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Hygrothermal habitability in social housing in Mazatlán: Preliminary psychometric properties of a scale

Habitabilidad hidrotérmica en vivienda social de Mazatlán: propiedades psicométricas preliminares de una escala

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ABSTRACT

Heat and humidity inside the dwelling are part of what residents of warm coastal cities experience as habitability. This instrumental, cross-sectional and exploratory study examined the preliminary psychometric properties of a twelve-item hygrothermal habitability scale with two dimensions, thermal comfort in the dwelling and humidity control in the dwelling, administered in the pilot survey of project FZ-HAB-0001 of the Factoriza UAS platform among adults living in social housing in Mazatlán, Mexico. A preliminary cut of 13 cases, out of a target of 100, was analyzed with descriptive statistics, Cronbach's alpha, McDonald's omega, Pearson inter-item correlations, exploratory factor analysis with parallel analysis, and a Spearman correlation between dimensions. Thermal comfort items obtained lower means than humidity items, and coolness during the hottest hours had the lowest mean (M = 2.38). Internal consistency was moderate in both dimensions (α = .684 and .671; ω = .743 and .745); air currents, comfort for sleeping and the two reverse-worded humidity items contributed little to their dimensions. Sampling adequacy was very low (KMO = .190); parallel analysis suggested one factor on which the direct items of both dimensions loaded, while the three reverse-worded items, air currents and bedroom coolness had loadings below .30. The correlation between dimensions was ρ = .302, with a confidence interval that included zero. These results document the initial functioning of the items and must be re-examined with the final data cut.

Keywords: thermal comfort; indoor humidity; social housing; psychometric properties

RESUMEN

El calor y la humedad dentro de la vivienda forman parte de lo que los habitantes de las ciudades costeras cálidas experimentan como habitabilidad. Este estudio instrumental, transversal y exploratorio examinó las propiedades psicométricas preliminares de una escala de habitabilidad higrotérmica de doce reactivos, con dos dimensiones, Confort térmico en la vivienda y Control de la humedad en la vivienda, aplicada en el levantamiento piloto del proyecto FZ-HAB-0001 de Factoriza UAS a personas adultas que habitan vivienda social en Mazatlán. Se analizó un corte preliminar de 13 casos, de una meta de 100, con estadísticos descriptivos, alfa de Cronbach, omega de McDonald, correlaciones de Pearson entre reactivos, análisis factorial exploratorio con análisis paralelo y correlación de Spearman entre dimensiones. Los reactivos de confort térmico obtuvieron medias más bajas que los de humedad, y la frescura en las horas de más calor tuvo la media más baja (M = 2.38). La consistencia interna fue moderada en las dos dimensiones (α = .684 y .671; ω = .743 y .745); las corrientes de aire, la comodidad para dormir y los dos reactivos inversos de humedad contribuyeron poco a su dimensión. La adecuación muestral fue muy baja (KMO = .190); el análisis paralelo sugirió un factor en el que cargaron los reactivos directos de ambas dimensiones, mientras que los tres reactivos inversos, las corrientes de aire y la frescura de las recámaras tuvieron cargas inferiores a .30. La correlación entre dimensiones fue ρ = .302, con un intervalo que incluyó el cero. Estos resultados documentan el funcionamiento inicial de los reactivos y deben revisarse con el corte final.

Palabras clave: confort térmico; humedad interior; vivienda social; propiedades psicométricas

INTRODUCTION

The home is where most people spend the greater part of the day and night; its thermal and humidity conditions are part of what its occupants experience as habitability.

In hot climates, a dwelling's capacity to stay cool during the hottest hours of the day, to allow nighttime rest, and to prevent moisture from building up in the air, walls, and furniture is associated with the well-being, sleep, and respiratory health of its occupants. These two facets, the thermal and the hygrometric, are usually studied separately, the former from the perspective of thermal comfort and the latter from that of environmental health, although in the everyday experience of the inhabitants of hot coastal regions they occur together.

Heat exposure is increasing in Latin America. The 2023 Lancet Countdown report for the region estimated that in 2022 the population was exposed to ambient temperatures that were, on average, 0.38 °C higher than in the period from 1986 to 2005, and that heat-related mortality increased by 140% between the decades 2000 to 2009 and 2013 to 2022 (Hartinger et al., 2024).

