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BRIEF REPORT

Association Between Physical Activity, Psychosocial Factors, and the Built Environment in Rural Adults

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Background: Psychosocial and built environment (BE) factors can influence physical activity (PA). Objectives were to assess whether psychosocial or BE variables were associated with PA and whether associations differed by sociodemographic characteristics in rural communities. ***Methods:*** The sample included 2215 adults enrolled in a healthy lifestyle intervention cluster-randomized trial. Sociodemographic variables included age, sex, race/ethnicity, education, and income. Health variables included general health status and body mass index. PA was assessed using the International Physical Activity Questionnaire-long form. Metabolic Equivalent-minutes per week were calculated for total PA, moderate and vigorous PA, and walking. Psychosocial (exercise attitudes, exercise confidence, social support for PA from family/friends) and BE variables (walking environment, sidewalks, street shoulders, community safety, community aesthetic quality) were assessed via questionnaire. Linear regressions modeled bivariate associations between PA and PA context variables. Multivariate regression models evaluated whether sociodemographic or health variables modified relationships between PA and PA context variables. ***Results:*** All psychosocial measures were positively associated with all measures of PA. Walking environment and community safety were the only BE measures associated with all measures of PA. Being an older adult (65+) had significantly greater effects on exercise attitudes, exercise confidence, and social support from friends on walking. Education and income did not consistently moderate associations between psychosocial factors and any measure of PA. ***Conclusions:*** Future studies should confirm whether psychosocial characteristics are associated with PA in other populations and explore how these effects are moderated by sociodemographic characteristics. Further research is needed on the role of the environment in influencing PA in rural communities.

Keywords: exercise attitudes, exercise confidence, social support, walking environment

Key Points

- All psychosocial measures (exercise attitudes, exercise confidence, social support for physical activity [PA] from family/friends) were positively associated with all PA measures (self-reported total PA, moderate/vigorous PA, and walking).
- Walking environment and community safety were the only built environment measures associated with all measures of PA.
- Being an older adult (65+) had significantly greater effects of exercise attitudes, exercise confidence, and social support from friends on walking.

As conveyed through the socioecological model,[1] the context and interactions of psychosocial factors and built environment (BE) influence many health behaviors, including physical activity (PA). Specific psychosocial factors known to impact PA (any bodily movement that results in energy expenditure), exercise (planned PA with the goal of improving or maintaining physical fitness), and sedentary time are attitudes, confidence, and social support, as well as the context of the BE of communities.[2–6] Self-determination theory, a framework for understanding human motivation emphasizes the importance of intrinsic motivation[7]; intrinsic motivation is predictive of PA participation and long-term exercise adherence.[2] Attitudes toward PA are also significantly correlated with PA behaviors.[8] Self-efficacy, defined as confidence or belief in personal capabilities, is one of the clearest correlates with adult exercise, with multiple reviews noting a positive association.[3,9] Note that the word "confidence" is used throughout this paper rather than "self-efficacy." A number of studies have shown confidence to be a significant predictor of exercise adherence; this was true for studies with participants ranging in age from adolescence to older adults and in health from healthy to symptomatic.[3] Social support is also positively associated with PA; one review found every study that included a measure of social support for PA found a significant positive association.[4] The results of a systematic review examining the relationship between social support and PA in older adults also suggest there is a positive association between social support for PA (particularly from family members) and PA

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levels in older adults, but there were no clear PA associations with general social support or social support for PA from friends.[10] The relationship between these factors and PA may differ by sociodemographic characteristics; some studies have found women of lower socioeconomic status have less motivation to exercise.[11] Also in terms of sociodemographic differences, social support may be more important for exercise behaviors in women than men.[12] Aspects of the BE and changes in the BE are often found to be associated with PA.[5,6] For example, land use mix, connectivity, population density, and overall neighborhood design are important determinants of PA.[5] Likewise, changes in the BE that result in higher accessibility or new infrastructure for walking, cycling, or public transportation are associated with increased overall PA, as well as increased transportation-related PA.[6]

