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Perceived walkability and pedestrian environmental stress in Mazatlán: Preliminary psychometric properties of a scale

Caminabilidad percibida y estrés ambiental del peatón en Mazatlán: propiedades psicométricas preliminares de una escala

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ABSTRACT

Walking is the most basic way of moving through the city, and its quality depends on street conditions and on the tension pedestrians experience along the route. This instrumental, cross-sectional and exploratory study examined the preliminary psychometric properties of a ten-item scale with two dimensions, walking conditions and tension while walking, administered in the pilot survey of project FZ-HAB-0010 of the Factoriza UAS platform among adults who usually walk along an urban segment of Mazatlán, Mexico. A preliminary cut of 13 cases, out of a target of 100, was analyzed with descriptive statistics, Cronbach's alpha, item analysis, Pearson inter-item correlations, exploratory factor analysis with parallel analysis, and a Spearman correlation between dimensions. All walking-condition items had means below the scale midpoint, and shade obtained the lowest mean (M = 2.38). Internal consistency was low (α = .469 and .322), and omega could not be interpreted because sidewalk continuity, obstacles, perceived traffic danger and exhaustion contributed little to their dimensions. Sampling adequacy was very low (KMO = .295); parallel analysis suggested one bipolar factor on which favorable conditions and tension loaded in opposite directions. Walking conditions and tension were negatively correlated, ρ = -.621, with a confidence interval that excluded zero. These results document the initial functioning of the items and must be re-examined with the final data cut.

Keywords: perceived walkability; pedestrian stress; urban habitability; psychometric properties

RESUMEN

Caminar es la forma más elemental de moverse por la ciudad, y su calidad depende de las condiciones de la calle y de la tensión que el peatón experimenta durante el recorrido. Este estudio instrumental, transversal y exploratorio examinó las propiedades psicométricas preliminares de una escala de diez reactivos, con dos dimensiones, Condiciones para caminar y Tensión al caminar, aplicada en el levantamiento piloto del proyecto FZ-HAB-0010 de Factoriza UAS a personas adultas que caminan habitualmente por un tramo urbano de Mazatlán. Se analizó un corte preliminar de 13 casos, de una meta de 100, con estadísticos descriptivos, alfa de Cronbach, análisis de reactivos, correlaciones de Pearson entre reactivos, análisis factorial exploratorio con análisis paralelo y correlación de Spearman entre dimensiones. Todos los reactivos de condiciones tuvieron medias inferiores al punto medio, y la sombra obtuvo la media más baja (M = 2.38). La consistencia interna fue baja (α = .469 y .322), y el omega no fue interpretable porque la continuidad de las banquetas, los obstáculos, el peligro percibido por el tráfico y el agotamiento contribuyeron poco a su dimensión. La adecuación muestral fue muy baja (KMO = .295); el análisis paralelo sugirió un factor bipolar en el que las condiciones favorables y la tensión cargaron en sentidos opuestos. Las condiciones para caminar y la tensión se correlacionaron en negativo, ρ = -.621, con un intervalo de confianza que excluyó el cero. Estos resultados documentan el funcionamiento inicial de los reactivos y deben revisarse con el corte final.

Palabras clave: caminabilidad percibida; estrés del peatón; habitabilidad urbana; propiedades psicométricas

INTRODUCTION

Walking is the most basic way of moving around the city and, for a substantial part of the population, the only one available or the one that connects to public transport. The experience of walking depends on street conditions: on sidewalks that are continuous and free of obstacles, on shade, on safe crossings, and on traffic and noise not turning the journey into a source of stress.

Walkability, understood as the extent to which the urban environment supports travel on foot, is therefore a dimension of urban livability that is experienced bodily, stretch by stretch.

Research on the urban environment and health has linked walkability to various outcomes. A systematic review of 112 studies found that physical neighborhood characteristics, including walkability, were associated with lower levels of loneliness, and that subjective perceptions of the neighborhood generally showed stronger associations than objective measures (Schepers et al., 2025).

The evidence on mental health is less conclusive: in a review of the moderation of neighborhood socioeconomic inequalities, findings on walkability were inconsistent, and the authors suggested that they might reflect unmeasured factors such as safety and environmental quality (Reid et al., 2026). These results indicate that what matters for well-being is not only the availability of pedestrian infrastructure, but also how people experience it.

In Latin America, walking entails risks that research has clearly documented. In Bogotá, pedestrians accounted for approximately 25% of people injured and 50% of those killed in traffic between 2015 and 2019, and neighborhoods with more street trees, traffic lights, and bus stops were associated with lower pedestrian mortality (Zewdie et al., 2024).

In Guadalajara, observation of 1018 pedestrian crossings showed that 14.0 % of pedestrians combined two or more risky behaviors, and that this accumulation was associated with the number of traffic directions, the presence of curbs, and the absence of traffic lights (Del Moral-Trinidad et al., 2026).

Heat adds a further burden: across 272 cities in six Latin American countries, the risk of traffic-related mortality increased on extremely hot days, with higher risks in cities with warmer climates (Hsu et al., 2025).