A systematic review and meta-analysis of 88 studies found that heatwaves and extremely high temperatures were associated with an increased risk of mental and behavioral disorders (Li et al., 2023).

In humid regions, humidity adds a burden of its own: in Guangdong Province, China, indicators combining temperature and humidity captured the association between humid heat and sleep disorders among school-aged children better than temperature alone did, which led the study authors to recommend incorporating humidity into health studies in such areas (Gao et al., 2025).

Dampness inside the home also has documented health consequences. A synthesis of systematic reviews on housing and health found that all reviews addressing housing exposures associated poor conditions, including dampness and mold, with adverse health effects (Richards et al., 2023). A meta-analysis of 30 studies of children in high-income countries estimated odds ratios ranging from 1.28 for dampness and respiratory infections to 1.76 for mold and respiratory symptoms, with the caveat that the evidence comes mainly from cross-sectional studies (Groot et al., 2023).

However, occupants' perception of humidity does not always reflect environmental conditions: in a field study of rural dwellings in southwest China, the perception of a parameter that remains relatively constant, such as humidity, appeared to be attenuated (Wei et al., 2022).

In Mexico, housing policy during the first decades of this century favored the mass production of social housing, characterized by small dwellings, developments located far from urban centers, and insufficient services (Hernández Ilizaliturri et al., 2025).

In the northwest of the country, residents of a social housing development in Culiacán described their homes as very hot (Barraza-Bracamontes et al., 2022); in Hermosillo, the predominant social housing type showed less favorable energy performance than a dwelling built in accordance with energy efficiency standards (Muñoz López et al., 2023).

During the COVID-19 pandemic lockdown, more than half of the respondents to a nationwide online survey about their homes reported not being thermally comfortable (Jaimes Torres et al., 2021); space cooling has also become one of the main residential energy demands in the country's hot climates (Galindo-Borbón et al., 2024; Treviño Hernández and Hernández Rejón, 2026).

Regional research on thermal experience in social housing has focused on the hot dry climates of the northwest, such as that of Hermosillo (Espinoza Gallego et al., 2014; Muñoz López et al., 2023), and on the analysis of energy performance. In the country's warm subhumid climates, studies have assessed the feasibility of adaptive comfort models using weather files and have concluded that local models are needed to propose strategies with greater regional impact (May-Tzuc et al., 2023).

What is lacking, however, is a brief instrument for recording, from the residents' perspective, how they appraise the thermal performance and humidity of their dwellings, and whose psychometric properties have been examined in social housing in a northwestern coastal city such as Mazatlán.

For this purpose, project FZ-HAB-0001 of the Factoriza UAS platform designed a twelve-item hygrothermal habitability scale organized into two dimensions: Thermal comfort in the dwelling and Humidity control in the dwelling. The title of the project in Factoriza refers to the validation of the scale. However, with a preliminary data cut of 13 cases, this article can offer no more than an initial body of evidence on how the scale performs, which is why the article's title refers to preliminary psychometric properties. Validity is not a property that a scale acquires in a single study but a judgment built on accumulated evidence; this work provides the first such evidence

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for the instrument.

The overall objective was to examine the preliminary psychometric properties of the hygrothermal habitability scale among people living in social housing in 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 McDonald's omega total, 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 the scores of the two dimensions. The project did not state any hypotheses; therefore, the study is framed as exploratory.

MAIN BODY

HYGROTHERMAL HABITABILITY OF THE DWELLING

In this work, hygrothermal habitability is understood as the residents' appraisal of the temperature and humidity conditions of their dwelling in relation to their everyday activities: being at home during the day, sleeping at night, breathing comfortably, and keeping their furniture and walls in good condition. The definition does not replace physical measurement of the indoor environment; rather, it records the experience of those who live in it, which depends on the climate, on the dwelling, and also on how people adapt.

For this reason, the project scale combines items on thermal sensation at different times of day, on the coolness of bedrooms and ventilation, and on air humidity, stains on walls, and mold.

