

Test-retest reliability of a self-reported physical activity environment instrument for use in rural settings

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Abstract

Objective: Little is known about how the physical environment impacts physical activity behaviour among rural populations, who are typically less active and at higher risk of chronic disease than urban dwellers. The lack of individual-level instruments to assess the physical environment in rural areas limits advancement of this field. Among rural adults, this study aimed to evaluate (a) the test-retest reliability of a self-reported questionnaire of individual-level perceptions of the physical activity environment, and (b) the stability of a self-reported physical activity questionnaire.

Design: Cross-sectional questionnaire repeated twice, 2 weeks apart. The questionnaire included 94 items relating to the perceived physical environment (representing nine summary scores), demographic characteristics and physical activity.

Setting: Rural Australia.

Participants: Rurally residing adults (≥ 18 years) across three Australian states.

Main outcome measures: Test-retest reliability evaluated by weighted Kappa statistics (individual items) and intra-class correlations (summary scores).

Results: A total of 292 participants (20% men) completed both questionnaires, on average 22 days apart. Test-retest reliability of individual items ranged from weighted Kappa 0.37-0.85 (median: 0.59). Internal reliability for five summary scores was good to excellent (Cronbach's alpha: 0.81-0.97). Test-retest reliability was good to excellent for six summary scores (intra-class correlations: 0.67-0.77).

Conclusions: The findings indicated good to excellent test-retest reliability for most items, particularly "fixed" constructs for this new questionnaire measuring the perceived physical environment in rural populations. This study represents an important step towards improving measurement of physical activity environments in rural populations, potentially leading to better tailored interventions to promote active and healthy living in rural areas.

KEYWORDS

epidemiologic methods, public health, rural population, surveys and questionnaires

1 | INTRODUCTION

Rural-dwelling adults are less active than urban-dwelling adults,¹ so understanding factors that influence physical activity (PA) in rural populations is important. In urban populations, numerous physical environmental features affect PA (eg accessible places for PA, design and functionality, safety, walkability, residential density, public transport and aesthetics).^{2,3} A systematic review found that associations between the environment and PA differed between rural and urban settings (eg sidewalks, parks and walkable destinations seem more important in urban compared with rural locations) and highlighted the need for rural specific measurement tools.⁴

Our rural Australian work identified that while many constructs considered important for PA in urban populations⁵ were similarly influential in rural areas, these were sometimes operationalised differently. For instance, in rural settings, issues related to “heavy traffic” involved large trucks on narrow and winding roads, rather than traffic density. Personal safety related to crime, walkability and aesthetics had less relevance than in urban areas.⁵ These findings emphasise the need to depart from use of urban-centric tools in rural environments.

Numerous self-measures of the physical environment exist,⁶⁻⁹ but these have been designed for use in urban environments. While the Rural Active Living Assessment/RALA audit tool¹⁰ was developed to assess environments in rural areas, it only measures the environment at the town/neighbourhood level. Because of a lack of appropriate self-reported PA environment measures designed specifically for non-urban areas, the relationship between the PA environment and PA behaviour in rural settings remains uncertain.⁴ To progress this field, reliable and valid self-report tools that assess the rural PA environment at the individual level, as well as PA, are necessary.⁴

The study objective was to assess the psychometric properties of a new questionnaire, the Physical Activity Environment-Rural/PAE-R, and determine the: (a) internal consistency of the PAE-R; (b) test-retest reliability of the PAE-R; and (c) stability of a modified version of the International PA Questionnaire (Short version, IPAQ-S).

2 | METHODS

The study is reported according to STROBE¹¹ guidelines for observational studies (Table S1).

2.1 | Sample

Adults (aged 18+) were recruited from rural areas in three Australian states (Tasmania, Victoria and South Australia).

What is already known on this subject:

- In urban populations, the physical environment influences physical activity levels
- The relationship between the physical environment and physical activity among rural populations remains unclear, because tools to measure this relationship are urban-centric

What this study adds:

- This study assesses the psychometric properties of a new self-administered questionnaire (the Physical Activity Environment-Rural) designed to assess the adult perceived rural physical activity environment.
- Better measurement of the rural physical activity environment is needed to aid decision-making regarding the creation of rural spaces and places that promote active living.

Recruitment occurred through purposive sampling techniques—advertisements in local amenities (eg convenience stores and community centres), through media outlets (eg newspapers, radio), social media (eg Facebook, Twitter), word of mouth and local networks. Inclusion criteria were an ability to read and understand English and be living outside a “Major City,” as defined by the Australian Bureau of Statistics' Australian Standard Geographical Classification.¹²

Potential participants were directed to the web-based participant information sheet and provided informed consent. At completion of the first online questionnaire (hosted by Survey Monkey), participants provided contact details. An email with a direct link to a second questionnaire was sent 2 weeks later. Email reminders with the questionnaire link were sent weekly thereafter for 3 weeks as required. All participants completing both questionnaires were eligible to enter a random prize draw (two \$100 credit card vouchers). Enrolment was open for a 3-month period (October to December 2016).

