

# Exploring the Role of Environmental Supports in Leisure-time Physical Activity and Quality of Life Among Older Adults: A Mixed-Methods Approach

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## Abstract

**Objectives:** This mixed-methods study examined the relationship between perceived accessibility of leisure-time physical activity (LTPA) resources, LTPA engagement, and quality of life (QoL) among older adults in the United States.

**Design:** A cross-sectional mixed-methods study was conducted. Quantitative data were collected through an online survey and supplemented with qualitative data from focus groups.

**Participants:** A total of 94 participants were included in the study.

**Outcome Measures:** The outcome measures in this study included accessibility of LTPA-related resources, leisure-time physical activity, quality of life, and quantitative data from focus groups.

**Results:** Mediation analysis using the PROCESS macro (Model 4) in SPSS indicated that greater perceived access to facilities such as walking/biking trails, parks/sports fields, and recreation centers was associated with higher LTPA, which, in turn, predicted better QoL. Qualitative findings revealed that LTPA experiences (positive or negative), shifting benefits across the lifespan, and environmental supports critically influence participation.

**Conclusions:** Findings from this mixed-methods approach suggest that enhancing the perceived accessibility of LTPA-related resources may increase LTPA participation and, consequently, improve QoL among older adults. They also underscore the need for well-targeted public infrastructure investments and awareness campaigns to promote healthy aging. Implications for research and practice are discussed.

**Keywords:** Leisure time physical activity, Older adults, Healthy aging, Quality of life, Built environment

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## Introduction

As the global population continues to age, the concept of healthy aging has gained increasing attention, going beyond merely living without disease, disability, or illness.<sup>1,2</sup> Although there is no universally accepted definition, healthy aging or successful aging is commonly understood as freedom from disability along with high cognitive, physical, and social functioning.<sup>3,4</sup> These concepts reflect the multidimensional nature of health (i.e., physical, mental, cognitive, and social domains) and underscore the importance of maintaining balance among these aspects to achieve a good quality of life. Therefore, identifying the factors that contribute to healthy or successful aging has become a central focus of research across a range of health-related academic fields.

Previous studies have demonstrated that leisure-time physical activity (LTPA) contributes to multiple

dimensions of health, including physical, psychological, and cognitive well-being in older adults.<sup>5-8</sup> LTPA refers to physical activities that are voluntarily undertaken during free time, outside of work or daily responsibilities, for enjoyment, recreation, or improving physical fitness. Common examples include walking, playing sports, exercising at the gym, and engaging in outdoor activities. Lee et al<sup>7</sup> found that older adults with mild cognitive impairment who participated in leisure walking more frequently reported better mental health. Similarly, Kim et al<sup>9</sup> revealed the mental health benefits of both light-to-moderate and vigorous LTPA in a representative sample of older adults in the US.

As a more comprehensive measure of health outcomes, quality of life (QoL) has been widely used to assess the overall health effects of LTPA in older adults.<sup>10</sup> QoL is a multidimensional construct that simultaneously



measures an individual's physical, mental, and social aspects of health.<sup>11,12</sup> Prior studies have emphasized the important role of LTPA participation in enhancing QoL among older adults by improving mobility and supporting mental health.<sup>10,13,14</sup> Despite the well-documented benefits of LTPA, physical inactivity and sedentary behavior remain more prevalent in older adults.<sup>15,16</sup> Such physical inactivity often leads to poorer physical and mental health outcomes, such as depression, social isolation, and lower levels of life satisfaction.<sup>17-19</sup>

In this context, health scholars have examined the role of environmental factors as key determinants of LTPA participation, with a primary focus on the availability of resources in local areas and their influence on health behaviors.<sup>20-22</sup> For example, previous review studies have found that specific elements of the built environment (e.g., walkability, residential density, street lighting, neighborhood safety, etc.) were associated with LTPA among older adults.<sup>23,24</sup> Although previous findings provide valuable insight into the relationship between environment and LTPA, this approach does not fully capture how individuals' perceptions of the LTPA-related environment, especially aspects relevant to them, influence LTPA behavior. For example, while some people may consider parks important for engaging in LTPA, others may not. In other words, if it is not personally valued, the presence of a park nearby may have little relevance to changes in their LTPA.