The adaptive approach to thermal comfort has shown that the temperature people perceive as neutral varies with context. In rural dwellings in southwestern China, the residents' neutral operative temperature was 29.33 °C, higher than that reported by previous studies in the same climate region; adaptive behaviors improved their ability to tolerate demanding indoor conditions (Wei et al., 2022).

In naturally ventilated rural dwellings in the northern part of China's hot summer and warm winter zone, a study of 251 individuals from 98 households estimated a neutral temperature of 25.34 °C and an acceptable range of 21.69 °C to 30.55 °C; the study also found that older people tolerated heat better than younger adults (Gong et al., 2025).

These findings indicate that a hygrothermal habitability scale does not directly measure temperature, but rather the relationship between the conditions of a dwelling and the adaptive expectations and resources of its occupants.

Adaptive behaviors are part of this relationship. In a village in Guangzhou with a hot, humid climate, older adults adapted in summer mainly by opening windows, using curtains and electric fans, and moving to different spaces. Fan use was not associated with indoor air temperature but was negatively associated with indoor relative humidity. In addition, the proportion of those who left the dwelling to cool off increased with temperature and decreased with relative humidity (Tian et al., 2022).

Ventilation therefore plays a role in both thermal and humidity experience, and occupants' appraisal of it does not necessarily equate to an improvement in indoor temperature.

DAMPNESS, MOLD, AND HEALTH IN THE HOME

Household dampness has two sides for the people who live with it. One is sensory: the feeling that the indoor air is humid or, conversely, light. The other is material: persistent dampness leaves stains on the walls and is accompanied by mold on surfaces and furniture.

The literature on housing and health has consistently associated dampness and mold with adverse health effects (Richards et al., 2023) and, in particular, with respiratory infections and symptoms in children (Groot et al., 2023). These effects are linked to the physical conditions of the dwelling, which do not always match what its occupants perceive.

The relationship between humidity and thermal sensation is not straightforward either. In tropical homes in Padang, Indonesia, more than 80% of individuals in both the community groups and the groups with respiratory symptoms reported feeling too hot; higher temperature, lower humidity, modern housing style and attached housing were positively associated with this sensation (Prima et al., 2026).

The sign of the association with humidity in that study is a reminder that, in environments

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where humidity is usually high, its variation may influence this sensation less than temperature or housing characteristics do, consistent with the attenuated perception of constant parameters described in southwestern China (Wei et al., 2022).

For a scale aimed at residents of a humid coastal area, this implies that items on air humidity might discriminate less than those concerning its visible consequences or overall comfort.

SOCIAL HOUSING AND CLIMATE IN NORTHWESTERN MEXICO

Social housing mass-produced over recent decades follows prototypes that are replicated across very different climates. In northwestern Mexico, the available evidence describes hot dwellings: in Culiacán, residents of a social housing development identified heat as the main characteristic of their homes and kept their air conditioning running (Barraza-Bracamontes et al., 2022); in Hermosillo, the thermal environment of social housing was negatively associated with psychological well-being in summer (Espinoza Gallego et al., 2014).

The cost of cooling dwellings and the implementation of energy efficiency regulations are central issues in the regional debate (Galindo-Borbón et al., 2024; Treviño Hernández and Hernández Rejón, 2026).

Passive strategies are an alternative for reducing this dependence. In the state of Campeche, which has a warm subhumid climate, natural ventilation proved applicable throughout the state, and adaptive comfort models reduced estimated energy consumption compared with the static approach (May-Tzuc et al., 2023).

In a pilot trial involving forty rural African dwellings, those with cool roofs had the lowest indoor heat index both during the day and at night, whereas no differences were observed between dwellings with cross-ventilation and the control dwellings (Abong'o et al., 2026).

In Irbid, Jordan, dwelling type was associated with the perceived effectiveness of passive strategies: residents of apartments rated tree shading and natural ventilation as less effective than did residents of single-family houses (Obeidat, 2026). For measurement purposes, this means that the presence of air movement, perceived coolness, and indoor temperature are related but distinct aspects of the thermal experience.