2.2 | Measures

The PAE-R questionnaire (available through direct request) was designed specifically for this study as a self-administered tool. This tool was largely based on three existing instruments designed for urban settings with established psychometric properties.⁶⁻⁸ The PAE-R also incorporated elements of the RALA, principles of the Australian Heart Foundation's Healthy by Design guidelines¹³ and context-specific modifications informed by our non-urban-based qualitative work (Table S2).¹⁴ The PAE-R consists of nine sections:

Your Locality (four items), Shops and Facilities (22 items), Recreation Spaces (18 items), Access to Services (six items), Streets and Roads (three items), Places for Walking and Cycling (14 items), Aesthetics (13 items), Road and Traffic Safety (seven items) and Personal Safety (seven items). Each section contained between three and 22 questions, with responses for six sections (Access to Services, Streets and Roads, Places for Walking and Cycling, Aesthetics, Road and Traffic Safety, Personal Safety) provided on 5-point Likert scales of agreement (“strongly disagree” to “strongly agree”; items negatively worded were reverse-scored). Your Locality responses were on a 5-point scale (none, a few, some, most and all), while responses for Shops and Facilities and Recreation Spaces were in time-based categories (0-5, 6-10, 11-20, 21-30, 31-60, >60 minutes or not applicable [this recreational facility is not available in my local area], don't know).

The IPAQ-S assessed past week minutes of walking and moderate and vigorous intensity PA.¹⁵ Because walking for leisure and transport are differentially associated with environmental constructs and are conceptually most closely linked to the PA environment in urban settings,^{16,17} IPAQ-S walking items were separated into walking for leisure or transport. The questionnaire collected demographic information: age, sex, pregnancy, country of birth, education, occupation status and type, marital status, family and household characteristics, motor vehicle access, language usually spoken at home and injury, illness or disability affecting PA behaviour, length of time at current address and area, and distance from nearest town. The questionnaire was designed for completion in 20 minutes.

2.3 | Analysis

Data were analysed using Stata software (version 12; StataCorp). Participant characteristics were summarised using means and standard deviations (SD) or median (25th and 75th percentiles; continuous variables), and numbers and proportions (categorical variables). Characteristics (from Questionnaire 1) of those who did and did not complete Questionnaire 2 were examined using chi-square tests (categorical variables) and Kruskal-Wallis equality-of-populations rank tests (non-normally distributed continuous PA variables) to compare the characteristics of those who did and did not complete a second questionnaire.

Weighted Kappa statistics¹⁸ ascertained reliability of responses to the first and second questionnaires for all 94 ordinal items individually. Landis and Koch guidelines were used to rate Kappa agreement of the point estimate as slight (0-0.20), fair (0.21-0.40), moderate (0.41-0.60), substantial (0.61-0.80) and almost perfect (0.81-1.0).¹⁹ Summary scores for each section were created according to the original

published protocols.⁶⁻⁸ Cronbach's alpha was calculated to assess the internal consistency of each summary score (except Your Locality which used a non-Likert response scale), and point estimates were rated as unacceptable (<0.50), poor (0.50-0.59), questionable (0.60-0.69), acceptable (0.70-0.79), good (0.80-0.89) and excellent (≥ 0.9).²⁰ One-way random effects intra-class correlation coefficients (ICC) for single-rater consistency²¹ determined reliability of summary scores and the stability of IPAQ-S measures of walking for transport, walking for leisure and total PA. The use of Cicchetti guidelines categorised ICC values as poor (<0.40), fair (0.40-0.59), good (0.60-0.74) and excellent (0.75-1.00).²² Some items (Table 2) were excluded from two summary scores because this improved both the scale's internal reliability (Cronbach's alpha) and retest reliability (ICC) by more than 10%.

We hypothesised a priori that more time between completion of questionnaires would reduce the strength of estimates. We therefore conducted sensitivity analyses by calculating weighted Kappas for each item and ICCs on summary scores stratified by average length of time between questionnaire completions (<3, ≥ 3 weeks).

2.4 | Ethics approval

Ethics approval (H0016048) was granted by the [University of Tasmania] Social Sciences Human Research Ethics Committee.

3 | RESULTS

A total of 447 people completed Questionnaire 1, of which 292 completed Questionnaire 2 (65%). Eleven participants took >2 hours to complete Questionnaire 1 and 30 took >2 hours to complete Questionnaire 2, possibly due to only completing some of the questionnaire and returning to complete it at a later time. The remaining participants took on average 23.8 (SD: 17.7) minutes to complete Questionnaire 1 and 19.0 (SD: 14.3) minutes to complete Questionnaire 2. Questionnaires were completed an average of 22 days apart.

Respondents were more commonly women (80%) and older adults (30% age 56+ years), although younger adults were represented (Table 1). The entire sample spoke English at home, more than 50% had a university/higher degree, and 73% were employed. Around one third had children ≤ 18 years living in the household, and around 25% had an injury, illness or disability restricting PA. Around 40% had lived at their current address more than 10 years, and just over half lived in or on the outskirts of a rural town. Those that completed Questionnaire 2 were more commonly retired and had higher education levels and were less commonly not in the labour force (unemployed, keeping house).