According to Van Vianen<sup>25</sup>, "person and environment together predict behavior better than either alone," which represents one of the fundamental principles of person-environment fit theory. In other words, when environmental resources align with individuals' needs and perceived relevance, they are more likely to have a stronger impact on behavior. According to the person-environment fit theory, leisure-time physical activity (LTPA) is most likely to occur when environmental resources, such as parks, recreation centers, and trails, align with individuals' needs, values, and abilities. In this study, environmental characteristics are conceptualized as "supplies", whereas individuals' needs, values, and preferences are conceptualized as "personal demands". This study aimed to investigate whether there is a stronger relationship between environmental resources and LTPA when perceived relevance and need-fit are high. To more accurately assess this relationship, the present study aimed to examine both whether individuals perceive specific features as important for LTPA and whether those features are actually available. To date, only a limited number of studies have measured situational perceptions of accessibility to LTPA facilities by considering both the perceived importance and availability of accessible environments.<sup>9,26</sup> These studies suggest that individuals who had access to LTPA sites they personally considered important were more likely to report higher levels of LTPA. Although these studies offer important methodological contributions, they are limited to church-going African American populations and immigrant

populations. Therefore, applying these assessment strategies in research involving older adults may provide more accurate insights into how environmental factors influence their LTPA and QoL.

Based on our review, we identified the following research gaps. First, previous LTPA studies are limited in that they often measure LTPA without accounting for all types of activities (i.e., light, moderate, vigorous, and muscle-strengthening). To address this gap, the present study assessed total levels of LTPA by combining the frequencies of these activity types and examined their relationship with QoL. Second, we found that no studies have measured both the perceived importance and actual availability of LTPA-related facilities and resources, especially among older adults. Therefore, we assessed both the perceived importance and actual presence of LTPA-related resources to more accurately examine the extent to which PA-related environmental factors influence LTPA and QoL.

Using a mixed-methods design, we first tested a comprehensive mediation model linking perceived accessibility, leisure-time physical activity (LTPA), and quality of life (QoL) (i.e., Perceived Accessibility → LTPA → QoL). Specifically, we examined the extent to which the perceived accessibility of leisure-related resources was associated with LTPA and QoL among older adults. This analysis was guided by the conceptual model recently proposed by Kim et al<sup>9</sup>, which suggests that awareness of existing leisure facilities and programs can enhance leisure time physical activity participation and leisure time satisfaction, ultimately contributing to greater happiness. Additionally, qualitative data were collected to explore more deeply the role of LTPA in shaping QoL and to identify which aspects of the LTPA-related environment contribute to participation and well-being. This qualitative exploration provides valuable insight into themes particularly relevant to older adults and enhances our understanding of the interconnected relationships among environment, LTPA, and QoL in this population.

## Materials and Methods

### Quantitative Data Collection

The cross-sectional data were collected through an online survey. With permission, the research team collaborated with various institutions, including university-affiliated centers for healthy aging, senior centers, and community churches, as well as healthcare professionals and health service providers to promote the study. The initial sample included 120 participants; however, 26 cases were removed due to incomplete data that lacked critical information necessary for analysis. As a result, 94 participants were included in the final analysis of this study. This study was approved by the Institutional Review Board of East Carolina University (Protocol #22-002594).

Most participants were between 65 and 87 years old, with an average age of 71. The majority of participants were female (72.3%) and married or partnered (72.3%). Most of them were identified as White or Caucasian

(77.7%), followed by Black or African American (16.0%) and Asian (4.3%). Educational attainment was generally high, with 60.6% holding a graduate degree and 20.2% having a college degree. Regarding household income, 42.6% reported earning \$100,000 or more annually.