MEASURING PERCEIVED HABITABILITY USING SCALES

Perceived habitability scales are built from items assumed to be manifestations of one or more latent dimensions. 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 make this assumption; simulation studies have compared the performance of the two coefficients under different data conditions (Malkewitz et al., 2023).

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

Two measurement issues are particularly relevant to this scale. The first is mixed item wording: scales with regular and reverse-worded items may show wording-related biases, because some respondents respond inconsistently to positive and negative items within the same dimension (Steinmann et al., 2022); identifying these responses can reduce such biases (García-Batista et al., 2021).

The second is the nature of the indicators: in measurement theory, indicators that make up a construct, rather than reflecting it, are termed formative; their implications for factor analysis and reliability theory differ from those of reflective indicators (Bollen and Diamantopoulos, 2017).

Drafts or damp stains on walls are housing characteristics that might behave more like conditions that make up hygrothermal habitability than like reflections of an overall appraisal; this possibility should be borne in mind when interpreting the structure of the scale.

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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 permit causal inferences.

POPULATION, SAMPLE, AND DATA CUTOFF

The data come from the survey "Piloto Mazatlán · Habitabilidad higrotérmica" (LEV-0006) of project FZ-HAB-0001 on the Factoriza UAS platform and from the frozen dataset DST-0042, with a data cutoff date of 14 October 2026. The survey population comprises people aged 18 years or older living in social housing developments in Mazatlán, Sinaloa, that were selected by the project lead.

Table 1 presents the composition of the sample. The questionnaire was opened by 22 people and completed by 13; no cases were excluded by the platform's quality control, and 13 cases with 12 items were analyzed. This is a preliminary data cut: n = 13 of a target of 100, with data collection still ongoing. The results in this article describe this cut and should not be regarded 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	22
Completed questionnaires	13
Cases excluded by quality control	0
Cases analyzed	13
Items	12

Note. Survey "Mazatlán Pilot · Hygrothermal Habitability" (LEV-0006); population: people aged 18 years or older living in social housing in Mazatlán; territory: Mazatlán, Sinaloa, in social housing developments selected by the project lead. Dataset DST-0042, fingerprint 3480c4f0a5fd2743. Source: Factoriza UAS. Preliminary cutoff: n = 13 of a target of 100, with the survey still open.

INSTRUMENT

The hygrothermal habitability scale consists of twelve items rated on a 5-point response scale, ranging from Strongly disagree to Strongly agree, organized into two dimensions of six items each. Thermal comfort in the home (R1 to R6) assesses pleasant temperature during the day, sleeping comfort on summer nights, coolness during the hottest hours, heat in the afternoons, coolness of the bedrooms at night, and air currents that cool the interior.

Humidity control in the home (R7 to R12) assesses the perception of humid air, damp stains on the walls, the sensation of light air, the absence of mold on furniture, ease of breathing, and the pleasantness of the indoor environment during the rainy season. Three items are reverse-worded (R4, R7, and R8) and have been recoded in the data matrix, so that a high value on every item indicates a favorable condition. Table 2 presents the wording of each item.

Table 2. Structure of the instrument.

Code	Item	Reverse-scored
R1	The temperature inside my home is pleasant during the day	No
R2	On summer nights, I can sleep comfortably in my home	No
R3	My home stays cool during the hottest hours of the day	No
R4	In my home, I feel hot in the afternoons	Yes
R5	The bedrooms in my home feel cool at night	No
R6	Air currents cool the interior of my home	No
R7	The air feels humid inside my home	Yes

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Code	Item	Reverse-scored
R8	The walls of my home have damp stains	Yes
R9	Inside my home, the air feels light	No
R10	The furniture in my home is kept free of mold	No
R11	I can breathe comfortably inside my home during the rainy season	No
R12	During the rainy season, the interior of my home feels pleasant	No

Note. R1 to R6 = Thermal comfort in the home; R7 to R12 = Humidity control in the home. The dimension column is omitted to preserve the readability of the table. Response scale: 5-point (Strongly disagree, Disagree, Neither agree nor disagree, Agree, Strongly agree). Reverse-scored items have already been recoded in the delivered data matrix. Source: Factoriza UAS, project FZ-HAB-0001, survey LEV-0006, dataset DST-0042.