Sociodemographic characteristics, such as rurality, can impact the BE's influence on PA. Rural areas in the United States generally refers to areas outside of urbanized areas and urban cluster areas and are characterized by low population density and distance from urban centers.[13] People living in rural areas experience unique challenges, such as wide roads (which increase the probability of traffic accidents),[14] and the presence of trucks, which may make them less likely to walk or bicycle.[15] Additionally, factors associated with socioeconomic status (eg, employment, education, income, health insurance) are consistently lower in rural areas compared with urban areas.[16] While rural residents in some areas have access to natural amenities that facilitate PA, such as walking or biking, factors such as weather can present meaningful barriers to rural residents compared to urban residents.[17] Crime, safety, and social support may also be associated with lower PA prevalence in rural areas, although few studies have compared these factors across rural and urban settings.[17,18] A study that compared rural with urban residents found that positive attitudes toward PA, greater PA confidence, and greater social support were significant predictors of PA only in rural residents.[19] Top barriers to PA among rural men include low motivation, cold weather, and tiredness.[20] Some studies have found that social support for PA may be more important in rural areas than urban areas.[19,21] Rural residents identify social engagement as the main facilitator of PA participation and describe PA as a way to connect with their community but report a lack of social support more frequently than urban residents.[21] Others have noted PA primarily occurs in the occupational domain in some rural communities,[22] and rural communities are distinct from one another as far as what constitutes barriers and facilitators to PA.[23] Results of a recent review of environmental correlates of PA for adults living in rural areas suggested that investing in places for PA, safe infrastructure for active transportation, and nature-based activities are recommended strategies to address low PA levels in rural areas.[24]

As noted, the rural context influencing PA may be different from other contexts; it is unclear exactly how psychosocial factors and the BE are associated with PA and whether the associations differ by sociodemographic characteristics in rural communities. This paper has 2 objectives: (1) assess whether baseline PA-related psychosocial variables and/or the BE factors are associated with PA in rural communities and (2) assess whether any observed associations between psychosocial factors, BE, and PA are moderated by sociodemographic characteristics (eg, age, sex, race/ethnicity, education, income) in rural communities. We hypothesized that psychosocial variables, such as confidence, and social support and BE attributes, such as cleanliness and safety, would be associated with higher amounts of PA. We also hypothesized that these associations may be impacted by sociodemographic characteristics; for instance, education may impact the amount of leisure time PA.

Methods

This study used a cross-sectional design to explore associations between PA-related psychosocial factors, BE, and measures of PA. The analytic sample included 2215 adults enrolled in a cluster-randomized controlled trial of healthy lifestyle intervention in 12 rural towns in Texas and New York. The communities are rural per the Rural-Urban Community Area (RUCA) version 2.0 definition.[13] RUCA codes classify US census tracts based on population density, urbanization, and commuting patterns; they are often used by researchers and organizations involved in health services and policy related to rural and urban areas.[13] RUCA codes 4 to 10 are considered rural.[13] For example, RUCA code 4 indicates an micropolitan area core within an urban cluster of 10,000 to 49,999 people, while RUCA code 10 indicates a rural area with primary flow to a tract outside an urban area or urban cluster.[13,25] The rural towns, included in the study had a population density averaging 116 people per square mile (median is 89 per square mile), the least dense town had 2.9 people per square mile, and the most dense town had 347.4 per square mile. All data were obtained via online questionnaires at baseline (2022–2023). All participants provided written online informed consent since the Texas A&M University Institutional Review Board encourages the use of a consent form even for short surveys. The study was approved by the Texas A&M University Institutional Review Board.

Sample Sociodemographic and Health Characteristics

Sociodemographic characteristics, included indicators of age, sex, race/ethnicity, education, and income. These characteristics were categorized for these analyses as follows: age: <65 years old versus ≥65 years old; sex: male versus female, nonbinary/fluid, or prefer not to answer; race/ethnicity: non-Hispanic White, Hispanic, or non-Hispanic Black; education: < college graduate versus ≥ college graduate; and annual household income: <$50,000 versus ≥$50,000. Health was indicated by a response to the question "In general, would you say that your health is:" with the response options of "poor," "fair," "good," "very good," or "excellent," from the MOS 35-Item Short-Form Health Survey-36.[26] Responses were categorized as fair/poor versus good/very good/excellent. Body mass index (BMI) was based on self-reported height and weight and characterized as obese (BMI ≥ 30 kg/m^2) versus nonobese (BMI < 30 kg/m^2).