Mazatlán combines several of these conditions. It is a city with a warm climate that is undergoing an urban transformation associated with tourism: the boom in high-rise construction aimed at tourism and second homes has generated social tensions and placed pressure on the infrastructure of the coastal strip (Bojorquez Luque et al., 2023). Recent studies also describe touristification processes with sociocultural impacts on the local population (Mendieta Vega and Roldán Clarà, 2024).

In this context, the conditions under which residents walk and the stress they experience while doing so are aspects of livability that warrant measurement from the perspective of those who move through the city on foot.

The most widely used perceived walkability instruments focus on neighborhood attributes and their relationship with physical activity. In Chile, the abbreviated version of the Neighborhood Environment Walkability Scale showed that greater perceived traffic safety was associated with more transport-related and leisure-time physical activity (Kloss et al., 2025). In the Balearic Islands, a questionnaire on perceived urban walkability administered on healthy routes achieved an internal consistency of 0.8 across all its sections (Artigues et al., 2020).

However, these instruments rarely capture both the conditions of a specific street segment and the stress that pedestrians experience while walking along it, and none has been examined in a coastal city in northwestern Mexico.

To this end, project FZ-HAB-0010 of the Factoriza UAS platform designed a ten-item scale organized into two dimensions: Walking Conditions and Walking Tension. The project's current title in Factoriza, which this article adopts, refers to perceived walkability and pedestrian environmental stress. Environmental stress is addressed here through the tension that people report while walking along the segment, rather than through physiological indicators.

With a preliminary sample of 13 cases, this study can offer no more than an initial body of evidence on how the scale functions, which is why its title refers to preliminary psychometric properties.

The overall aim was to examine the preliminary psychometric properties of the perceived walkability and pedestrian stress scale among people who habitually walk along an urban stretch of Mazatlán.

The specific objectives were: (a) to describe the distribution of responses to each item; (b) to estimate the internal consistency of each dimension using Cronbach's alpha and, where

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interpretable, McDonald's omega, and to analyze the contribution of each item; (c) to explore the internal structure of the item set through exploratory factor analysis; and (d) to estimate the relationship between walking conditions and walking strain. The project did not state any hypotheses, so the study is framed as exploratory.

DEVELOPMENT

OBJECTIVE WALKABILITY AND PERCEIVED WALKABILITY

Walkability has been measured in two ways. The first, objective walkability, combines indicators of the built environment, such as density, land-use mix, street connectivity and pedestrian infrastructure. The second, perceived walkability, records how people rate those same attributes and others that objective indicators do not capture, such as safety or aesthetics. The two do not necessarily coincide, and evidence on well-being suggests that perceptions may be more informative than objective measures (Schepers et al., 2025).

In the Gulf countries, a review of 79 studies found positive associations between neighborhood accessibility and physical activity, walkability, and quality of life, and identified car-oriented urban development and extreme heat as contextual factors (Janahi et al., 2026).

Perceived walkability questionnaires are usually organized into thematic blocks. The urban walkability perception questionnaire administered in the Balearic Islands assessed pedestrian facilities, the infrastructure of the surrounding environment, perceived safety and an overall opinion. It found that the safety and pedestrian facility items were the most strongly related to the final rating, whereas the items on noise and traffic density had the lowest coefficients (Artigues et al., 2020).

This result foreshadows an issue relevant at the project scale: not all attributes of the street segment contribute equally to the overall assessment of the walking experience.

STREET CONDITIONS IN LATIN AMERICAN CITIES

In Latin American cities, sidewalk quality and road safety are recurring barriers to walking. In Bogotá, unpaid caregivers identified poor-quality or absent sidewalks, limited personal safety, and the risk of being struck by a vehicle as barriers to accessing an urban care program (Guevara-Aladino et al., 2024). In the baseline assessment of a green corridor in the same city, 66 participants in a citizen science exercise documented through 1123 photo-narratives that deficient pedestrian infrastructure and safety concerns were the most frequently mentioned barriers (Gómez-García et al., 2026).

In Guadalajara, road characteristics were associated with the accumulation of risk behaviors among pedestrians crossing the street (Del Moral-Trinidad et al., 2026).

These conditions are not randomly distributed. Sidewalk continuity, the absence of obstacles that force pedestrians to step down into the street, and the safety of crossings depend on the design and maintenance of public space, and their absence exposes pedestrians to traffic. In Bogotá, the presence of street trees, traffic lights, and bus stops was associated with lower pedestrian mortality, whereas a higher density of wide roads was associated with more pedestrian injuries (Zewdie et al., 2024).

The project's scale captures these conditions through items on sidewalk continuity, the possibility of walking without stepping down into the street, obstacles that force pedestrians to detour, and the safety of crossings.

HEAT AND SHADE ALONG THE PEDESTRIAN ROUTE

In hot cities, shade is a condition for walkability. In an experiment on route choice in a tropical city, distance walked in the shade was discounted by a factor of 0.86 relative to distance walked in the sun, and shade cast by buildings had a stronger effect than shade from trees (Melnikov et al., 2022).

