethical aspects

The Institutional Review Board for human subjects at Eastern Kentucky University approved the study on May 27, 2017. After the primary author changed institutions, the Institutional Review Board for human subjects at Berea College approved of the survey on March 16, 2018 for the continuation of the four-year project.

RESULTS

Physical activities minutes per week in Berea trails did not differ between men and women (Table 1). Physical activities minutes per week in winter were found significantly different in winter with education and overall health of the people. However, a difference was noticed with ethnicity for overall physical activities minutes and in the sample (Table 2).

To observe differences in physical activities minutes per week overall as well with both seasons including summer and winter, a non-parametric Independent Samples Median test was used since an assumption of homogeneity of variance for ANOVA ($P < 0.05$) was unmet (Table 3).

ANOVA results ($P > 0.05$) met assumption for simple regression between overall, summer, and winter physical activity minutes with age and neutralized higher standard deviation. Squared correlation coefficient ($R^2 = 0.91$) suggested that overall physical activities can be explained with age by 9.1%, and in winter ($R^2 = 0.51$) by 5.0% (Table 4). This analysis suggests that increase in 1 year in age in population; people exercise three additional minutes on trail (Figure 2). In winter, 2 minutes physical activities increases with 1 year increase in age (Figure 3).

DISCUSSION

Physical health can be seen as the result of the interaction of individual, extended family, and community action with available, accessible and coordinated health care services and systems. [32]. Our findings did not result any difference in trail usage with gender. However, research has found that women engage more in walking on trails if they feel safe [33]. Population of Berea town is highly skewed towards white population, which may be a reason of the difference in physical activities with ethnicity.

Our results of this study can be compared to two other retrospective trail evaluations. Intercept survey of 2000 trail users at six Indiana trails ranging in length from 3 to 15 miles reported increased participation in trail activities, such as walking, jogging, or bicycling, while the rest reported that the trail did not increase those activities. The trail users reported a median of 100 to 200 minutes of use per week [34]. In a Missouri study, those who were not regular walkers were more likely to report increases in physical activity due to a trail than regular walkers [22]. Brownson et al. stated that there might be a ceiling effect, whereby regular walkers may use the trail to maintain activity, while those who are inactive might increase their activity [22]. Our retrospective evaluation also indicated a self-reported increase in activity due to the trail, but our prospective evaluation did not support this.

Differences in physical activities minutes per week with education and overall health in this research may be in correlation with previously conducted studies in the nation in which researchers have reported that people with higher education and better mental health tend to engage more in physical activities in trails and parks [35]. Difference in physical activities three years may be suggestive that the promotional work for trail usage may be effective in encouraging more people. Our findings in relation to increase in physical activities with age were found consistent with a research conducted in South Carolina. Their findings also demonstrated that older people

Table 1. Difference in physical activities minutes per week, overall, summer, and winter with gender (T-test).

Minutes per week	Gender	M	Sd	P-value
Overall	Female	155.08	189.20	0.56
	Male	167.65	190.03	
Summer	Female	339.70	330.97	0.43
	Male	403.72	932.97	
Winter	Female	210.16	164.83	0.52
	Male	221.66	145.39	

Table 2. Difference in physical activities minutes per week, overall, summer, and winter with ethnicity, education, income, overall health (ANOVA).