PA Variables

PA was assessed by the validated International Physical Activity Questionnaire-long form, which asks how many days per week and how many minutes on each of those days, the respondent usually spent walking and doing moderate and vigorous activity related to work, transportation, domestic chores and gardening, and leisure-time domains.[27] Study participants with "unreasonably high" PA values according to the measure's scoring protocol (>960 total min/d) were excluded from the sample (205, 8.5%).[25] The protocol assumes that respondents sleep an average of 8 hours per day, so responses of more than 16 hours of PA are unreasonable and should be excluded from analysis.[25] Minutes per week were transformed into Metabolic Equivalent (MET) minutes using standard scoring methods and summed into MET-minutes per week for total PA, moderate and

vigorous PA (MVPA), and walking.[25] We also calculated percent of MVPA time in occupational PA and leisure PA.

PA-Related Psychosocial Variables

Exercise attitudes were assessed using 4 questions adapted from Roper's[28] Exercise Attitudes and Behaviors questionnaire: (1) "It is hard to for me to fit exercise into my life," (2) "I exercise because it is good for my health," (3) "Exercise makes me feel better," and (4) "I cannot exercise" with 5 response options from strongly disagree (1) to strongly agree (5). Items 1 and 4 were reverse-coded and then all were averaged to create a continuous overall positive exercise attitudes score. Three exercise confidence questions were adapted from Sallis et al's[29] Exercise Confidence Survey. Respondents were asked how confident they were that "they could really motivate themselves to consistently to . . . (1) Set aside time for a physical activity program . . . 30 minutes, 3 times a week, (2) Stick to your exercise program when you are busy and (3) Stick to your exercise program when you are stressed" with 5 response options from not at all confident (1) to completely confident (5). Items were averaged to create a continuous overall exercise confidence score. Social support for PA from family and friends was measured with Ball et al's[30] Social Support for Physical Activity from Family and Friends Questionnaire, which asked how often in the past year family/household members (and separately about friends): (1) "Participated in physical activity or exercise with you?" (2) "Encouraged you to be physically active?"and (3) "Discouraged you from sitting around too much (ie, watching too much TV)?" with response options from never (1) to very often (5), and an option to choose "not applicable" which was subsequently recoded to "never." According to Ball et al,[30] recoding was based on "the assumption that this response indicated that respondents had no immediate family [and/or friends] and so did not receive support from family [and/or friends]." For family, and separately for friends, scores were averaged to create continuous variables reflecting overall social support from family and overall social support from friends. We used the mean for the social support scales rather than the sum as recommended by Ball et al,[30] so that all of the factors in this analysis ranged from 1 to 5 and effect sizes could be more easily contextualized.

Built Environment Variables

All environment variables were statements with response options from strongly disagree (1) to strongly agree (5). All 7 questions of the walking environment subscale from the Neighborhood Environment Measures Survey were asked.[31] Responses were averaged to create a continuous overall walking environment score, where higher scores indicate more favorable walking conditions. Respondents were also asked to rate their agreement with 2 walking statements from Boehmer et al's[32] Health Behavior and Environment Questionnaire: (1) "There are sidewalks on most of the streets in my community" and (2) "There are shoulders on most of the roads that allow for safe walking or biking." Two ordinal variables recorded responses to sidewalk and shoulders questions. These 2 items are 2 separate scores. Three items were adapted from the Neighborhood Environment Measures Survey community safety subscale[31]: (1) "I feel safe walking in my community, day or night," (2) "Violence is not a problem in my community," and (3) "My community is safe from crime." Responses to these 3 questions were averaged to create a continuous community safety score. Two questions were adapted from the Neighborhood Environment Measures Survey community aesthetic quality subscale[31]: (1) "There is a lot of trash and litter on the streets in my community" and (2) "There is a lot of noise in my community." Adaptations included small modifications such as changing "neighborhood" from the original questionnaire to "community" which is more relevant for rural areas. Responses to the 2 statements were reverse coded and then averaged to create a continuous community aesthetic quality scale.