The temperature of the surfaces pedestrians walk on varies at a fine scale, mainly because of instantaneous shade, so cooling metrics derived from satellite imagery may overestimate the effective benefit of shade at street level (Stumpe et al., 2026). In the open spaces of university campuses, tree shade was identified as the most important factor for thermal comfort in summer

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(Ding et al., 2023).

In Austin, Texas, tree cover around bus stops was associated with a smaller decline in ridership during high temperatures (Lanza and Durand, 2021).

Heat is not only a matter of comfort. A systematic review and meta-analysis of 88 studies found that heatwaves and extremely high temperatures were associated with a higher risk of mental and behavioral disorders (Li et al., 2023). In Latin American cities, the relationship between heat and traffic mortality (Hsu et al., 2025) suggests that, for pedestrians, exposure to the sun and exposure to traffic combine.

The project's scale includes an item on shade along the route segment and another on exhaustion upon finishing the walk, which, in a hot city, may reflect both exertion and heat exposure.

PEDESTRIAN STRAIN AS ENVIRONMENTAL STRESS

Pedestrian environmental stress refers to responses of strain, alertness or discomfort experienced in the street environment. Studies using physiological measurements have shown that these responses are associated with specific route characteristics.

In Perugia, Italy, fourteen older adults walked five routes wearing portable devices: streets that were narrower relative to their height and higher concentrations of nitrogen dioxide and particulate matter were associated with poorer perceived air quality and with changes in skin conductance and emotional indicators, whereas a higher visible greenery index was associated with more relaxed states (Mahia et al., 2026).

Traffic noise is part of that experience: in a tourist city in Bangladesh, more than 95% of the 675 people surveyed perceived an increase in noise during the peak season, and most reported annoyance and headaches (Nath et al., 2024).

Walking stress can be understood as the affective component of walkability: the flip side of street conditions. A systematic review of 45 observational studies on commuting found that long commutes and congestion were consistently associated with lower satisfaction and well-being (Liu et al., 2022). In Chile, perceived road safety was associated with more transport-related physical activity (Kloss et al., 2025).

The project's scale captures this tension through items on nervousness, perceived traffic danger, discomfort from vehicle noise, calmness while walking, and exhaustion upon completing the trip.

SCALE-BASED MEASUREMENT

The internal consistency of each dimension is usually estimated with Cronbach's alpha (Cronbach, 1951), which assumes equivalent loadings across items, and with McDonald's omega (McDonald, 1999/2013), which does not; simulation studies have compared how the two coefficients perform under different data conditions (Malkewitz et al., 2023).

Internal structure is examined through exploratory factor analysis. Current recommendations for this analysis call for first verifying the adequacy of the data, including at the item level, determining the number of factors with procedures such as parallel analysis, and treating cutoff values as guidelines rather than rules (Ferrando et al., 2022; Goretzko et al., 2021; Lorenzo-Seva and Ferrando, 2021).

Scales with positively and negatively worded items may show wording-related biases, because some respondents respond inconsistently to the positive and negative items of the same dimension (Steinmann et al., 2022). Identifying these responses can reduce such biases (García-Batista et al., 2021).

METHODOLOGY

DESIGN

An instrumental study with a quantitative approach, a cross-sectional design and an exploratory scope was conducted to examine the preliminary psychometric properties of a scale. Because the design was cross-sectional, the relationships reported are associations and do not allow causal inferences.

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POPULATION, SAMPLE, AND DATA CUTOFF

The data come from the survey "Piloto Mazatlán · Caminabilidad y estrés del peatón" [Mazatlán Pilot · Walkability and Pedestrian Stress] (LEV-0015) of project FZ-HAB-0010 on the Factoriza UAS platform, and from the frozen dataset DST-0044, with a cutoff date of 16 October 2026. The survey population consists of people aged 18 years or older who habitually walk along the study segment in Mazatlán, Sinaloa, an urban segment selected by the project lead.

Table 1 shows the composition of the sample. A total of 26 people opened the questionnaire and 13 completed it; no cases were excluded by the platform's quality control, and 13 cases with 10 items were analyzed. This is a preliminary data cut: n = 13 out of a target of 100, with data collection still open. The results reported in this article describe this cut and should not be taken as definitive; the analysis will need to be repeated with the final data cut.

Table 1. Sample composition.

Indicator	Value
People who opened the questionnaire	26
Completed questionnaires	13
Cases excluded by quality control	0
Cases analyzed	13
Items	10

Note. Survey "Piloto Mazatlán · Caminabilidad y estrés del peatón" [Mazatlán Pilot · Walkability and Pedestrian Stress] (LEV-0015); population: people aged 18 years or older who regularly walk along the study segment in Mazatlán; area: Mazatlán, Sinaloa, an urban segment selected by the project lead. Dataset DST-0044, fingerprint 3d2458bf3c6f25f5. Source: Factoriza UAS. Preliminary cut-off: n = 13 of a target of 100, with data collection still open.