TABLE 1 Characteristics of the sample reported in Questionnaire 1

Characteristic	Questionnaire 1 Only	Questionnaire 1 and 2	<i>P</i> ^a
N (%)	447 (100)	292 (100)	—
Sex, n (%)			
Woman	358 (80.1)	232 (79.5)	.352
Man	89 (19.9)	60 (20.6)	
Age (y), n (%)			
18-35	102 (22.5)	56 (18.9)	.071
36-45	87 (19.2)	57 (19.3)	
46-55	130 (28.6)	87 (29.4)	
56+	135 (29.7)	96 (32.4)	
Pregnant (women only), n (%)	7 (2.0)	4 (1.8)	.673
English usually spoken at home, n (%)	447 (100)	296 (100)	n/a
Highest level of education ^b , n (%)			
Low	58 (12.9)	30 (10.2)	.044
Medium	143 (31.9)	92 (31.4)	
High	248 (55.2)	171 (58.4)	
Employment status, n (%)			
Full-time	61 (38.9)	121 (41.9)	<.001
Part-time	50 (31.9)	92 (31.1)	
Not in labour force	34 (21.7)	28 (9.5)	
Retired	12 (7.6)	52 (17.6)	
Marital status, n (%)			
Married/living as married	320 (70.8)	209 (70.1)	.920
Separated/divorced/Widowed	59 (13.1)	37 (12.6)	
Never married	73 (16.2)	48 (16.3)	
Number of children (<18 y) in household, n (%)			
None	291 (64.4)	201 (68.4)	.090
One	56 (12.4)	30 (10.2)	
Two	72 (15.9)	43 (14.6)	
Three or more	33 (7.3)	20 (6.8)	
Injury/illness restricting physical activity, n (%)	98 (21.7)	67 (22.7)	.466
Length of time at current address, n (%)			
<2 y	83 (18.3)	51 (17.2)	.125
2-5 y	98 (21.6)	67 (22.6)	
6-10 y	97 (21.4)	55 (18.9)	
>10 y	176 (38.8)	123 (41.6)	

(Continues)

TABLE 1 (Continued)

Characteristic	Questionnaire 1 Only	Questionnaire 1 and 2	<i>P</i> ^a
Distance from nearest town, n (%)			
Lives in town	196 (43.2)	127 (42.9)	.242
Lives on outskirts of town	66 (14.5)	37 (12.5)	
<5 km from nearest town	40 (8.8)	31 (10.5)	
5-10 km from nearest town	75 (16.6)	49 (16.6)	
11-20 km from nearest town	48 (10.6)	30 (10.1)	
>20 km from nearest town	29 (6.4)	22 (7.4)	
Physical activity, Median (25th, 75th percentile)			
Transport walking (min/wk)	60 (0, 180)	60 (0, 180)	.981
Leisure walking (min/wk)	85 (0, 210)	90 (0, 240)	.244
Total walking (min/wk)	195 (70, 420)	190 (80, 420)	.640
Moderate physical activity (min/wk)	120 (0, 270)	120 (30, 270)	.064
Vigorous physical activity (min/wk)	90 (0, 240)	90 (0, 225)	.431
Total physical activity (min/wk)	480 (245, 920)	480 (260, 855)	.368

^a*P*-values from chi-square tests for categorical variables and the Kruskal-Wallis equality-of-populations rank test for the non-normally distributed continuous physical activity variables.

^bLow: less than or equal to Year 12, medium: trade/apprenticeship/certificate/diploma, high: (Bachelor)/higher university degree (Masters, PhD).

Most individual items demonstrated either moderate (48/94; 51%) or substantial (39/94; 41.1%) agreement, while some demonstrated excellent (4/94; 4.3%) or fair (3/94; 3.2%) agreement (Table 2). The point estimates for Your Locality (0.51-0.59), Streets and Roads (0.41-0.56) and Aesthetics (0.45-0.56) items demonstrated moderate test-retest reliability, Shops and Facilities (0.64-0.85) had substantial or excellent test-retest reliability, Recreation Spaces (0.51-0.78) had mostly (15/18 items) substantial agreement, and Places for Walking and Cycling (0.43-0.75), Road and Traffic Safety (0.40-0.62) and Personal Safety (0.37-0.59) had mostly (6/7 items) moderate test-retest reliability. Point estimates for Access to Services were mixed (0.40-0.79), with three items demonstrating substantial agreement, two moderate and one fair. In sensitivity analyses when stratified by time between

TABLE 2 Test-retest reliability (weighted Kappas) of Physical Activity Environment-Rural (PAE-R) questionnaire items, for the whole sample and stratified by time between questionnaires