Statistical Analysis

Sample characteristics, PA measures, and PA-related context variables were summarized and tabulated. We assessed the normality of the PA measures and continuous PA-related context variables by inspecting skewness and boxplots, and all variables were considered normally distributed (skewness < 2).[33] The 2 ordinal variables recording perceptions of sidewalks and road shoulders also met these criteria and, for consistency, were analyzed as continuous town variables. Linear regressions modeled bivariate associations between measures of PA and the PA context variables. Estimates were considered significant at 95% confidence after Bonferroni correction to account for 3 measures of PA. To evaluate whether any sociodemographic or health status variables modified relationships between PA and the PA context, we constructed multivariate regression models that also included age (65 and older), for example, and its interaction with each PA context variable. Separate analyses considered each of the other binary sociodemographic (sex [male], college graduate, annual household income <$50,000) and health status variables (fair/poor health, obesity) and their interactions. Additional multivariate models, included indicators of Hispanic and non-Hispanic Black and their interactions simultaneously. Bonferroni correction was also applied to these analyses to account for the 3 measures of PA. Only characteristics with significant interaction terms were tabled. Analyses were performed using SPSS (version 29).

Results

Predominant characteristics for this sample were being less than 65 years old (84.8%), female (68.6%), and non-Hispanic White (81.0%; Table 1). Almost half of the sample had a college degree or more education (47%). A similar percentage had an annual household income of less than $50,000 (48%), although 20 individuals

Table 1 Sample Characteristics and Health Status

	n	Count, %
Sociodemographic information		
65 y and older, %	2215	336 (15.2%)
Male, %	2215	696 (31.4%)
Race/ethnicity, %		
Non-Hispanic White	2212	1794 (81.0%)
Hispanic	2215	185 (8.4%)
Non-Hispanic Black	2212	147 (6.6%)
College graduate or more, %	2215	1085 (49.0%)
Annual household income <$50,000, %	2195	1060 (47.9%)
Health status		
Fair/poor health, %	2215	406 (18.3%)
Obese, %	2215	987 (44.6%)

did not respond to this question. Only 18% of the sample reported their general health status was fair or poor; 45% were obese.

Mean total PA for the sample was 1474 MET-minutes per week (Table 2). Of that total, most was MVPA (1087 MET-min/wk) and the balance was from walking (387 MET-min/wk). Of MVPA MET-minutes, 38.6% was from occupational PA and 11.8% was from leisure PA. All mean PA context scores (range 1–5) were between 3.0 and 3.6. Exercise confidence varied more than any other measure of PA context (SD = 1.23), but there was also high variation for community sidewalk and shoulder availability, safety, and aesthetic quality (SD ranged from 0.94 to 0.99). The modal responses for both sidewalk and shoulder availability were "agree."

Table 2 PA and PA Context Descriptive Statistics, n = 2215

	Mean (SD)
PA	
Total PA, MET-min/wk	1474.18 (880.61)
Moderate and vigorous PA, MET-min/wk	1086.97 (741.35)
Walking, MET-min/wk	387.21 (248.40)
PA context	
Psychosocial variables	
Positive exercise attitudes (range 1–5)	3.59 (0.81)
Exercise confidence (range 1–5)	3.12 (1.23)
Social support for PA, family (range 1–5)	3.09 (0.67)
Social support for PA, friends (range 1–5)	2.96 (0.64)
BE variables	
Positive walking environment (range 1–5)	3.37 (0.80)
Sidewalks on most community streets (range 1–5)	3.62 (0.99)
Shoulders on most community roads (range 1–5)	3.39 (0.99)
Community safety (range 1–5)	3.11 (0.97)
Community aesthetic quality (range 1–5)	3.30 (0.94)

Abbreviations: BE, built environment; MET, metabolic equivalent of task; PA, physical activity.

The psychosocial measures of PA context (attitudes, confidence, and social support from family/friends) were each positively associated with all 3 measures of PA (Table 3). Out of these 4 predictors, the largest effect sizes were between exercise attitudes and PA and the lowest were between exercise confidence and PA. Walking environment and community safety were the only measures of PA environment associated with all 3 measures of PA and those associations were all positive. The presence of sidewalks on most streets was positively associated with total weekly MET-minutes and MVPA but not walking. There was also a positive association between the presence of shoulders on most roads and total PA and MET-minutes of walking, but not for MVPA.

In all multivariate regression models that included sociodemographic variables and interactions, exercise attitudes, exercise confidence and social support were positively associated with all measures of PA (Total PA, MET-minutes per week; MVPA, MET-minutes per week; and Walking, MET-minutes per week). Three of 7 sociodemographic characteristics (age 65 or older, college graduate, and income <$50,000) moderated associations between psychosocial factors and at least one measure of PA (Table 4). Overall, sample members aged 65+ had lower PA by all measures, but their age significantly amplified the positive effects of attitudes, confidence, and social support from family on walking. Being a college graduate positively moderated the positive effects of exercise attitudes and confidence on MVPA, and the effect of attitudes on total PA. However, a college education significantly decreased the positive effect of social support from family on MVPA and total PA. Having a low household income (<$50,000) positively moderated only the positive relationship between family support and MVPA.