Category	Mean	Minutes per week			Summer		Winter		
		Sd	p-value	Mean	Sd	p-value	Mean	Sd	p-value
Ethnicity	<i>White</i>	169.20	187.58	0.07	372.48	692.86	0.89	216.73	156.21
	<i>Black</i>	55.50	161.32		257.50	120.90		223.33	167.50
	<i>Others</i>	153.55	263.52		314.28	237.59		153.71	69.44
Education	<i>High school or below</i>	150.52	222.44	0.32	360.54	603.53	0.62	135.93	117.37
	<i>Associate or some college level</i>	139.71	161.19		280.80	145.10		207.74	164.85
	<i>College degree</i>	141.63	164.56		327.65	175.81		223.76	151.64
	<i>Master and advance degree</i>	183.38	185.72		429.85	998.83		235.37	158.47
Income	<i>25K</i>	126.71	232.42	0.37	372.15	652.92	0.96	167.21	140.51
	<i>25 to 49 K</i>	177.41	179.64		336.70	195.47		191.73	145.72
	<i>50 to 74 K</i>	169.19	158.07		416.02	1098.31		233.77	156.68
	<i>75 to 99 K</i>	176.74	220.49		368.46	210.04		236.78	156.14
	<i>100 to 149K</i>	112.86	90.046		288.00	152.97		191.25	141.34
Overall Health	<i>150 K and more</i>	120.60	88.73	0.39	323.11	214.91	0.39	187.33	147.54
	<i>Fair</i>	159.20	285.10		645.10	1127.31		252.90	152.43
	<i>Good</i>	139.01	196.22		288.35	167.26		161.06	112.49
	<i>Very Good</i>	142.50	141.33		396.07	933.65		209.13	159.22
	<i>Excellent</i>	212.57	222.64	357.92	188.18	266.25	169.08		

Table 3. Differences in physical activities minutes per week in three years: 2017, 2018, and 2019.

Physical activities minutes per week	Year	N	Mean	SD	P-value
Overall	2017	94	195.65	210.99	0.006
	2018	140	142.49	180.72	
	2019	78	151.50	171.40	
Summer	2017	94	449.87	1070.97	0.091
	2018	129	329.22	354.46	
	2019	63	322.39	172.16	
Winter	2017	92	224.52	147.50	0.042
	2018	122	193.80	149.00	
	2019	61	246.19	176.91	

Table 4. Simple regression physical activities minutes with age.

Model	Minutes / Week	R ²	ANOVA		Regression		
			F	p		B	P
1	Overall	0.091	29.97	0.001	Constant	-3.07	
					Age	3.49	0.001
2	Summer	0.015	4.36	0.038	Constant	114.27	
					Age	5.22	0.038
3	Winter	0.050	14.09	0.001	Constant	104.84	
					Age	2.22	0.001