## Measures

### Accessibility of LTPA-related Resources

The independent variable for perceived accessibility of LTPA-related resources was calculated by multiplying importance by availability. First, 7 specific types of LTPA sites were selected based on the SIP 4-99 Research Group.<sup>26</sup> For this study, the survey included: (1) walking trails, (2) parks, playgrounds, or sports fields (e.g., soccer, football, softball, tennis, skate parks, public playgrounds with equipment, etc.), (3) swimming pools, (4) public recreation centers, (5) school recreation facilities open to the public, (6) beaches, lakes, rivers, or creeks, and (7) bicycle paths or bike trails.<sup>27</sup>

Availability of each LTPA site was assessed with the question “Does your neighborhood have...?” using dichotomous response options (1=yes, 2=no). Additionally, the importance of each LTPA site was measured by asking “Please rate the importance of having access to the listed sites or facilities for you to perform the leisure-time physical activities you enjoy, regardless of whether your neighborhood has them.” Each item was rated on a 5-point Likert scale (ranging from 1=not at all important to 5=very important). To ensure only positive numbers in the dataset, five (5) was added to all accessibility values (resulting in possible scores of 0, 1, 2, 3, 4, 6, 7, 8, 9, and 10). Values of 0, 1, 2, 3, and 4 were then re-coded to 1, 2, 3, 4, and 5, respectively, to produce a continuous series of numbers (i.e., 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10). Higher scores indicate greater accessibility to LTPA resources and facilities that participants considered important for their participation. This approach has been applied and validated in a prior study on environmental accessibility and leisure-time physical activity.<sup>26</sup>

### Leisure Time Physical Activity

As a mediating variable, LTPA was assessed using the Physical Activity Scale for the Elderly (PASE), developed by Washburn et al.<sup>28</sup> Older participants rated the frequency and intensity of various leisure-time activities (e.g., walking, recreational activities, exercise, etc.) performed during the previous week. All frequency items were rated on a 4-point Likert scale: 1=Never, 2=Seldom (1–2 days), 3=Sometimes (3–4 days), and 4=Often (5–7 days). The total PASE score was calculated by averaging the frequencies of light, moderate, vigorous, and muscle-strengthening activities performed during the past 7 days. The PASE has demonstrated strong validity and reliability, making it useful for large epidemiological studies in the general population.<sup>29</sup>

### Quality of Life

We assessed Quality of life (QoL) using the 14-item

Quality of Life Enjoyment and Satisfaction Questionnaire–Short Form.<sup>30</sup> Participants rated their satisfaction across diverse life domains, such as physical health, mood, work, household duties, social relationships, family relationships, leisure activities, and daily functioning. Each item was rated on a 5-point Likert scale ranging from 1 (very poor) to 5 (very good). Higher total QoL scores indicate greater life satisfaction and enjoyment.

### Covariates

Several demographic factors (i.e., gender, income, education level, marital status, and race) were controlled for in the analyses to account for their potential confounding effects on the relationships among perceived accessibility, LTPA, and QoL.

### Qualitative Data Collection

At the end of the survey, participants were asked if they were interested in participating in an interview or focus group. Participants who expressed interest were included in the study. Then, we collected their contact information and followed up to schedule a session at a convenient time. Focus groups (N=4) were scheduled via Microsoft Teams. Sample questions included: (1) How do you think your life experiences have impacted your leisure time physical activity? (2) Thinking about your life, how has your leisure time physical activity changed throughout your life? and (3) What factors can influence leisure-time physical activity participation and well-being?

The focus group components of the study were provided by a researcher with substantial experience in qualitative research. The researcher conducted the focus groups and completed the primary analyses. The researcher in charge of qualitative data collection and analysis had an extensive background and experience in the disciplines of public health, physical activity, and aging, which informed the study design including focus group questions along with the interpretation of findings. To support reflexivity, analytic decisions were discussed within the research team with extensive notes maintained throughout data collection and analysis to reflect on assumptions and interpretations of the researchers. All analytic decisions were reviewed systematically and collaboratively to improve the credibility of findings while minimizing any potential bias.