PROCEDURE

The questionnaire was administered through the Factoriza UAS platform, which records explicit online informed consent before the first question and does not collect data that would allow individuals to be identified. The platform applies quality control to completed questionnaires before incorporating them into the dataset; in this data collection round, it excluded no cases.

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 between the items within each dimension, with 95% confidence intervals obtained by Fisher's z transformation.

In addition, the project's supplementary analysis program, analisis_psicometrico.py, version 1.0, was 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 minimum-residual model and without reverse-scoring items.

The internal structure was examined by exploratory factor analysis of the twelve items, using the Pearson correlation matrix of the 13 complete cases. This analysis was preceded by the Kaiser-Meyer-Olkin measure of sampling adequacy, both overall (Kaiser, 1974) and per item (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 used the minimum residual method, and the planned rotation, oblimin, which allows correlation between factors, was not applied because a single factor was retained. The relationships between dimensions were estimated using Spearman's coefficient between the mean scores of each dimension, with its 95% confidence interval obtained through Fisher's 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 cutoff for the overall measure of sampling adequacy, are used as indicative benchmarks from the methodological literature rather than as rules (Ferrando et al., 2022; Lorenzo-Seva and Ferrando, 2021). No confirmatory factor analysis was performed; with a preliminary data cut and the same sample as the exploratory analysis, it would not be defensible.

With 13 cases for 12 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 data cut is therefore presented as documentation of how the items initially functioned; its results are not interpreted as evidence of the structure of the scale.

ETHICAL CONSIDERATIONS

Participation was voluntary, with explicit informed consent recorded online through the platform, which does not collect names, addresses, or other identifying data. Data were analyzed

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in aggregate form.

STATEMENT ON THE USE OF ARTIFICIAL INTELLIGENCE

During the preparation of this manuscript, the following were used: the Factoriza UAS platform, for data management and the descriptive and internal consistency analyses; a Python analysis program with fixed, 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 searching, 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.

RESULTS

DESCRIPTION OF RESPONSES

Table 3 and Figure 1 present the descriptive statistics for the twelve items. No mean reached a value of 4, which corresponds to Agree. The Thermal comfort items had the lowest means: the coolness of the dwelling during the hottest hours had the lowest mean on the instrument (R3: *M* = 2.38, *SD* = 1.12), followed by the reverse-scored item on afternoon heat (R4: *M* = 2.69, *SD* = 0.95). The recoded mean of R4 indicates that responses leaned toward agreement with feeling hot in the afternoon.

Pleasant daytime temperature and comfort when sleeping on summer nights had the same mean (R1 and R2: *M* = 3.08); the air currents that cool the interior had the highest mean in the dimension (R6: *M* = 3.46, *SD* = 0.88).

Overall, the Humidity Control items showed higher means. The pleasantness of the indoor environment during the rainy season (R12: *M* = 3.77, *SD* = 1.09), breathing comfort during that season (R11: *M* = 3.69, *SD* = 0.95), and the sensation of light air (R9: *M* = 3.62, *SD* = 0.77) had the highest means on the instrument.

The two reverse-scored items of the dimension had means close to the midpoint: the perception of humid air (R7: *M* = 2.85, *SD* = 0.99) and damp stains on the walls (R8: *M* = 3.15, *SD* = 1.21), the latter showing the greatest dispersion on the scale. The distributions of R9 and R11 were the most skewed (skewness = -1.76 and -2.05, respectively). R11 also had a kurtosis of 5.66, indicating a marked concentration of responses at a single value. R9's ceiling of 77% was the highest value observed, as indicated in the table note.