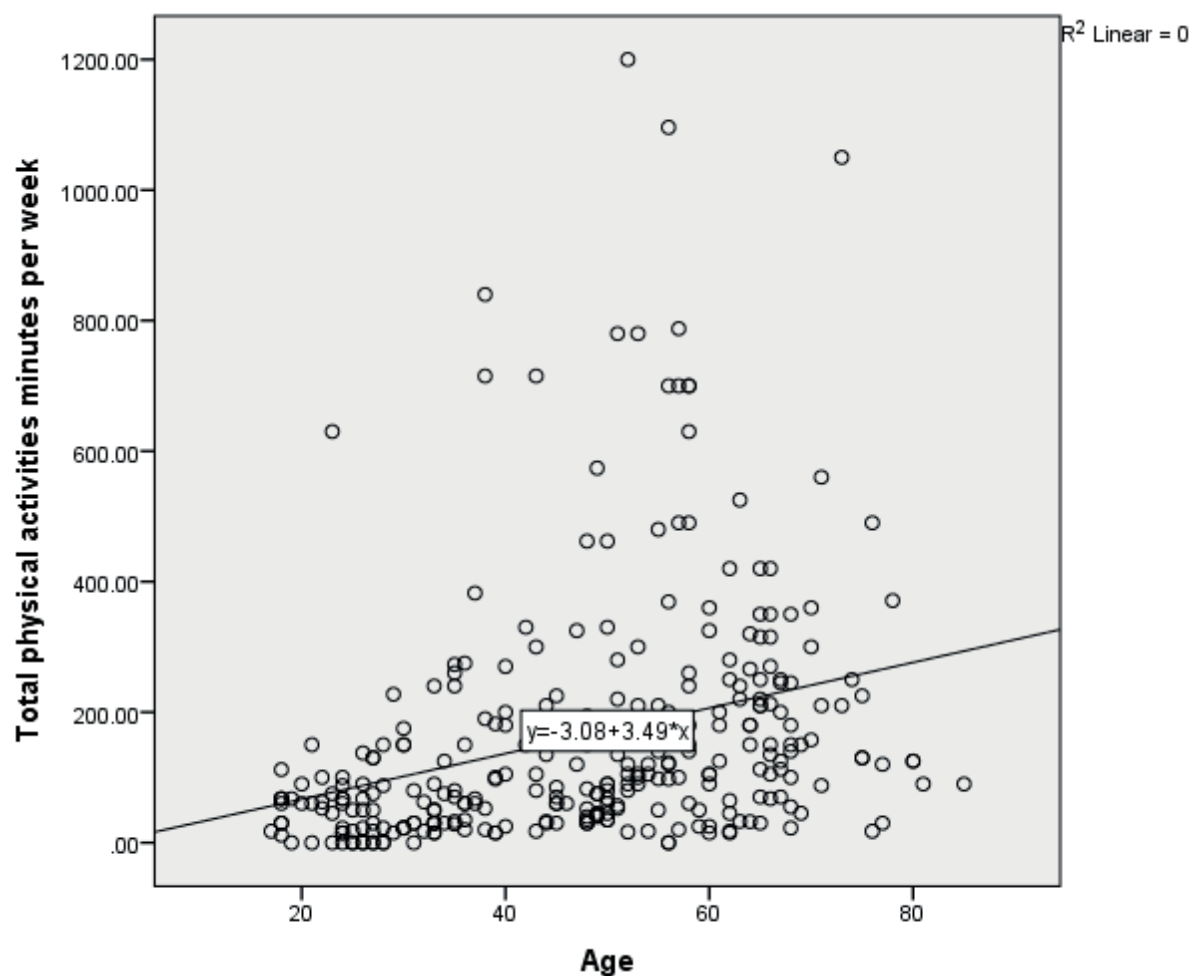


Figure 2. Trail usage for physical activities increases with increasing age in population.