No sociodemographic measures moderated relationships between the BE and PA.

Discussion

For this sample of rural adults, PA-related attitudes, confidence, and social support from family and friends were all positively associated with all self-reported measures of PA. For BE variables, walking environment and community safety were the only measures associated with all 3 measures of PA (Total PA, MET-minutes per week; MVPA, MET-minutes per week; and Walking,

Table 3 Bivariate Associations Between PA and Measures of PA Context, n = 2215

	Total PA, MET-min/wk		MVPA, MET-min/wk		Walking, MET-min/wk	
	β	95% CI	*β*	95% CI	*β*	95% CI
Psychosocial variables						
Exercise attitudes	**359.79**	**307.34 to 412.24**	**275.88**	**231.27 to 320.49**	**83.91**	**68.83 to 98.99**
Exercise confidence	**209.94**	**175.14 to 244.74**	**160.54**	**131.00 to 190.08**	**49.40**	**39.44 to 59.35**
Social support for PA, family	**246.83**	**181.36 to 312.31**	**179.92**	**124.55 to 235.29**	**66.92**	**48.42 to 85.41**
Social support for PA, friends	**317.64**	**249.11 to 386.16**	**245.24**	**187.30 to 303.19**	**72.39**	**52.88 to 91.91**
BE variables						
Walking environment	**145.41**	**89.73 to 201.10**	**100.00**	**52.99 to 147.02**	**45.41**	**29.74 to 61.09**
Sidewalks on most community streets	**52.14**	**6.72 to 97.57**	**41.71**	**3.46 to 79.96**	10.43	–2.39 **to** 23.26
Shoulders on most community roads	**46.04**	**0.82 to 91.26**	29.61	–8.48 **to** 67.70	**16.43**	**3.69 to 29.18**
Community safety	**72.88**	**26.61 to 119.15**	**52.40**	**13.41 to 91.39**	**20.48**	**7.42 to 33.53**
Community aesthetic quality	–29.33	–77.11 **to** 18.46	–28.85	–69.07 **to** 11.37	–0.48	–13.96 **to** 13.01

Abbreviations: BE, built environment; CI, confidence interval; MET, metabolic equivalent of task; MVPA, moderate and vigorous physical activity; PA, physical activity.
Note: *β*, change in MET-minutes associated with a 1-unit difference in the row variable from bivariate linear regression models. 95% confidence intervals after Bonferroni correction. Bold indicates significant associations.

Table 4 Moderation Effects of Sociodemographic Characteristics on the Relationships Between Context and PA

	Total PA, MET-min/wk		MVPA, MET-min/wk		Walking, MET-min/wk	
	β		*β*		*β*	
Age: 65 y or older (n = 2215)						
Exercise attitudes						
Main effect	342.67	***	269.66	***	73.02	***
65+ main effect	–771.89	***	–494.30	*	–277.60	***
Interaction effect	122.59		57.44		**65.15**	***
Exercise confidence						
Main effect	202.71	***	158.85	***	43.86	***
65+ main effect	–515.03	***	–361.71	**	–153.32	***
Interaction effect	60.21		24.73		**35.48**	**
Social support for PA, family						
Main effect	214.37	***	159.67	***	54.70	***
65+ main effect	–641.30	*	–420.70		–220.60	**
Interaction effect	125.01		59.81		**65.19**	**
Social support for PA, friends						
Main effect	286.73	***	223.31	***	63.42	***
65+ main effect	–704.76	**	–527.40	*	–177.35	*
Interaction effect	147.45		96.50		50.95	
Education: College graduate or more (n = 2215)						
Exercise attitudes						
Main effect	313.47	***	236.13	***	77.34	***
College graduate main effect	–465.79	*	–415.96	**	–49.83	
Interaction effect	**115.64**	*	**101.45**	*	14.19	
Exercise confidence						
Main effect	176.00	***	126.26	***	49.75	***
College graduate main effect	–217.81		–236.90	*	19.09	
Interaction effect	70.12		**72.17**	*	–2.05	
Social support for PA, family						
Main effect	318.51	***	246.46	***	72.06	***
College graduate main effect	429.33	*	377.90	*	51.44	
Interaction effect	**–136.23**	*	**–123.63**	*	–12.61	
Social support for PA, friends						
Main effect	298.65	***	224.34	***	74.31	***
College graduate main effect	–70.10		–107.64		37.54	
Interaction effect	32.30		38.73		–6.42	
Income: <$50,000 annual household income (n = 2195)						
Exercise attitudes						
Main effect	373.29	***	297.11	***	76.18	***
<$50k main effect	86.17		141.85		–55.68	
Interaction effect	–30.87		–42.88		12.01	
Exercise confidence						
Main effect	233.81	***	187.10	***	46.71	***
<$50k main effect	74.50		115.97		–41.47	
Interaction effect	–54.34		–58.50		4.17	
Social support for PA, family						
Main effect	176.95	***	116.89	***	60.06	***