INSTRUMENT

The scale consists of ten items with a 5-point response format, ranging from Strongly disagree to Strongly agree, organized into two dimensions of five items each. Walking conditions (R1 to R5) assesses the continuity of sidewalks, the possibility of walking without stepping down into the street, shade along the route segment, obstacles that force pedestrians to detour, and the safety of crossings.

Tension while walking (R6 to R10) addresses nervousness when walking along the segment, perceived danger from traffic, discomfort due to vehicle noise, calmness while walking, and exhaustion at the end of the walk. Two items (R4 and R9) are reverse-worded relative to their dimension and are recoded in the data matrix. Thus, in Conditions a high score indicates favorable conditions, and in Tension a high score indicates greater tension, so a negative relationship between the two dimensions is expected. Table 2 presents the wording of each item.

Table 2. Structure of the instrument.

Code	Item	Reverse
R1	The sidewalks along the stretch where I walk are continuous	No
R2	I can walk along this stretch without stepping down into the street	No
R3	There is shade along the stretch where I walk	No
R4	Obstacles on the sidewalk force me to go around them	Yes
R5	Crossing the streets along this section is safe for pedestrians	No
R6	Walking along this stretch makes me nervous	No
R7	The traffic on this road section makes me feel unsafe	No
R8	Vehicle noise bothers me when I walk	No
R9	I walk calmly along this stretch	Yes
R10	After walking along this section, I feel exhausted	No

Note. R1 to R5 = Walking conditions; R6 to R10 = Walking stress. The dimension column is omitted to preserve table readability. 5-point response scale (Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree). Reverse-scored items have already been recoded in the matrix provided. Source: Factoriza UAS, project FZ-HAB-0010, survey LEV-0015, dataset DST-0044.

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PROCEDURE

The questionnaire was administered through the Factoriza UAS platform, which records express informed consent online before the first question and does not collect data that could identify individuals. The platform runs a quality check on completed questionnaires before adding them to the dataset; in this data collection wave, no cases were excluded.

DATA ANALYSIS

Factoriza UAS calculated the descriptive statistics for each item (mean, standard deviation, skewness, kurtosis, and percentages of responses at the minimum and maximum values); the internal consistency of each dimension using Cronbach's alpha (Cronbach, 1951) and the corrected item-total correlation; and the Pearson correlations among the items within each dimension, with 95% confidence intervals obtained by Fisher's z transformation.

The project's supplementary analysis program, analisis_psicometrico.py (version 1.0), was also run in Python 3.13.16 (Python Software Foundation, 2026) with NumPy 2.5.3 (Harris et al., 2020), SciPy 1.18.1 (Virtanen et al., 2020) and pandas 3.0.5.

The program estimated the internal consistency of each dimension using Cronbach's alpha and McDonald's omega total (McDonald, 1999/2013), based on a one-factor model fitted by minimum residual without reversing items. It does not report omega when any item has a negative item-rest correlation or a negative loading in that model.

The internal structure was examined by exploratory factor analysis of the ten items based on the Pearson correlation matrix of the 13 complete cases, preceded by the overall Kaiser-Meyer-Olkin measure of sampling adequacy (Kaiser, 1974) and the item-level measure (Lorenzo-Seva and Ferrando, 2021), and by Bartlett's test of sphericity (Bartlett, 1950).

The number of factors was determined by parallel analysis (Horn, 1965) with 100 simulations and a seed of 2026; extraction was by minimum residual, and the planned oblimin rotation was not applied because a single factor was retained. The relationships between the dimensions were estimated using Spearman's coefficient between the mean scores of each dimension, with its 95% confidence interval obtained through the Fisher transformation and the Bonett and Wright standard error (Bonett and Wright, 2000).

The program does not remove items automatically: it flags those with a loading below .30, a cross-loading, an opposite sign, or a measure of sampling adequacy below .50, and leaves the decision to the authors. These values, like the .60 value for the overall measure of sampling adequacy, are used as guidelines from the methodological literature and not as rules (Ferrando et al., 2022; Lorenzo-Seva and Ferrando, 2021). No confirmatory factor analysis was performed.

With 13 cases for 10 items, the case-to-item ratio is far below what the methodological literature considers adequate for item factor analysis (Ferrando et al., 2022; Goretzko et al., 2021). The factor analysis of this cohort is therefore presented as documentation of the items' initial functioning, and its results are not interpreted as evidence of the scale's structure.

ETHICAL CONSIDERATIONS

Participation was voluntary, with express informed consent recorded online by the platform, which does not collect names, addresses or other identifying data. The data were analyzed in aggregate.

STATEMENT ON THE USE OF ARTIFICIAL INTELLIGENCE

During the preparation of this manuscript, the following tools were used: the Factoriza UAS platform, for data management and for descriptive and internal consistency analyses; a Python analysis program with fixed and validated procedures, for omega, exploratory factor analysis and the correlations between dimensions; and the Claude Opus language model (Anthropic), for running that program, assisted literature search, writing a draft and assembling the document from the results. The authors reviewed, corrected and approved the entire text, verified every reference and take full responsibility for the content of the article.