Section (n items)	Weighted Kappa (CI ^a)	Rating ^b	Weighted Kappa (<3 wk) (CI ^a)	Weighted Kappa (≥3 wk) (CI ^a)
A: Your Locality (4 items)				
N detached/stand-alone houses	0.51 (0.40, 0.60)	Moderate	0.51 (0.40, 0.63)	0.52 (0.36, 0.68)
N townhouses/units 1-3 stories	0.55 (0.47, 0.63)	Moderate	0.58 (0.47, 0.67)	0.48 (0.34, 0.61)
N blocks of flats/apartments 1-3 stories	0.59 (0.51, 0.68)	Moderate	0.66 (0.57, 0.75)	0.42 (0.27, 0.59)
N blocks of flats/apartments >3 stories	0.54 (0.23, 0.80)	Moderate	0.60 (0.21, 0.89)	0.38 (-0.03, 1.00)
B: Shops and Facilities (22 items)				
About how long would it take to walk from your home to the nearest businesses or facilities listed below?				
Convenience/corner shop (incl. deli/milk bar)	0.79 (0.74, 0.83)	Substantial	0.80 (0.75, 0.84)	0.77 (0.68, 0.85)
Supermarket	0.85 (0.81, 0.88)	Excellent	0.86 (0.81, 0.90)	0.83 (0.76, 0.89)
Independent food shops such as baker, butcher, fruit and vegetable shops	0.78 (0.73, 0.83)	Substantial	0.78 (0.72, 0.83)	0.80 (0.72, 0.87)
Farmers or produce market	0.65 (0.56, 0.72)	Substantial	0.64 (0.53, 0.72)	0.67 (0.51, 0.79)
Takeaway shop/fast food restaurant (eg fish and chips, McDonalds)	0.74 (0.69, 0.80)	Substantial	0.75 (0.68, 0.81)	0.72 (0.63, 0.81)
Café/restaurants	0.77 (0.72, 0.81)	Substantial	0.77 (0.71, 0.83)	0.75 (0.67, 0.83)
Post office	0.80 (0.76, 0.84)	Substantial	0.81 (0.75, 0.85)	0.79 (0.71, 0.86)
Library	0.83 (0.79, 0.87)	Excellent	0.84 (0.80, 0.88)	0.80 (0.72, 0.88)
Bank/credit union	0.78 (0.72, 0.73)	Substantial	0.82 (0.76, 0.87)	0.72 (0.60, 0.81)
Pharmacy/chemist	0.83 (0.79, 0.87)	Excellent	0.85 (0.80, 0.88)	0.80 (0.71, 0.87)
Doctor/general practice	0.78 (0.74, 0.82)	Substantial	0.80 (0.76, 0.85)	0.74 (0.65, 0.82)
Hairdresser/barber	0.79 (0.74, 0.83)	Substantial	0.81 (0.75, 0.85)	0.76 (0.66, 0.84)
Laundromat	0.82 (0.77, 0.86)	Excellent	0.82 (0.77, 0.87)	0.80 (0.72, 0.87)
Hardware shop	0.78 (0.73, 0.82)	Substantial	0.79 (0.73, 0.83)	0.75 (0.67, 0.83)
Clothing shop	0.76 (0.70, 0.81)	Substantial	0.77 (0.70, 0.82)	0.74 (0.63, 0.83)
Book shop	0.64 (0.56, 0.72)	Substantial	0.64 (0.55, 0.73)	0.63 (0.48, 0.77)
DVD/video library	0.68 (0.61, 0.74)	Substantial	0.69 (0.60, 0.78)	0.63 (0.47, 0.76)
Kindergarten/primary school	0.74 (0.69, 0.79)	Substantial	0.76 (0.70, 0.81)	0.71 (0.61, 0.80)
Secondary school/TAFE/Adult Education Centre	0.71 (0.65, 0.76)	Substantial	0.72 (0.66, 0.78)	0.67 (0.56, 0.80)
Your work/school	0.77 (0.71, 0.82)	Substantial	0.78 (0.71, 0.84)	0.75 (0.62, 0.84)
Any offices/workplaces	0.67 (0.62, 0.73)	Substantial	0.68 (0.61, 0.75)	0.65 (0.53, 0.75)
Pub	0.78 (0.73, 0.82)	Substantial	0.79 (0.72, 0.84)	0.74 (0.64, 0.82)
C: Recreations Spaces (18 items)				
About how long would it take to get from your home to the nearest recreational facilities listed below if you walked to them?				
Indoor recreation/exercise facility (public or private)	0.74 (0.69, 0.79)	Substantial	0.77 (0.71, 0.83)	0.68 (0.58, 0.78)
Beach/lake/river/creek	0.67 (0.61, 0.73)	Substantial	0.68 (0.60, 0.75)	0.66 (0.56, 0.76)
Cycling/walking/hiking trails/paths	0.66 (0.60, 0.72)	Substantial	0.67 (0.60, 0.74)	0.64 (0.51, 0.74)
Walking/running (athletics) track	0.57 (0.49, 0.64)	Moderate	0.56 (0.47, 0.65)	0.56 (0.43, 0.66)
Basketball/netball courts	0.70 (0.63, 0.75)	Substantial	0.68 (0.60, 0.75)	0.74 (0.65, 0.83)
Tennis courts	0.73 (0.68, 0.79)	Substantial	0.75 (0.69, 0.82)	0.70 (0.59, 0.79)
Football oval (Aussie rules)	0.76 (0.71, 0.80)	Substantial	0.77 (0.70, 0.82)	0.73 (0.65, 0.80)

(Continues)

TABLE 2 (Continued)