(continued)

Table 4 *(continued)*

	Total PA, MET-min/wk		MVPA, MET-min/wk		Walking, MET-min/wk	
	β		*β*		*β*	
<$50k main effect	–482.74	*	–425.77	*	–56.97	
Interaction effect	127.25		**116.97**	*	10.28	
Social support for PA, friends						
Main effect	300.38	***	238.94	***	61.44	***
<$50k main effect	–197.38		–96.96		–100.42	
Interaction effect	28.67		5.83		22.84	

Abbreviations: MET, metabolic equivalent of task; MVPA, moderate and vigorous physical activity; PA, physical activity. Note: β, change in MET-minutes associated with a 1-unit difference in row variable from multivariate linear regression models. Bold indicates significant interaction effects after Bonferroni correction: *95% confidence, **99% confidence, and ***99.9% confidence.

MET-minutes per week); associations were all positive. Three sociodemographic characteristics (65 y old or older, college graduate, and annual household income <$50,000) moderated associations between psychosocial context and PA. We discuss each of these moderators in turn below. Older adults (>65 y old) had less total PA than younger adults, but this lower level of PA was moderated among older adults by greater effects of positive exercise attitudes, exercise confidence, and social support from friends on walking. This is important because walking is the most preferred form of PA for older adults,[34] and walking can decrease the risk or severity of cardiovascular disease, diabetes, and cognitive impairment, as well as improving mental well-being, sleep, and longevity.[35] Among college graduates, the effects of exercise attitudes and exercise confidence on MVPA were accentuated relative to sample members with less education. It is possible that MVPA for college graduates would be "leisure" activities that require a conscious, active choice to devote time to them (and are more vigorous so accrue more MET-minutes in a shorter time). In this sample, college graduates reported more leisure-time MVPA (MET-minutes per day, $P = .013$) than those who were not college graduates. College graduates with more positive attitudes toward exercise or higher exercise confidence may choose to pursue exercise-related leisure activities, while college graduates with worse attitudes toward exercise or lower exercise confidence may choose to do less active hobbies in their leisure time. Noncollege graduates may have more active jobs or spend more time on active chores, where they would accrue moderate/vigorous MET-minutes regardless of their attitudes toward exercise or exercise confidence, since these activities are part of daily life responsibilities, rather than an active choice to exercise. This is demonstrated by the fact that noncollege graduates in our sample reported more MVPA (MET-minutes per day) from work ($P < .001$) and chores ($P < .001$) than college graduates. Among adults in lower income households, the effect of social support from family on MVPA was greater than among adults in higher income households. Individuals in low-income households have significantly fewer opportunities for PA compared with those in higher income households,[36] so social support may have a greater effect on PA levels for individuals in lower income households.