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RESULTS

DESCRIPTION OF RESPONSES

Table 3 and Figure 1 present the descriptive statistics for the ten items. All Walking Conditions items had means below the scale midpoint: shade along the route had the lowest mean (R3: *M* = 2.38, *SD* = 0.96), followed by the possibility of walking without stepping down into the street (R2: *M* = 2.46, *SD* = 1.39), which showed the greatest dispersion in the instrument, and by the reverse-scored item on obstacles that force pedestrians to detour (R4: *M* = 2.46, *SD* = 0.88). The recoded mean of this last item indicates that responses leaned toward agreement with encountering obstacles. Sidewalk continuity (R1: *M* = 2.62, *SD* = 1.19) and crossing safety (R5: *M* = 2.77, *SD* = 1.01) had somewhat higher means, though these were also below 3.

In the Tension while walking dimension, the means fell around the midpoint. The reverse-scored item on feeling calm while walking had the highest mean (R9: *M* = 3.15, *SD* = 0.99); once recoded, this indicates a slight tendency toward not feeling calm while walking. Nervousness (R6: *M* = 3.08, *SD* = 0.64) and perceived traffic danger (R7: *M* = 3.08, *SD* = 1.04) had the same mean, and exhaustion at the end of the walk (R10: *M* = 3.00, *SD* = 1.15) was at the midpoint. Discomfort from vehicle noise had the lowest mean in the dimension (R8: *M* = 2.62, *SD* = 1.04).

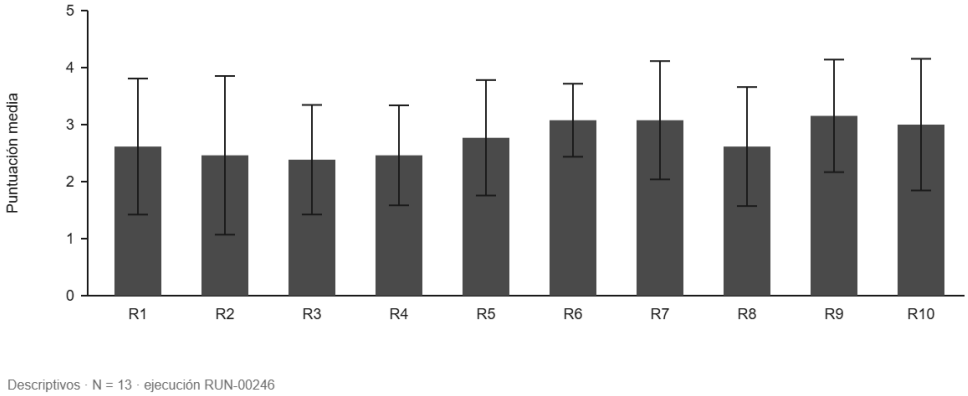
R9 had the flattest distribution (kurtosis = -2.12), which reflects responses split between two values; this item's floor of 38% and ceiling of 54% correspond to the observed values, as indicated in the table note.

Table 3. Descriptive statistics of the items.

Item	M	SD	Skewness	Kurtosis	Floor	Ceiling
R1	2.62	1.19	-0.15	-1.50	23%	31%
R2	2.46	1.39	0.53	-1.10	31%	8%
R3	2.38	0.96	0.39	-0.44	15%	15%
R4	2.46	0.88	0.58	-0.12	8%	15%
R5	2.77	1.01	-0.03	-1.21	8%	31%
R6	3.08	0.64	-0.05	0.06	15%	23%
R7	3.08	1.04	-0.70	-0.72	8%	46%
R8	2.62	1.04	-0.10	-0.99	15%	23%
R9	3.15	0.99	-0.35	-2.12	38%	54%
R10	3.00	1.15	-0.00	-0.82	8%	8%

Note.N = 13. R1 to R5 = Walking Conditions; R6 to R10 = Walking Strain. Reverse-scored items R4 and R9 are shown recoded: in Conditions, a high value indicates favorable conditions, and in Strain, a high value indicates greater strain. Floor and ceiling indicate the percentage of responses at the minimum and maximum values. The item-total correlation column of the Factoriza descriptive table is omitted because it is computed on the total of all ten items, whose dimensions run in opposite directions. Factoriza UAS run RUN-00246. Preliminary cut-off: n = 13 out of a target of 100, with data collection still open.

Figure 1. Mean item scores with one-standard-deviation bars.



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INTERNAL CONSISTENCY

Table 4 presents the item analysis for each dimension. For Walking conditions, alpha was .469. Shade (R3: .624), crossing safety (R5: .486), and the possibility of walking without stepping down into the street (R2: .378) had the highest corrected item-total correlations; sidewalk continuity had a near-zero correlation (R1: .034), and the reverse-scored item on obstacles had a negative correlation (R4: -.134). Removing R4 would raise alpha to .603, and removing R1 would raise it to .565.

For Tension While Walking, alpha was .322. Nervousness (R6: .353), discomfort due to noise (R8: .338), and calmness while walking (R9: .302) showed moderate item-total correlations; exhaustion had a null correlation (R10: .000), and perceived traffic danger a negative one (R7: -.062). Removing R7 would raise alpha to .459, and removing R10 would raise it to .430.