### Data Analysis

For the quantitative analysis, all statistical procedures were conducted using SPSS software version 29 and the PROCESS macro (Model 4) developed by Hayes.<sup>31</sup> Descriptive statistics were calculated for all demographic and study variables (Table 1), and bivariate correlations between the main study variables are presented in Table 2. Although there was no significant direct relationship between the independent variable (i.e., perceived accessibility) and the dependent variable (i.e., quality of life), a condition long considered a key requirement for mediation analysis,<sup>32</sup> we proceeded to test

**Table 1.** Descriptive Statistics of Older Adult Participants

Variables	Older adults (N=94)			
	N	%		
<b>Gender</b>				
Female	68	27.7		
Male	26	72.3		
<b>Marital status</b>				
Married	68	72.3		
Divorced	4	4.3		
Widowed	6	6.4		
Never married	16	17.0		
<b>Educational attainment</b>				
Some high school education	2	2.1		
High school degree	2	2.1		
Some college education	11	11.7		
College degree	19	20.1		
Graduate school	57	60.6		
Other	3	3.2		
<b>Race/ethnicity</b>				
White/Caucasian	73	77.7		
Black or African American	15	16.0		
Asian	4	4.3		
Other	2	2.1		
<b>Annual household income</b>				
< \$ 15,000	5	5.3		
\$15,000 - \$29,999	3	3.2		
\$30,000 - \$49,999	8	8.5		
\$50,000 - \$74,999	21	22.3		
\$75,000 - \$99,000	17	18.1		
\$100,000 or more	40	42.6		
<b>Variables</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>
Perceived accessibility	34.19	9.00	7.00	50.00
Total LTPA (untransformed)	1.81	0.63	1.00	3.50
Quality of life	4.00	0.58	2.46	5.00

Note: Accessibility scores could range from 7 to 70. LTPA frequency items were assessed on a 4-point Likert scale: 1=Never, 2=Seldom (1–2 days), 3=Sometimes (3–4 days), and 4=Often (5–7 days). Quality of life items were measured using a 5-point Likert scale, with response options from 1 (very poor) to 5 (very good).

the mediation model in line with contemporary arguments in mediation analysis.<sup>33</sup> Moreover, given that the LTPA variable demonstrated positive skewness (1.99), a log<sub>10</sub> transformation was applied to normalize the distribution, which reduced the skewness to 0.17. Descriptive statistics were reported using the original (untransformed) LTPA values for interpretability, whereas log<sub>10</sub>-transformed LTPA values were used in mediation analyses. To test the mediation model, an ordinary least squares (OLS) path analysis was conducted. For the specific analytic procedures, perceived accessibility was entered as the independent variable (X), total LTPA as the mediator (M), and QoL as the dependent variable (Y). The model controlled for covariates, including gender, income, education level, marital status, and race. Indirect effects

**Table 2.** Intercorrelation Statistics of the Main Variables

Variable	1.	2.	3.
1. Perceived accessibility	1		
2. Total LTPA	0.23*	1	
3. Quality of life	0.19	0.32**	1

\*  $P < 0.05$ . \*\*  $P < 0.001$

were tested using 5000 bootstrap samples, and mediation was considered statistically significant if the 95% bias-corrected confidence interval (CI) for the indirect effect did not include zero.

For the qualitative analysis, thematic analysis of focus group transcript data was used to develop themes since thematic analysis focuses on overarching themes within the dataset along with how those themes relate to one another. This “deliberative, reflective, and thorough” approach (Braun & Clarke, 2014, p. 2) is used to identify themes to answer health and well-being research questions.<sup>34,35</sup> The thematic analysis utilized the following steps: (1) familiarize oneself with the data, (2) code interviews to generate initial codes, (3) search for preliminary themes, based on an a priori threshold of 50% of participants, (4) review themes, (5) define and name themes, and (6) produce a report.<sup>36</sup> Coders independently completed steps 1-3 and collaborated with fellow coders for steps 4 and 5. Consensus was met during stage 5, with the final themes being identified in stage 6.