The average reported mean moderate/vigorous MET-minutes per week reported for this sample was 1474. This is higher than has been reported in other representative US adult samples. For example, analysis of over 30,000 participants in the National Health and Nutrition Examination Survey, which did not differentiate by urban/rural status, reported an average of 860 total moderate/vigorous MET-minutes of PA per week,[37] although over two-thirds of adults in that sample failed to meet the recommended 600 MET-minutes per week of MVPA. The National Health and Nutrition Examination Survey uses the Global Physical Activity Questionnaire to collect self-reported PA data[38]; the Global Physical Activity Questionnaire has poor to fair concurrent validity with accelerometers, pedometers, and PA logs and tends to overestimate PA.[39] Similarly, the International Physical Activity Questionnaire has poor to fair correlations with objective PA measurements and also tends to overestimate PA level.[40] Current public health guidelines suggest at least 500 to 600 MET-minutes per week of MVPA, which equates to about 150 minutes of moderate-intensity aerobic activity.[41] However, rural Americans typically report less PA compared with suburban and urban populations[42]; for example, the National Health Interview Survey, a representative national survey of over 20,000 adults, reported that 25.3% of urban residents (vs 19.6% of rural residents) met the combined aerobic and muscle-strengthening guidelines.[43] Likewise, data from the National Health and Nutrition Examination Survey showed that rural adults were more likely than urban adults to report no leisure-time PA and fewer rural adults met the recommended leisure-time PA guidelines of ≥450 MET-minutes per week for leisure-time PA.[44]

A number of other studies, many of which were not specific to rural areas, have also found PA-related psychosocial variables (eg, attitudes, confidence, social support) are associated with total PA, MVPA, and/or walking.[3,9] Rural-specific studies have also noted a correlation between confidence and PA or exercise.[45,46] Social support is also a commonly reported correlate of PA for adults,[4,9] including rural adults.[47] In contrast to the current study, others have found no association between attitudes toward PA and PA behaviors.[4] One recent study found that rural adults had more positive attitudes toward PA than urban adults and that a more positive attitude toward PA was associated with greater amounts of PA for rural adults, but not urban adults.[19]

Other researchers have also found associations between BE variables (eg, walking environment, community safety) and total PA, MVPA, and/or walking. For example, a review and meta-analysis of 100 articles examining BE attributes related to PA for older adults concluded that walkability, walk-friendly infrastructure, and safety from crime were among the top positive BE correlates of PA.[48] Other systematic reviews have also noted an association between perceived community safety and increased PA.[6] Most reviews do not differentiate between rural and urban areas; some reviews have examined BE correlates of PA of adults in rural areas and found convincing positive relationships between PA and BE features conducive to PA (eg, recreation facilities,

pleasant aesthetics).[24,49] Some tools used to measure BE in urban areas (ie, Walk Score) may not be appropriate for rural communities.[50] Further refinement of BE measures for rural communities may be needed.[51]

Although we did not find other studies that examined sociodemographic moderators between the same psychosocial factors and PA behaviors, other researchers have similarly found that education moderated the relationship between PA intention and PA behavior; in other words, studies with better educated samples reported stronger PA intention and PA behavior relationships.[52] The meta-regression analysis that found that better educated samples reported stronger PA intention did not find that income was a moderator between PA intention and PA behavior.[52] A different review reported that it was unclear whether age moderated the relationship between PA intention and PA behavior, but concluded that gender, race/ethnicity, and BMI did not moderate the relationship.[53] Although the current study did not find that sex moderated the relationship between social support and PA behaviors, a study of over 17,000 adults in Spain reported that sex moderated the relationship between social support and cardiovascular prevention behaviors; social support was more strongly associated with adherence to cardiovascular prevention recommendations, including meeting PA recommendations, in men than women.[54]

This study has strengths as well as limitations. Strengths of the study include a large sample size for understudied medically underserved rural communities, and leveraging data collected from a randomized controlled trial to better understand relationships between PA and psychosocial, environmental, and sociodemographic factors. Limitations include use of a self-report PA questionnaire and a relatively homogeneous sample. PA was assessed via a validated self-report questionnaire, but correlations between self-reported and objective measures of PA have been found to be only low to moderate.[55] Although the study sample included similar numbers of adults from lower and higher income households, with and without college degrees, and obese and nonobese individuals, the majority of the sample was non-Hispanic White, younger than 65 years old, and in good or excellent health, which may limit generalizability to populations with other racial or ethnic identities, older adults, and those in poor or fair health.

Conclusions

In this sample of rural adults, exercise attitudes, exercise confidence, and social support for PA from family and friends were positively associated with self-reported PA with particularly strong relationships observed among adults aged 65+. Walking environment and community safety were BE variables associated with self-reported PA. Future public health interventions should consider ways to bolster exercise attitudes, confidence (such as motivational interviewing), and social support among rural adults in an effort to improve PA throughout the life course. Addressing the environment for walking and community safety may support PA and particularly walking, but the importance of other changes to the BE is less clear.

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