Table 4. Item analysis by dimension.

Dimension	Item	Corrected item-total r	α if item deleted
Conditions	R1	.034	.565
Conditions	R2	.378	.303
Conditions	R3	.624	.168
Conditions	R4	-.134	.603
Conditions	R5	.486	.255
Tension	R6	.353	.173
Tension	R7	-.062	.459
Tension	R8	.338	.088
Tension	R9	.302	.137
Tension	R10	.000	.430

Note.N = 13. Scale from 1 to 5; reverse-scored items R4 and R9 are shown recoded. Run RUN-00246 of Factoriza UAS. Preliminary cutoff: n = 13 of a target of 100, with data collection still open.

Table 5 presents the alpha and omega coefficients estimated by the supplementary analysis program. The alpha values match those from Factoriza (.469 and .322). The program did not report omega for either dimension because, in the one-factor model of each, two items had a negative item-rest correlation or loading: R1 and R4 in Conditions, and R7 and R10 in Tension. Since R4 is flagged as reverse-scored and recoded, this result is not due to a coding error but to the behavior of the items in this data cut.

Table 5. Internal consistency by dimension.

Dimension	Items	n	α	ω
Conditions	5	13	.469	
Tension	5	13	.322	

Note.N = 13. Conditions = Walking conditions; Strain = Strain when walking. The corrected item-total correlation excludes the item itself from the total of its dimension. Cronbach's α for each full dimension, with 5 items each: Conditions = .469 (run RUN-00247); Strain = .322 (RUN-00249). Source: Factoriza UAS, Tables 4 and 6 of the package, combined without modifying values. Preliminary cutoff: n = 13 out of a target of 100, with data collection still open.

INTER-ITEM CORRELATIONS

Correlations between items within each dimension, computed with Factoriza (runs RUN-00248 and RUN-00250), refine the preceding pattern. In Walking Conditions, only the correlation between the possibility of walking without stepping down into the street and shade excluded zero (R2 and R3: r = .729, 95% CI [.297, .913], p = .005); the correlations of shade with crossing safety (R3 and R5: r = .527, 95% CI [-.034, .835], p = .064) and of the possibility of walking without stepping down into the street with crossing safety (R2 and R5: r = .496, 95% CI [-.076, .822], p = .085) were moderate, with intervals that included zero.

Sidewalk continuity showed near-zero correlations with the other items, ranging from -.078 to .104. The recoded obstacles item was negatively related to the possibility of walking without stepping down into the street (R2 and R4: r = -.462, 95% CI [-.808, .119], p = .112).

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In Tension While Walking, no correlation excluded zero. The highest were between nervousness and recoded calmness (R6 and R9: r = .375) and between nervousness and traffic danger (R6 and R7: r = .366), and between noise discomfort and exhaustion (R8 and R10: r = .346). Traffic danger was negatively related to exhaustion (R7 and R10: r = -.278) and weakly related to noise discomfort (R7 and R8: r = -.124), whereas recoded calmness was not related to exhaustion (R9 and R10: r = .000).

INTERNAL STRUCTURE

The overall Kaiser-Meyer-Olkin measure of sampling adequacy was .295, well below the value of .60 commonly cited as a guideline (Ferrando et al., 2022; Lorenzo-Seva and Ferrando, 2021). The item-level measure was below .50 for all items except the shadow item, with values ranging from .151 (R1) to .526 (R3).

Bartlett's test of sphericity rejected the hypothesis of an identity matrix, $\chi^2(45) = 67.16$, p = .018. Given these values, the correlation matrix for this cohort is poorly suited to factor analysis, and the following results are reported as documentation of item functioning.

Parallel analysis suggested retaining one factor (Figure 2), which explained 28.55% of the variance, with a sum of squared loadings of 2.86 (Table 6). Table 7 reports the loadings. The factor was bipolar: crossing safety (R5: .813), the possibility of walking without stepping down into the street (R2: .798), and shade (R3: .705) loaded positively, whereas recoded calmness (R9: -.760), discomfort due to noise (R8: -.483), and nervousness (R6: -.407) loaded negatively. Because the Tension items are oriented in the opposite direction to the Conditions items, their negative sign is as expected, and the opposite-sign flag that the software issues for them reflects this orientation rather than a problem with the items. Four items had loadings below .30 in absolute value: traffic danger (R7: -.260), sidewalk continuity (R1: .102), obstacles (R4: -.073), and exhaustion (R10: .042). The software did not remove any items, and the decision on them rests with the authors once the final data cut is available.

Figure 2. Scree plot with parallel analysis.