**Results**

**Quantitative Results from Mediation Analysis**

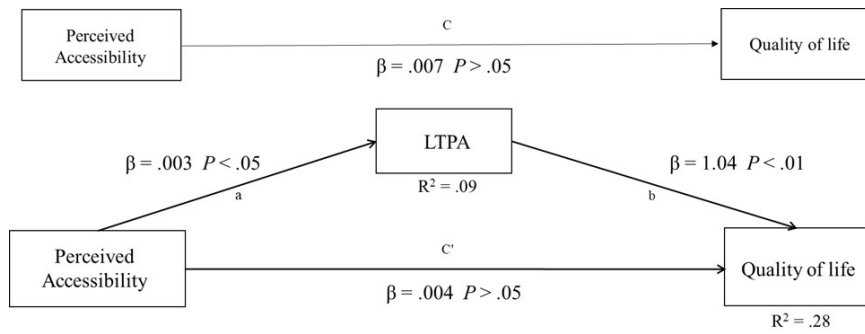
As shown in Figure 1, perceived accessibility significantly predicted total LTPA ( $B = 0.0034$ ,  $P < 0.05$ ), indicating that participants with greater perceived access to LTPA-related resources reported higher engagement in LTPA. This model accounted for approximately 9.9% of the variance in total LTPA ( $R^2 = 0.0994$ ). In turn, total LTPA significantly predicted QoL ( $B = 1.0399$ ,  $P < 0.01$ ), suggesting that greater participation in LTPA was associated with better QoL. The model explained 28.5% of the variance in QoL scores ( $R^2 = 0.2845$ ;  $F(7, 85) = 4.83$ ,  $P < 0.001$ ).

The total effect of perceived accessibility on QoL was non-significant ( $B = 0.0073$ ,  $P > 0.05$ ), as was the direct effect ( $c'$ ;  $B = 0.0037$ ,  $P > 0.05$ ), suggesting that perceived accessibility alone did not influence QoL. As presented in Table 3, however, results of the mediation analysis indicated a significant indirect effect of perceived accessibility on QoL through total LTPA (Effect = 0.0036, 95% CI [0.0003, 0.0088]). These findings suggest that perceived accessibility contributes to QoL only through increased participation in LTPA.

**Qualitative Results from Focus Group**

Findings of the thematic analysis suggest that (1) LTPA engagement can be positive or negative, (2) benefits of LTPA shift throughout the lifespan, and (3) environmental supports are needed to promote LTPA.

The first theme, “LTPA engagement can be positive



**Figure 1.** The Mediation Model of the Effect of Perceived Accessibility (Independent Variable, X), through the Mediator (LTPA), on QoL (Dependent Variable, Y) \*  $P < 0.05$ . \*\* $P < 0.001$

**Table 3.** The Mediating Role of LTPA in the Relationship between Perceived Accessibility and Quality of Life

Effect	Effect	Boot SE	Boot LLCI	Boot ULCI
Total effect (c; ACC→QoL)	0.0073	0.0061	-0.0048	0.0194
Direct effect (c'; ACC→QoL)	0.0037	0.0060	-0.0082	0.0156
Indirect effect (ACC→LTPA→QoL)	0.0036	0.0022	0.0003	0.0088

**Note.** Effect=unstandardized coefficient; Boot=Bootstrap; SE=Standard Error; LLCI=Lower Limit Confidence Interval; ULCI=Upper Limit Confidence Interval; ACC=Perceived Accessibility; LTPA=Leisure Time Physical Activity; QoL=Quality of Life

or negative,” highlights participants’ lived experiences with LTPA. One participant explained, “I did it because I was good at it, and I feel like, you know, like that’s rewarding.” Another participant added, “You know, like, why wouldn’t you want to continue doing something that you feel confident and good about yourself in?” While many participants reported positive experiences with LTPA, some described negative associations, which influenced their engagement throughout their lifespan. One participant reported “I was not a sports person. I’m very bad at that. I was always the last person to be chosen on the playground; that sort of thing.” Another stated, “I don’t enjoy it. I don’t like to do it. So I can move but I just don’t like to.” One participant reported, “I never liked it. I never got the energy boost that people say they love it.” These quotes demonstrate that while much focus is placed on participants who enjoy LTPA, the lived experiences of those who do not enjoy LTPA are also critical for promoting participation.