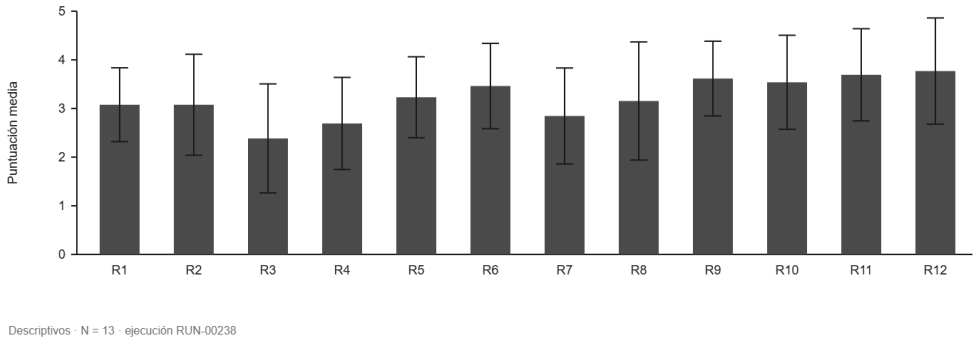
Table 3. Descriptive statistics of the items.

Item	M	SD	Skewness	Kurtosis	Floor	Ceiling
R1	3.08	0.76	-0.14	-1.05	23%	31%
R2	3.08	1.04	-0.70	-0.72	8%	46%
R3	2.38	1.12	-0.08	-1.39	31%	15%
R4	2.69	0.95	0.04	-0.82	8%	23%
R5	3.23	0.83	-0.50	-1.34	23%	46%
R6	3.46	0.88	-0.30	-0.34	15%	8%
R7	2.85	0.99	-0.26	-0.91	8%	31%
R8	3.15	1.21	-0.34	-1.18	8%	8%
R9	3.62	0.77	-1.76	1.62	15%	77%
R10	3.54	0.97	-0.78	-0.49	23%	8%
R11	3.69	0.95	-2.05	5.66	8%	8%
R12	3.77	1.09	-0.83	-0.41	23%	23%

Note.N = 13. R1 to R6 = Thermal comfort in the home; R7 to R12 = Humidity control in the home. Reverse-scored items R4, R7, and R8 are shown recoded, so that a high value always indicates a favorable condition. Floor and ceiling indicate the percentage of responses at the minimum and maximum values. The item-total correlation column from the Factoriza descriptive table is omitted; its values do not match those in Table 4 because they are not calculated from the total score of each dimension. Factoriza UAS run RUN-00238. Preliminary cut: n = 13 out of a target of 100, with data collection still open.

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Figure 1. Mean scores per item with error bars representing one standard deviation.



INTERNAL CONSISTENCY

Table 4 presents the item analysis for each dimension. For Thermal comfort, the dimension's alpha was .684. Pleasant temperature during the day (R1: .767) and coolness during the hottest hours (R3: .723) had the highest corrected item-total correlations, followed by heat in the afternoons (R4: .510) and coolness of the bedrooms at night (R5: .422). Sleeping comfort on summer nights had a low correlation (R2: .209), and the correlation for air currents was practically zero (R6: .006). Removing R6 would raise the alpha to .758, and removing R2 would raise it to .716.

For Humidity Control, alpha was .671. Indoor pleasantness during the rainy season (R12: .710) and breathing comfort (R11: .698) had the highest corrected item-total correlations, followed by the sensation of light air (R9: .498) and the absence of mold on furniture (R10: .386). The two reverse-scored items had low correlations, .168 for damp stains (R8) and .110 for humid air (R7), and deleting either one would raise the dimension's alpha (to .725 without R8 and to .721 without R7).

Table 4. Item analysis by dimension.

Dimension	Item	Corrected item-total r	α if item deleted
Thermal comfort	R1	.767	.544
Thermal comfort	R2	.209	.716
Thermal comfort	R3	.723	.509
Thermal comfort	R4	.510	.609
Thermal comfort	R5	.422	.641
Thermal comfort	R6	.006	.758
Humidity	R7	.110	.721
Humidity	R8	.168	.725
Humidity	R9	.498	.608
Humidity	R10	.386	.634
Humidity	R11	.698	.525
Humidity	R12	.710	.502

Note.N = 13. Scale from 1 to 5; reverse-scored items R4, R7, and R8 are shown recoded. Run RUN-00238 of Factoriza UAS. Preliminary data cut: n = 13 of a target of 100, with data collection ongoing.

Table 5 presents the alpha and total omega estimated by the complementary analysis program. The alpha values match those from Factoriza (.684 and .671). Total omega was .743 for Thermal comfort and .745 for Humidity control, higher than alpha in both cases, which is consistent with unequal loadings across the items of each dimension. No dimension had items with a negative item-rest correlation or a negative loading within its own one-factor model, so the program reported omega for both.