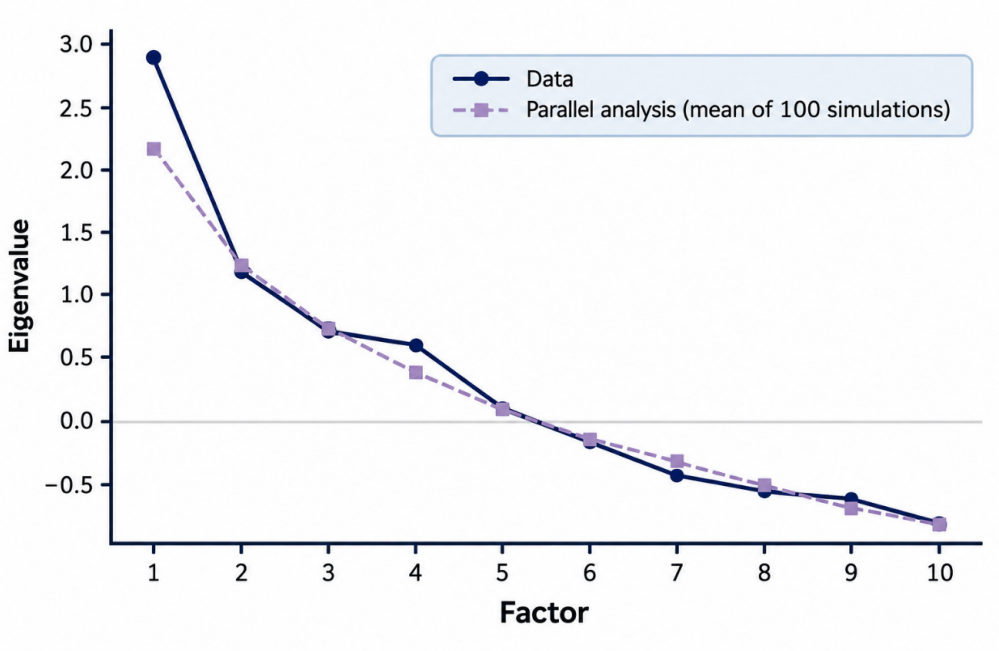


Table 6. Variance explained by the factors.

Factor	Sums of squared loadings	% of variance	Cumulative %
1	2.86	28.55	28.55

Note. Eigenvalues of the reduced data matrix compared with the mean of 100 simulated matrices of the same size (seed 2026). Source: Prepared by the author using analisis_psicometrico.py 1.0 (Python 3.13.16), dataset DST-0044_FZ_HAB_0010. Preliminary data cut: n = 13 out of a target of 100, with data collection still ongoing.

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Table 7. Factor loadings from the exploratory factor analysis.

	Factor		
Item	1	h^2	MSA
R1	.102	.010	.151
R2	.798	.636	.355
R3	.705	.497	.526
R4	-.073	.005	.153
R5	.813	.660	.387
R6	-.407	.166	.333
R7	-.260	.068	.419
R8	-.483	.233	.257
R9	-.760	.578	.344
R10	.042	.002	.170

Note. KMO = .295; Bartlett's test of sphericity: $\chi^2(45) = 67.16$, p = .018. Number of factors by parallel analysis: 1. Source: prepared by the authors using analisis_psicometrico.py 1.0 (Python 3.13.16), dataset DST-0044_FZ_HAB_0010. Preliminary data cut: n = 13 of a target of 100, with data collection still ongoing.

RELATIONSHIP BETWEEN THE DIMENSIONS

Table 8 presents the Spearman correlation between the mean scores of the two dimensions. The relationship was negative and large in magnitude, and its confidence interval excluded zero, ρ = -.621, 95% CI [-.886, -.049], *p* = .024, with 13 cases: people who rated the walking conditions on the segment more favorably reported less stress when walking along it. The interval is wide, so the magnitude of the relationship is highly imprecise, but its direction is as expected.

Table 8. Correlations between dimensions.

Dimension pair	n	ρ	IC 95 %	p
Conditions and Tension	13	-.621	[-.886, -.049]	.024

Note. Pattern matrix. Minimum residual extraction and oblimin rotation (γ = 0) on the Pearson correlation matrix; 13 complete cases. h^2 = communality; MSA = item-level measure of sampling adequacy. All loadings are shown. Source: Authors' own elaboration using analisis_psicometrico.py 1.0 (Python 3.13.16), dataset DST-0044_FZ_HAB_0010. R1 to R5 = Walking conditions; R6 to R10 = Walking stress. With a single factor retained, there is no rotation to apply. The dimension and observation columns are omitted; the program flagged low MSA for all items except R3, insufficient loading for R1, R4, R7 and R10, and an opposite sign for R4, R6, R7, R8 and R9. Because the factor is oriented by walking conditions, the negative sign of the Walking stress items is as expected. Preliminary cut: n = 13 out of a target of 100, with data collection still open.

DISCUSSION OF RESULTS

This study examined the preliminary psychometric properties of a scale of perceived walkability and pedestrian stress using a data cut of 13 cases along an urban segment in Mazatlán.

The first finding is descriptive: respondents rated walking conditions unfavorably, with means below the midpoint on all five items of the dimension, and shade was the lowest-rated aspect. This pattern is consistent with the importance the literature attaches to shade in hot cities (Ding et al., 2023; Melnikov et al., 2022) and with the barriers documented in other Latin American cities, where poor pedestrian infrastructure and safety are the most frequently mentioned (Gómez-García et al., 2026; Guevara-Aladino et al., 2024).