The second theme, benefits of LTPA shift throughout the lifespan, focuses on how LTPA engagement shifts as different benefits and values shift as one ages. One participant stated, “I have realized kind of the hard way that I have to move my body or else it just doesn’t do what I want it to do right when I need it to do so.” Another participant stated, “Basically, the reason I do it is because I don’t have pain if I do it.” One participant is quoted as saying “Especially as I grow older, I see colleagues and friends who have, you know, problems with movement, and I just feel very fortunate that I have not had any of that.” Another participant stated, “Previously, it was associated with enjoyment for me but now it’s a family thing with my toddler. It’s not an individual activity for me anymore, it’s almost always associated with my son.” One participant commented, “It [being an athlete] was fun for me cause. I was good at it and if I didn’t win, I probably wouldn’t have kept doing it because it’s not that fun. But

I’m competitive and like to win, so that’s where it came from. They expect athletes to still have the same body they had when they were in college or professional even. And it just doesn’t happen so I’ve shifted how I move.” Another former athlete stated, “I was good at gymnastics and I was good at cheerleading, but I did it because I was good at it and I feel like it, you know, that’s rewarding. Now, my own personal enjoyment is to be able to go out and do that and explore on my own.” These statements reveal that as people age and identities shift (e.g., from athlete to non-athlete), their perceptions of LTPA and its benefits shift as well.

The final theme, environmental supports are needed to promote LTPA, discusses the importance of environmental supports to engage in LTPA, including policies and programs. One participant reported, “We live in the woods, and I feel that is the best thing I could ever imagine. This house that I have is situated in a great location, great location helps.” Another reported, “I do have a kayak and I’ve gone kayaking on the river. Because of where I live, I don’t even need to leave my house to have a lot of activity.” Another participant stated, “Now living in Texas, it’s very car-focused and I work from home so I don’t get steps so then I have to be way more conscious about what I do.” Yet another reported, “For me, the biggest source is being able to go out and just walk to places or walk on a trail because I have a trail next to my apartment too. That’s helpful.” Another participant stated, “I had my old house, had a lovely sidewalk, and I had a perfect three-mile track down to where I could do it. And then I moved to this house and there are no sidewalks, it’s literally an asphalt road.” These quotes demonstrate the value environmental supports provide in LTPA promotion across the lifespan for all individuals.

**Discussion**

A mixed-methods design was used in this study to (1)

quantitatively test a comprehensive mediation model linking perceived accessibility of LTPA resources, LTPA, and QoL, and (2) further explore the role of LTPA in shaping QoL and identify which aspects of the LTPA-related environment contribute to participation and well-being among older adults. The quantitative results indicated that older adults who reported greater perceived access to LTPA-related resources engaged in higher levels of LTPA and, in turn, reported better QoL. The qualitative findings revealed that (1) LTPA experiences can be positive or negative, which can impact engagement, (2) LTPA benefits shift throughout the lifespan, and (3) environmental supports are critical for promoting LTPA. Our quantitative and qualitative findings from this mixed-methods study provide a more comprehensive understanding of how perceived accessibility to LTPA-related resources influences both LTPA and QoL among older adults.

The main finding of this study is that perceived accessibility of LTPA-related facilities (e.g., bike trails, parks, recreation centers, etc.) was associated with greater LTPA engagement among older adults. Specifically, older adults who had more resources they considered important for their LTPA (e.g., parks, bike/walking trails, recreation centers, etc.) tended to report higher levels of LTPA. This finding is consistent with socioecological models, which emphasize the influence of environmental factors on LTPA behavior of individuals.<sup>37,38</sup> The socioecological framework underscores the importance of accounting for a broad array of environmental influences on LTPA behaviors (e.g., neighborhood safety, accessibility, etc.) rather than focusing solely on individual demographic or psychological factors.<sup>39</sup> Previous research has suggested that environmental factors play a significant role in promoting LTPA behavior in aging populations.<sup>9,17</sup> These findings highlight the need to create supportive LTPA-related environments that facilitate healthy leisure-time behaviors, such as LTPA, among older adults.