Section (n items)	Weighted Kappa (CI ^a)	Rating ^b	Weighted Kappa (<3 wk) (CI ^a)	Weighted Kappa (≥3 wk) (CI ^a)
Soccer ground	0.66 (0.60, 0.72)	Substantial	0.69 (0.62, 0.75)	0.60 (0.46, 0.74)
Hockey field	0.67 (0.59, 0.75)	Substantial	0.69 (0.60, 0.77)	0.62 (0.43, 0.77)
Softball/baseball ground	0.55 (0.43, 0.66)	Moderate	0.58 (0.46, 0.69)	0.47 (0.25, 0.67)
Bowling club	0.78 (0.72, 0.82)	Substantial	0.77 (0.70, 0.83)	0.78 (0.70, 0.85)
Swimming pool	0.74 (0.69, 0.80)	Substantial	0.76 (0.68, 0.82)	0.72 (0.63, 0.80)
School with recreational facilities open to the public	0.61 (0.53, 0.68)	Substantial	0.67 (0.60, 0.75)	0.46 (0.29, 0.61)
Public playground with play equipment	0.78 (0.73, 0.82)	Substantial	0.79 (0.73, 0.84)	0.75 (0.67, 0.83)
Park	0.72 (0.67, 0.78)	Substantial	0.73 (0.67, 0.79)	0.71 (0.60, 0.80)
Other public open space (including bush, state/national parks)	0.51 (0.44, 0.58)	Moderate	0.48 (0.38, 0.57)	0.56 (0.44, 0.67)
Community gardens	0.61 (0.53, 0.68)	Substantial	0.58 (0.48, 0.67)	0.67 (0.53, 0.78)
Church and community halls	0.71 (0.66, 0.74)	Substantial	0.68 (0.60, 0.74)	0.76 (0.67, 0.83)
D: Access to Services (6 items)				
Shops are within easy walking distance from my home	0.79 (0.74, 0.84)	Substantial	0.79 (0.72, 0.84)	0.79 (0.70, 0.88)
There are many places to go within easy walking distance of my home	0.64 (0.58, 0.70)	Substantial	0.65 (0.57, 0.72)	0.63 (0.51, 0.74)
From my home it is easy to walk to a bus stop and/or train station	0.72 (0.66, 0.77)	Substantial	0.74 (0.67, 0.81)	0.68 (0.58, 0.78)
There are major barriers to walking in the local area around my home that make it hard to get from place to place for example highways, railway lines/crossings, creeks/rivers ^c	0.40 (0.32, 0.47)	Fair	0.40 (0.30, 0.49)	0.39 (0.24, 0.55)
The streets/roads in the local area around my home are hilly, making it difficult to walk ^c	0.45 (0.37, 0.52)	Moderate	0.52 (0.43, 0.60)	0.30 (0.15, 0.44)
Parking is difficult in local shopping areas ^c	0.48 (0.39, 0.56)	Moderate	0.50 (0.42, 0.61)	0.44 (0.30, 0.59)
E: Streets and Roads (3 items)				
The distance between intersections in my local area is usually short (≤100 metres)	0.51 (0.43, 0.57)	Moderate	0.51 (0.42, 0.60)	0.49 (0.34, 0.62)
There are many alternative routes for getting from place to place in my local area (I don't have to go the same way every time)	0.56 (0.50, 0.64)	Moderate	0.63 (0.55, 0.71)	0.43 (0.30, 0.56)
The streets or roads in my local area do not have many cul-de-sacs (dead end streets) ^c	0.41 (0.33, 0.49)	Moderate	0.42 (0.33, 0.52)	0.38 (0.24, 0.52)
F: Places for Walking and Cycling (14 items)				
There are footpaths on most streets/roads in my local area	0.75 (0.69, 0.80)	Substantial	0.78 (0.71, 0.84)	0.69 (0.57, 0.78)
Footpaths are separated from the road/traffic in my local area by parked cars	0.47 (0.40, 0.54)	Moderate	0.44 (0.35, 0.52)	0.54 (0.40, 0.66)
There is a nature strip that separates the streets or roads from the footpath in my local area	0.62 (0.55, 0.68)	Substantial	0.61 (0.53, 0.68)	0.63 (0.52, 0.74)

(Continues)

TABLE 2 (Continued)

Section (n items)	Weighted Kappa (CI ^a)	Rating ^b	Weighted Kappa (<3 wk) (CI ^a)	Weighted Kappa (≥3 wk) (CI ^a)
There are footpaths and tracks in my local area that connect places so that you can walk from place to place	0.68 (0.62, 0.73)	Substantial	0.70 (0.63, 0.77)	0.63 (0.51, 0.74)
My local area offers many opportunities to be physically active	0.51 (0.43, 0.59)	Moderate	0.53 (0.44, 0.61)	0.48 (0.35, 0.61)
Local sports clubs and other facilities in my local area offer many opportunities to get exercise	0.54 (0.47, 0.61)	Moderate	0.59 (0.50, 0.66)	0.44 (0.29, 0.56)
It is pleasant to walk in my local area	0.54 (0.46, 0.62)	Moderate	0.53 (0.44, 0.62)	0.55 (0.43, 0.70)
In my local area it is easy to walk places	0.59 (0.52, 0.65)	Moderate	0.58 (0.49, 0.65)	0.60 (0.49, 0.72)
My local area has heavy traffic	0.52 (0.45, 0.59)	Moderate	0.53 (0.45, 0.61)	0.50 (0.35, 0.63)
There are busy roads to cross when out for walks in my local area	0.46 (0.38, 0.53)	Moderate	0.46 (0.37, 0.54)	0.43 (0.31, 0.57)
The footpaths and walking paths are well kept and not uneven in my local area	0.43 (0.35, 0.52)	Moderate	0.45 (0.35, 0.54)	0.40 (0.26, 0.53)
There is good signage clearly marking walking and cycling tracks in my local area	0.57 (0.51, 0.63)	Moderate	0.55 (0.48, 0.62)	0.59 (0.48, 0.69)
There is easy access to footpaths and tracks for all levels of mobility (including prams, wheel chairs, mobility scooters and walking frames) in my local area	0.60 (0.54, 0.66)	Moderate	0.58 (0.61, 0.67)	0.63 (0.51, 0.73)
The trees in my local area provide enough shade	0.44 (0.36, 0.51)	Moderate	0.43 (0.34, 0.52)	0.44 (0.31, 0.56)
G: Aesthetics (13 items)				
There are trees along the streets and roads in my local area	0.46 (0.38, 0.54)	Moderate	0.45 (0.35, 0.54)	0.47 (0.35, 0.63)
There are many interesting things to look at while walking or cycling in my local area	0.46 (0.38, 0.64)	Moderate	0.46 (0.35, 0.56)	0.45 (0.32, 0.58)
There are many attractive natural sights in my town or local area (such as views, landscaping, gardens, parks)	0.56 (0.48, 0.63)	Moderate	0.56 (0.45, 0.64)	0.54 (0.42, 0.65)
There are attractive buildings/homes in my local area that are nice to look at	0.47 (0.40, 0.55)	Moderate	0.47 (0.37, 0.56)	0.46 (0.33, 0.59)
There is a lot of rubbish on the streets in my local area	0.49 (0.40, 0.56)	Moderate	0.52 (0.42, 0.61)	0.42 (0.27, 0.58)
There is a lot of noise in my local area	0.45 (0.37, 0.54)	Moderate	0.41 (0.32, 0.50)	0.54 (0.39, 0.67)
I often see other people walking or cycling in my local area	0.56 (0.49, 0.63)	Moderate	0.57 (0.48, 0.64)	0.54 (0.41, 0.66)
The buildings and houses in my local area are interesting	0.49 (0.41, 0.55)	Moderate	0.51 (0.43, 0.61)	0.42 (0.29, 0.55)
My local area is attractive	0.56 (0.49, 0.64)	Moderate	0.55 (0.46, 0.64)	0.59 (0.45, 0.73)
There are interesting things to do in my local area	0.51 (0.44, 0.58)	Moderate	0.54 (0.45, 0.62)	0.45 (0.31, 0.59)
Outdoor exercise areas in my local area have public toilets/ change facilities	0.53 (0.46, 0.60)	Moderate	0.53 (0.45, 0.61)	0.53 (0.39, 0.64)