With 13 cases from a single segment, however, these means describe the experience of those who responded rather than the walkability of the city.

The second finding is the negative relationship between the two dimensions: those who rated the conditions of the segment more favorably reported less tension when walking it. This relationship, though imprecise, is the first evidence of the scale's validity based on the relations among its parts, and it is consistent with the notion that tension while walking is the affective component of walkability.

Studies using physiological measurement have associated route characteristics with indicators of stress and relaxation (Mahia et al., 2026), and perceived traffic safety has been associated with transport-related physical activity (Kloss et al., 2025). The factor analysis, which

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yielded a bipolar factor on which favorable conditions and tension loaded in opposite directions, points in the same direction, although with sampling adequacy this low (KMO = .295) it cannot be taken as evidence of the structure.

The third finding concerns internal consistency, which was low in both dimensions (α = .469 and .322) and did not allow omega to be reported. The behavior of each item is more informative than the overall coefficient.

In Walking conditions, three items (shade, crossing safety, and the possibility of walking without stepping down into the street) were related to one another and to the factor, whereas sidewalk continuity and obstacles were not. Sidewalk continuity describes a physical attribute of the segment that, if the segment is the same for everyone, should vary little across individuals; its dispersion suggests that participants may have referred to different parts of the route or interpreted continuity in different ways.

The obstacles item was negatively related to the possibility of walking without stepping down into the street, which lends itself to a content-based interpretation: a person who navigates around obstacles may detour within the sidewalk itself without stepping off it. This result is also consistent with a bias associated with reverse wording (García-Batista et al., 2021; Steinmann et al., 2022).

In Stress while walking, exhaustion and perceived danger from traffic were the items with zero or negative contributions. Exhaustion at the end of the walk may depend on distance, physical effort, each person's condition, and heat, rather than on the stress associated with the environment. In a warm city, its relationship with sun exposure is plausible (Hsu et al., 2025; Li et al., 2023).

Traffic danger, with a ceiling of 46% at the highest observed value, may reflect a concern shared by most respondents, which reduces its ability to covary with the other items.

This result is consistent with the Balearic Islands questionnaire, in which the noise and traffic density items had the lowest coefficients with the final rating (Artigues et al., 2020). It also suggests that pedestrian stress may have facets, such as alertness to traffic and fatigue, that do not behave as indicators of a single dimension.

The results suggest several adjustments for the next stage. As for the instrument, it would be advisable to specify in the instructions which stretch is being assessed and, if it is long, to divide it into segments; to revise the wording of the obstacles item to distinguish between swerving while staying on the sidewalk and stepping down into the street; and to consider whether exhaustion and danger from traffic should be retained within Tension or form facets of their own.

For the procedure, it would be useful to record the time of day of the walk and the temperature and shade conditions, and to complement the scale with an audit of the segment or with measurements of noise level and traffic. This would make it possible to gather validity evidence based on relations with other variables and to compare pedestrians' perceptions with the observed conditions, as has been done with perceived and objective walkability in other contexts (Schepers et al., 2025).

CONCLUSIONS

The study examined the preliminary psychometric properties of a scale of perceived walkability and pedestrian stress among people who habitually walk along an urban segment of Mazatlán, using an interim data cut of 13 cases out of a target of 100. Respondents rated walking conditions unfavorably, particularly shade, and walking stress fell around the midpoint.

The relationship between the two dimensions was negative, in the expected direction, and its interval excluded zero (ρ = -.621). Internal consistency was low for both dimensions (α = .469 and .322), and omega was not interpretable. The exploratory factor analysis, with very low sampling adequacy (KMO = .295), suggested a bipolar factor that documents only the initial functioning of the items.

The study has limitations that should be kept in mind when interpreting all of its results. The first concerns the size and nature of the data cut: 13 cases out of a target of 100, with data collection still ongoing, are insufficient to estimate internal consistency, correlations, and factor structure with precision.

The second concerns the sample and the reference population: the study segment, the contact procedure, the type of sampling and the characteristics of the respondents have yet to be documented, and the results cannot be generalized to other segments or to the city as a whole.

The third concerns measurement: environmental stress was assessed only through self-

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reported tension, without physiological indicators or environmental measurements; the floor and ceiling percentages from Factoriza need to be verified, and no confirmatory factor analysis was performed.

The fourth concerns design: because the study is cross-sectional, it does not allow causal inferences.

Future lines of work follow from these limitations. With the final data cut, the item analysis and the exploratory factor analysis should be repeated and, if sampling adequacy allows, used to examine whether the two-dimensional structure holds. The resulting structure should then be tested through confirmatory factor analysis in an independent sample, ideally across several segments with different conditions.

It will also be advisable to decide, using content criteria and not only statistical ones, what to do with the low-contribution items, and to complement the scale with a pedestrian audit of the street segment and with measurements of temperature, shade, noise and traffic. This combination would make it possible to determine the extent to which pedestrians' perceptions reflect street conditions and to guide urban design interventions that make walking in a hot city more livable.

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