Our study also revealed a positive association between total LTPA levels and QoL among older adults. This finding corroborates previous research demonstrating the benefits of active LTPA engagement for physical, mental, and social well-being in aging populations.<sup>9,40,41</sup> Furthermore, this study extends previous research by incorporating multiple intensities of LTPA into its measurement approach. Given that older adults often engage in different types and intensities of LTPA depending on their physical abilities, preferences, and available resources, our comprehensive assessment offers a clearer understanding of the various forms of LTPA and their collective impact on QoL.

An unexpected finding of our study was that perceived accessibility was not directly related to QoL. One possible interpretation of this result is that environmental perception alone may not be strong enough to improve health outcomes (i.e., QoL) unless it leads to a corresponding behavior change (i.e., increased LTPA). This interpretation supports our finding of an

indirect effect of perceived accessibility on QoL through its influence on LTPA. In other words, perceived and actual access to LTPA resources may improve individuals' quality of life only when they lead to increased engagement in health-related behaviors. This finding implies that community planning efforts by health professionals, policymakers, and researchers should prioritize maintaining and promoting access to LTPA resources to support healthy behavior adoption among older adults and, in turn, enhance their overall health and well-being.

Findings from the focus groups revealed 3 overarching themes that impact individuals' LTPA throughout the lifespan. In the first theme, LTPA engagement can be positive or negative, participants shared their current LTPA behaviors stemmed from either their positive or negative past and current experiences with LTPA. These findings corroborate existing literature demonstrating that both positive and negative childhood experiences impact adult LTPA behavior.<sup>42,43</sup> This study also revealed that people's benefits associated with LTPA change as they age and as identity shifts (e.g., non-parent to parent). For example, physical activity of athletes may decrease after retirement or they may have a focus on physical activity beyond competitive sport.<sup>44,45</sup> Finally, the study also demonstrates the importance of environmental supports to promote LTPA. This finding is well-documented in the literature, as numerous studies have revealed that sidewalks, green spaces, and safe walking areas greatly impact LTPA participation in a wide range of ages and populations.<sup>46-48</sup> Notably, although the mediation model showed that perceived accessibility did not directly predict QoL, this pathway was supported by qualitative insights. For example, participants described how mixed-use spaces (e.g., retail and residences in walking distance) shaped their LTPA behaviors, quality of life, and overall engagement with daily living.

Overall, from an academic perspective, our findings underscore the value of using mixed methods, as this approach offered a more nuanced understanding of the interconnected relationships between environment, LTPA, and QoL in this population. From a practical standpoint, we recommend that researchers, health professionals, decision makers, and key community members (e.g., older adults) collaborate in shaping decisions about the development of leisure and recreation infrastructure. Tabak et al<sup>49</sup> emphasized the importance of incorporating public opinion into policies that influence policymakers' priorities in developing physical activity promotion initiatives. They further suggested that "practitioners can use this information (public support for policies) to tailor communication about public health interventions, including policy approaches" (p. 6).

There are several limitations that should be noted. This study used cross-sectional data; therefore, the relationships between perceived accessibility of LTPA-related facilities, LTPA, and QoL should not be considered causal. Additionally, we acknowledge the reverse pathway, in which individuals with higher levels of life satisfaction

may be more likely to participate in LTPA. A longitudinal investigation is warranted to draw clearer conclusions about possible causal associations between the variables studied. Moreover, the study relied on participants' perceptions of accessibility to LTPA and self-reported LTPA. That may not provide accurate information about the actual availability and LTPA levels. This limitation highlights the need for objective measurements (e.g., accelerometers, geographic information systems, etc.). Additionally, our participants were relatively highly educated and predominantly White or Caucasian, which may limit the generalizability of our findings to more diverse or underserved older adult populations. Moreover, the quantitative analysis was conducted with a relatively small sample of 94 older adults. Future studies should include a larger and more representative sample with more balanced distributions across gender, educational attainment, and ethnic groups, as these demographic characteristics may influence health behaviors and related health outcomes. Finally, this study did not account for many potential confounders influencing LTPA participation, such as health status, functional limitations, cultural preferences, or neighborhood safety. Therefore, future studies, particularly those using instrumental variable analysis, will be warranted to address these unmeasured confounders and strengthen causal inference.