(Continues)

TABLE 2 (Continued)

Section (n items)	Weighted Kappa (CI ^a)	Rating ^b	Weighted Kappa (<3 wk) (CI ^a)	Weighted Kappa (≥3 wk) (CI ^a)
Outdoor exercise areas in my local area have drinking fountains	0.53 (0.46, 0.60)	Moderate	0.55 (0.46, 0.63)	0.48 (0.31, 0.60)
There is adequate seating in the parks and along walking paths in my local area	0.54 (0.48, 0.61)	Moderate	0.56 (0.48, 0.64)	0.51 (0.40, 0.62)
H: Road and Traffic Safety (7 items)				
There is so much traffic along nearby streets or roads that it makes it difficult or unpleasant to walk in my local area	0.52 (0.44, 0.60)	Moderate	0.53 (0.44, 0.61)	0.50 (0.31, 0.64)
The speed of traffic on most nearby streets or roads is usually slow (50km/h or less)	0.59 (0.53, 0.65)	Moderate	0.61 (0.53, 0.69)	0.54 (0.42, 0.66)
Most drivers exceed the posted speed limits while driving in my local area	0.40 (0.32, 0.47)	Fair	0.43 (0.33, 0.51)	0.31 (0.16, 0.43)
Streets or roads in my local area are well lit at night	0.62 (0.56, 0.69)	Moderate	0.63 (0.55, 0.71)	0.61 (0.49, 0.72)
Walkers and cyclists on the streets or roads in my local area can be easily seen by people in their homes	0.45 (0.38, 0.52)	Moderate	0.47 (0.39, 0.56)	0.40 (0.26, 0.52)
There are pedestrian crossings and/or traffic lights to help walkers cross busy streets or roads in my local area	0.56 (0.49, 0.63)	Moderate	0.60 (0.53, 0.68)	0.48 (0.33, 0.61)
On the roads in my local area there are a lot of trucks	0.53 (0.46, 0.60)	Moderate	0.58 (0.51, 0.66)	0.42 (0.30, 0.56)
I: Personal Safety (7 items)				
There is a high crime rate in my local area	0.59 (0.52, 0.66)	Moderate	0.65 (0.58, 0.73)	0.48 (0.32, 0.61)
The crime rate in my local area makes it unsafe to go on walks during the day ^c	0.42 (0.32, 0.52)	Moderate	0.46 (0.33, 0.57)	0.34 (0.19, 0.50)
The crime rate in my local area makes it unsafe to go on walks at night	0.59 (0.52, 0.66)	Moderate	0.63 (0.56, 0.70)	0.51 (0.35, 0.64)
I feel safe walking in my local area, day or night ^c	0.49 (0.42, 0.57)	Moderate	0.49 (0.40, 0.58)	0.48 (0.35, 0.63)
Violence is not a problem in my local area ^c	0.37 (0.28, 0.45)	Fair	0.41 (0.31, 0.51)	0.28 (0.13, 0.43)
My local area is safe from crime	0.51 (0.44, 0.59)	Moderate	0.55 (0.44, 0.63)	0.43 (0.29, 0.57)
When walking or cycling in my local area I have to be aware of natural hazards (eg falling branches, snakes, swooping magpies/plovers) ^c	0.48 (0.40, 0.55)	Moderate	0.48 (0.39, 0.57)	0.47 (0.33, 0.61)

^a95% confidence interval (CI) calculated using a bootstrap method.²⁶

^bAgreement of the point estimate rated as: slight (0-0.20), fair (0.21-0.40), moderate (0.41-0.60), substantial (0.61-0.80) and almost perfect (excellent; 0.81-1.0).¹⁹

^cItem was dropped to improve the internal consistency of the summary score.

first and second questionnaire completions, just over half (53.2%) of the items demonstrated higher agreement when questionnaires were completed <3 weeks apart, although of these, the magnitude of the difference was very modest, with a difference of ≥0.1 noted for only eight items (8.5%). Point estimates of agreement were better for 78% of items when questionnaires were completed <3 weeks apart. These differences were small in magnitude, with only 16% of these items showing a difference >0.1.