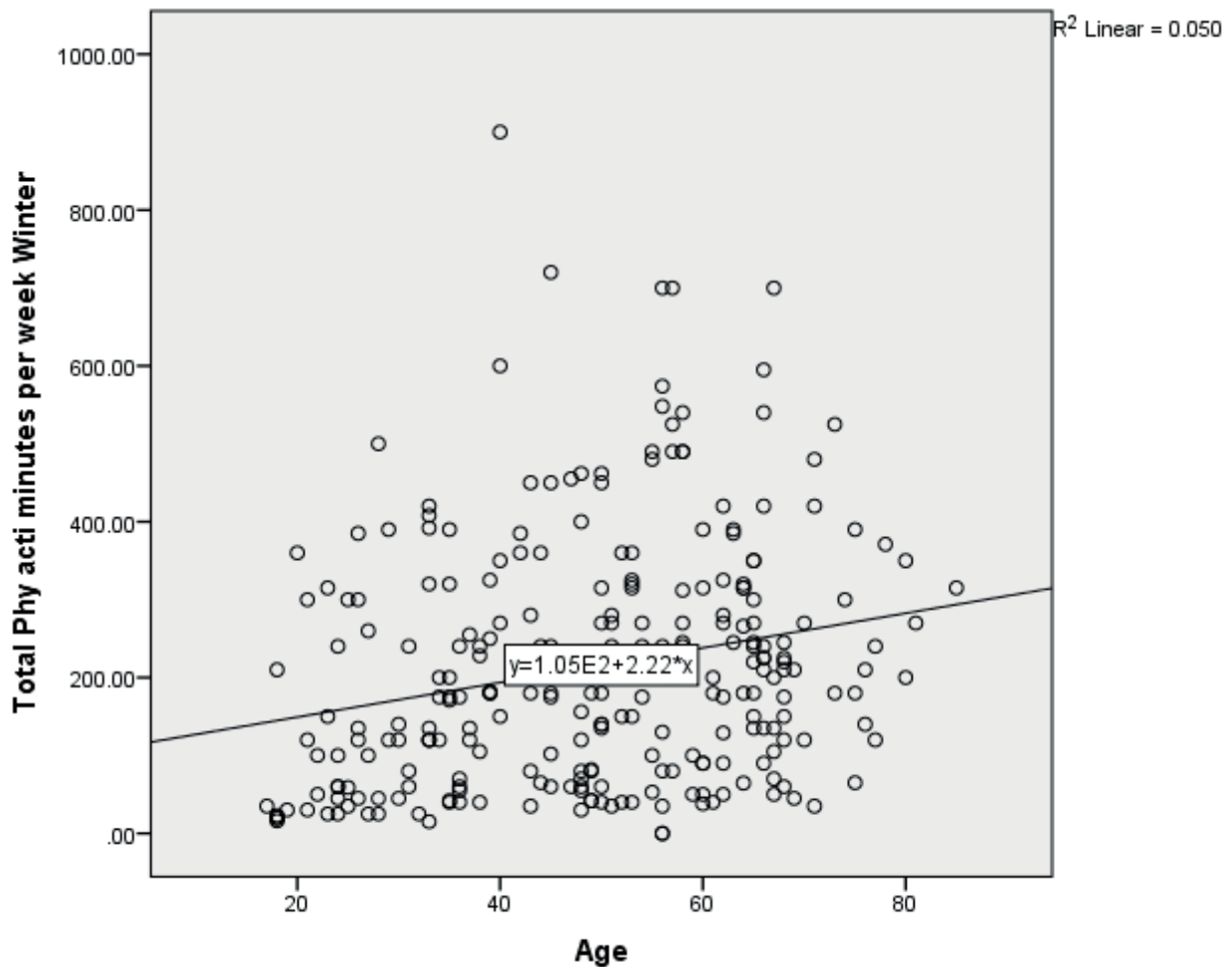


Figure 3. Trail usages increases for physical activities with increasing age in winter.

like to engage more in physical activities during moderate temperate [36].

Overall, findings of this study are very crucial in guiding future intervention. Summer season is being inversely associated with the physical activities minutes per week suggest for more weather supportive arrangements on trails. More creative activities need to be planned to motivate for young age people for trial usage. Activities for young children might attract more families to come and walk on these trails. Family oriented events along the trail might be also useful in encouraging walking. Built environments increasingly rely on data-driven metrics to prioritize project that maximize benefits compared with costs. This research adds to the body of evidence that

shows that the built environments can positively influence rural physical activity and health benefits. By using the ideas presented here, practitioners may be able to better predict or model impacts for other facilities.

The study strengths and limitations

A major strength of this study is that we made use of a tool specifically designed to assess rural settings such as found in Appalachia and the literature remains limited in published research using the tool. There is a fervent need for more analyses of rural communities in relation to environmental determinants of active living. This study helped to meet the call to action for more examination of rural active living. In addition, some directions for future studies could be identified. However, this

study has few limitations. Smaller sample size is a major limitation. In addition, we did not gather perspectives from community members regarding their perceptions of the built environment's role in their ability to participate in physical activity. Since, research was approved for people with 18 years and older. Youth who were cycling, running or walking on the trails were not included and that may be the reason behind a positive association between physical activities minutes per week and age. No water exists on the trail, thus trail users completing the entire 6.2 miles out and back, would have to provide their own. Lastly, a smaller sample size observed in 2019 resulted from a number of participants who

declined interviews. These individuals were primary on bicycles and less than half of the 2019 cyclists stopped. However, the reliable and valid survey and the long-term yearly replication of the project lends strength to the study. In addition, this cross-sectional study on a Berea Kentucky multi-use trail may have limited generalizability to other communities.

Acknowledgments

The primary author would like to acknowledge the Jaden Johnson, Glendy Pineda, Jose Villegas, Jair Jackson and the Entrepreneurship for the Public Good Cohorts 16, 17 and 18 for their contributions towards data collection and analysis.

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