### Implications for Practice and Research

Despite the discussed limitations, our findings offer several important implications for both practice and research. It can be concluded that older adults who perceived greater access to walking/biking trails, parks/sports fields, and public recreation centers were more likely to engage in LTPA. Therefore, it is essential to explore strategies for increasing public infrastructure investments aimed at improving the accessibility of LTPA-related facilities and resources, which can, in turn, promote LTPA participation among older adults. However, the measure of perceived accessibility used in this study did not allow for identifying which specific facility or resource was the strongest predictor of LTPA, highlighting an important direction for future research. Although beyond the scope of the primary study objectives, descriptive analysis revealed that participants rated parks/playgrounds/sports fields as the most important LTPA facilities, followed by biking/hiking/walking trails. This information may help guide practitioners and policymakers in prioritizing facility development and resource allocation.

Another important implication involves increasing awareness of accessible LTPA-related sites and resources within neighborhoods. Although focused on people with disabilities which may include older adults, Kim et al<sup>17</sup> found that greater awareness of nearby leisure resources, such as public leisure facilities and cultural and leisure programs, increased both leisure-time physical activity participation and satisfaction. The authors emphasized the importance of raising awareness about available public leisure facilities and programs to promote LTPA

participation. Similarly, Choi et al<sup>50</sup> reported that individuals who recognized the availability of community leisure resources (e.g., walking trails, parks) engaged in more LTPA than those who did not. Based on these findings, Kim et al<sup>17</sup> suggested that public awareness campaigns tailored to specific populations, delivered through mass media and social media, are essential for promoting awareness. This can enhance the health and well-being of community members. More importantly, such campaigns are likely to be more affordable and less resource-intensive than large-scale capital initiatives such as constructing new recreational facilities or refurbishing existing infrastructure.

As indicated earlier, self-reported LTPA levels remain a study limitation due to potential recall bias. Future research using objective measures (e.g., accelerometers) would help provide more accurate information about LTPA levels. Similarly, perceived accessibility of LTPA-related facilities was also self-reported, meaning that we captured a perceptual rather than objective representation of the actual environment. In other words, it is possible that some older adults in this study were simply unaware of available and accessible LTPA-related facilities and resources in their neighborhoods, even if they existed. Future research should aim to assess environmental accessibility more accurately by considering the actual presence of LTPA-related facilities, through geographic information systems, along with perceived importance, subjective access, and individual awareness.

Based on the results of previous studies, older adults in rural areas tend to report lower levels of QoL compared to their urban counterparts, primarily due to poorer access to recreational facilities, limited availability of programs and activities, and unsafe environments for LTPA.<sup>20,51,52</sup> Furthermore, these less favorable environmental conditions associated with rural living significantly influence leisure opportunities, satisfaction with leisure time, and overall quality of life.<sup>21,22</sup> Therefore, future research should consider differences in the characteristics of residential area (i.e., urban, suburban, and rural) and their effects on LTPA and health among older adults. These efforts will more accurately inform policymakers and health professionals in developing strategies to create environments that support LTPA participation.

### Conclusions

A mixed-methods approach was used in this study to provide a comprehensive understanding of how perceived accessibility of LTPA-related facilities relates to LTPA engagement and QoL among older adults. Quantitative results demonstrated that greater perceived access to these resources was associated with higher levels of LTPA, which, in turn, predicted better QoL. Qualitative findings further underscored the importance of environmental supports in promoting LTPA participation among older adults and, thus, improving QoL across the lifespan. These findings emphasize the critical role of environmental supports in shaping health behaviors and health

outcomes among older adults. Efforts to increase public infrastructure investments, raise awareness of existing LTPA resources, and tailor interventions to different residential settings (urban, suburban, rural) may promote participation and, ultimately, enhance health and well-being in aging populations. Future studies employing longitudinal designs and objective measurements (e.g., accelerometers, GIS, etc.) are warranted to more robustly confirm the relationships identified in this study.

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#### Author contributions

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#### Data availability statement

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

#### Ethical approval

This study was approved by the Institutional Review Board of East Carolina University (UMCIRB 23-002594).

#### Consent for publication

Not applicable

#### Conflict of interests

The authors declare that they have no conflict of interests.

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