The point estimates for internal consistency (Cronbach's alpha) were excellent for Shops and Facilities (0.97) and Recreation Spaces (0.92), good for Places for Walking and Cycling (0.87-0.88), Aesthetics (0.82-0.83) and Personal Safety (0.80-0.81), acceptable for Road and Traffic Safety (0.72-0.77), questionable/acceptable for Access to Services (0.68-0.71) and unacceptable for Streets and Roads (0.38-0.43; Table 3). Test-retest reliability (ICC) was excellent for Shops and Facilities (0.77) and Places for Walking and

TABLE 3 Internal consistency (Cronbach's alpha^a) and test-retest reliability (ICC^b) of Physical Activity Environment-Rural (PAE-R) questionnaire items, for the whole sample and stratified by time between questionnaires (<3 wk vs ≥3 wk)

Section (n items)	Cronbach's alpha ^a (CI ^c)		ICC ^b (CI)			
	Questionnaire		All	Time Between Surveys		
	1	2		Rating	<3 wk	≥3 wk
A: Your Locality (4 items)	n/a	n/a	n/a	0.51 (0.23, 0.79)	Fair 0.60 (0.33, 0.86)	0.35 (0.04, 0.66)
B: Shops and Facilities (22 items)	0.97 (≥0.97)	0.97 (≥0.97)	Excellent	0.77 (0.58, 0.97)	Excellent 0.81 (0.63, 0.99)	0.69 (0.44, 0.95)
C: Recreations Spaces (18 items)	0.92 (≥0.91)	0.92 (≥0.91)	Excellent	0.73 (0.54, 0.92)	Good 0.80 (0.64, 0.96)	0.59 (0.33, 0.86)
D: Access to Services (3 items)	0.68 (≥0.64)	0.71 (≥0.66)	Questionable/Acceptable	0.69 (0.55, 0.84)	Good 0.75 (0.61, 0.88)	0.54 (0.33, 0.76)
E: Streets and Roads (2 items)	0.42 (≥0.34)	0.38 (≥0.28)	Unacceptable	0.43 (0.19, 0.67)	Fair 0.43 (0.18, 0.68)	0.43 (0.15, 0.70)
F: Places for Walking and Cycling (14 items)	0.87 (≥0.86)	0.88 (≥0.86)	Good	0.76 (0.67, 0.85)	Excellent 0.75 (0.64, 0.85)	0.80 (0.68, 0.91)
G: Aesthetics (13 items)	0.83 (≥0.81)	0.82 (≥0.79)	Good	0.66 (0.52, 0.79)	Good 0.70 (0.57, 0.83)	0.62 (0.43, 0.80)
H: Road and Traffic Safety (7 items)	0.72 (≥0.68)	0.77 (≥0.74)	Acceptable	0.67 (0.52, 0.82)	Good 0.70 (0.56, 0.85)	0.55 (0.34, 0.77)
I: Personal Safety (7 items)	0.81 (≥0.79)	0.80 (≥0.77)	Good	0.56 (0.38, 0.75)	Fair 0.62 (0.44, 0.80)	0.41 (0.17, 0.66)

Abbreviation: CI, 95% confidence interval.

^aInternal consistency (Cronbach's alpha) of the point estimate rated as unacceptable (<0.5), poor (0.50-0.59), questionable (0.60-0.69), acceptable (0.70-0.79), good (0.80-0.89) and excellent (≥0.90).²⁷

^bTest-retest reliability (ICC) rated as poor (<0.40), fair (0.40-0.59), good (0.60-0.74) and excellent (0.75-1.00).²²

^cOne-sided 95% confidence interval (lower limit) for Cronbach's alpha.²⁸

TABLE 4 Stability (ICC^a) of physical activity items from the IPAQ-S

Section	ICC ^a (95% CI)			
	All	Rating	<3 wk	≥3 wk
Transport walking (min/wk)	0.53 (0.31, 0.74)	Fair	0.64 (0.43, 0.85)	0.30 (0.03, 0.56)
Leisure walking (min/wk)	0.35 (0.14, 0.56)	Poor	0.28 (0.07, 0.50)	0.54 (0.29, 0.79)
Total walking (min/wk)	0.51 (0.36, 0.66)	Fair	0.55 (0.39, 0.71)	0.81 (0.69, 0.93)
Moderate physical activity (min/wk)	0.26 (0.09, 0.43)	Poor	0.33 (0.13, 0.54)	0.10 (0.00, 0.32)
Vigorous physical activity (min/wk)	0.36 (0.14, 0.58)	Poor	0.53 (0.29, 0.77)	0.12 (0.00, 0.36)
Total PA (min/wk)	0.61 (0.49, 0.72)	Good	0.70 (0.59, 0.82)	0.37 (0.00, 0.77)

Abbreviations: CI, 95% confidence interval; ICC, intra-class correlation; IPAQ-S, International Physical Activity Questionnaire, Short version; PA, physical activity.

^aStability of the point estimate rated as poor (<0.40), fair (0.40-0.59), good (0.60-0.74) and excellent (0.75-1.00).²²

Cycling (0.76), good for Recreation Spaces (0.73), Access to Services (0.69), Aesthetics (0.66) and Road and Traffic Safety (0.67), fair for Your Locality (0.51) and Personal Safety (0.56), and poor for Streets and Roads (0.43). Seven of the nine summary scores improved when restricted to those completing questionnaires <3 weeks apart, while two remained the same.

The point estimates for stability of domain-specific PA items were poor to fair (0.26-0.53) but good for total PA (0.61; Table 4). In sensitivity analyses, stability improved for transport-related walking, total walking, moderate PA, vigorous PA and total PA when questionnaires were completed <3 weeks apart, but worsened for leisure-related walking and total walking.

4 | DISCUSSION

This study examined the psychometric properties of a self-administered questionnaire (the PAE-R) designed to assess the adult perceived rural PA environment. Individual PAE-R items were reliable, with 97% demonstrating at least moderate agreement (weighted Kappa values ≥0.41) and 46% demonstrating at least substantial agreement (weighted Kappa values ≥0.61) between questionnaire administrations. Internal consistency of summary scores was at least acceptable (Cronbach's alpha ≥0.70) for eight sections. Out of nine summary scores, test-retest reliability was excellent for two,

good for four and fair for three. Domain-specific PA stability was fair to poor, and good for total PA. Stability improved for most PA items when questionnaires were completed <3 weeks apart.

Except for Streets and Roads, summary scores focused on fixed environmental features tended to demonstrate better test-retest reliability. For example, Shops and Facilities and Places for Walking and Cycling demonstrated excellent test-retest reliability (ICC ≥ 0.75), while Personal Safety had fair test-retest reliability (ICC, 0.40-0.59). The poor performance of Streets and Roads might be because of questionable salience about intersections, alternative routes and cul-de-sacs. Perceptions of personal safety might be more volatile than perceptions of fixed environmental features. The presence or absence of fixed environmental features (eg shops, services, walking tracks) is unlikely to change in the short-term.

While stability of total PA from the IPAQ-S was good (ICC = 0.61), ICCs for walking were fair or poor (ICCs ≤ 0.53), suggesting cautious use of domain-specific IPAQ-S measures of PA in rural populations. The ICCs for context-specific walking seen in this study were generally weaker than that observed previously, although this has only been examined in urban samples. For example, the ICCs observed in the current study for transport-related walking were weaker overall (ICC = 0.53) but similar when duration between surveys was shorter (ICC < 3 weeks apart 0.64) to that of the Neighbourhood Adapted International PA

Questionnaire (N-IPAQ; ICC, 0.64)²³ and weaker than that observed in the Neighbourhood PA Questionnaire (NPAQ)²⁴ (ICC, 0.84-0.96 for those reporting walking). The ICCs observed in the current study for leisure-time walking (0.28-0.54) were weaker than that observed for both the N-IPAQ (0.69) and the NPAQ (0.55-0.92). These differences might be due to many factors, including the use of urban samples in the N-IPAQ and NPAQ studies, the shorter period of time between survey administrations in the N-IPAQ and NPAQ (7 days) or the specific focus on walking inside the neighbourhood in the N-IPAQ and NPAQ (unlike the current study which did not specify where walking occurred).

This study had limitations. The non-probability sampling approach means the generalisability of the findings is unknown. Self-report instruments are prone to recall bias, which might be influenced by uncontrollable factors (eg weather conditions). Those frequently accessing services or facilities might have more accurate recall. Although the questionnaire was based on existing measures and designed to be as inclusive as possible, there were some omissions (eg cricket or rugby fields), some items might no longer be relevant (eg DVD/video library), and some items lack specific details (eg "There is a lot of noise in my local area" does not enable an understanding of the type of noise). While there is debate over the relative importance of perceived vs objective environment measures,²⁵ this debate has largely focused on urban settings and the implications in rural settings are unclear.

This study fills a research gap through the psychometric testing of an instrument designed to assess perceptions of rural PA environments. The PAE-R was developed from existing urban-based instruments⁶⁻⁸ but refined according to our qualitative work^{5,14} to reflect the uniqueness of rural areas and ensure appropriateness and relevance of terminology and concepts.

5 | CONCLUSION

The PAE-R can be used, but with some caution. Six of nine summary scores demonstrated good to excellent test-retest reliability, three summary scores demonstrated fair reliability, and most individual items demonstrated at least moderate agreement. This study is an important step towards better measurement of the rural PA environment. Improved measurement is needed to provide stakeholders with better evidence to facilitate spaces and places that encourage active lifestyles.

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DISCLOSURES

The authors have no disclosures to make.

AUTHORS CONTRIBUTION

VC conceptualised and designed the study, analysed the data, interpreted the findings and developed the manuscript. AT designed the study, interpreted the findings and critically reviewed the manuscript. MS analysed the data, interpreted the findings and critically reviewed the manuscript. JD designed the study, interpreted the findings and critically reviewed the manuscript.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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