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Table 5. Internal consistency by dimension.

Dimension	Items	n	α	ω
Thermal comfort	6	13	.684	.743
Humidity	6	13	.671	.745

Note.N = 13. Thermal comfort = Thermal comfort in the home; Humidity = Humidity control in the home. The corrected item-total correlation excludes the item itself from the total of its dimension. Cronbach's α for each complete dimension (6 items each): Thermal comfort = .684 (run RUN-00239); Humidity = .671 (RUN-00241). Source: Factoriza UAS, Tables 4 and 6 of the package, combined without modifying values. Preliminary cutoff: n = 13 of a target of 100, with data collection ongoing.

INTER-ITEM CORRELATIONS

The inter-item correlations within each dimension, calculated with Factoriza (runs RUN-00240 and RUN-00242), show the pattern described above in greater detail. In Thermal Comfort, only two correlations had confidence intervals that excluded zero: one between pleasant daytime temperature and coolness during the hottest hours (R1 and R3: r = .843, 95% CI [.546, .952], p < .001) and one between the latter and bedroom coolness at night (R3 and R5: r = .612, 95% CI [.092, .870], p = .026).

Air drafts showed near-zero or negative correlations with the other items, such as with sleeping comfort (R2 and R6: r = -.317, 95% CI [-.739, .284], p = .291).

In Moisture Control, four correlations excluded zero, all between direct items: between the absence of mold and the pleasantness of the indoor environment during the rainy season (R10 and R12: r = .759, 95% CI [.357, .924], p = .003), between the sensation of light air and both breathing comfort (R9 and R11: r = .740, 95% CI [.319, .917], p = .004) and the pleasantness of the indoor environment during the rainy season (R9 and R12: r = .680, 95% CI [.207, .896], p = .010), and between breathing comfort and the latter (R11 and R12: r = .570, 95% CI [.028, .853], p = .042).

The reverse-scored items had low correlations with the others, with intervals that included zero; the highest was between humid air and breathing comfort (R7 and R11: r = .391, 95% CI [-.204, .775], p = .187), while those of damp stains with light air and with the absence of mold were practically null (R8 and R9: r = -.021; R8 and R10: r = -.005).

INTERNAL STRUCTURE

The overall Kaiser-Meyer-Olkin measure of sampling adequacy was .190, 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 twelve items, ranging from .064 (R7) to .471 (R1).

Bartlett's test of sphericity rejected the hypothesis of an identity matrix, $\chi^2(66) = 123.94$, p < .001. Given these values, the correlation matrix for this cohort is poorly suited to factor analysis; the results that follow are reported to document item functioning.

Parallel analysis suggested retaining one factor (Figure 2), which explained 32.92% of the variance, with a sum of squared loadings of 3.95 (Table 6). Table 7 presents the loadings. The factor grouped positively worded items from both dimensions: the highest loadings corresponded to pleasant temperature during the day (R1: .888) and the pleasantness of the indoor environment during the rainy season (R12: .888), followed by coolness during the hottest hours (R3: .802), the sensation of light air (R9: .704), the absence of mold (R10: .649), comfort when sleeping on summer nights (R2: .573), and comfort when breathing (R11: .555).

Five items had loadings below .30: coolness of the bedrooms at night (R5: .296), heat during the afternoons (R4: .244), damp stains (R8: .163), drafts (R6: -.036), and humid air (R7: -.026); for the last two, the software also flagged the opposite sign. Among these five are the instrument's three reverse-scored items. The software did not remove any item; the decision on them rests with the authors at the final cut.

RELATIONSHIP BETWEEN THE DIMENSIONS

Table 8 presents the Spearman correlation between the mean scores of the two dimensions. The relationship was positive and moderate, but its confidence interval included zero (ρ = .302, 95% CI [-.311, .738], p = .316; 13 cases). With this sample size, the interval is too wide to determine whether the two dimensions are independent or share a substantial portion of their variance.

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Figure 2. Scree plot with parallel analysis.

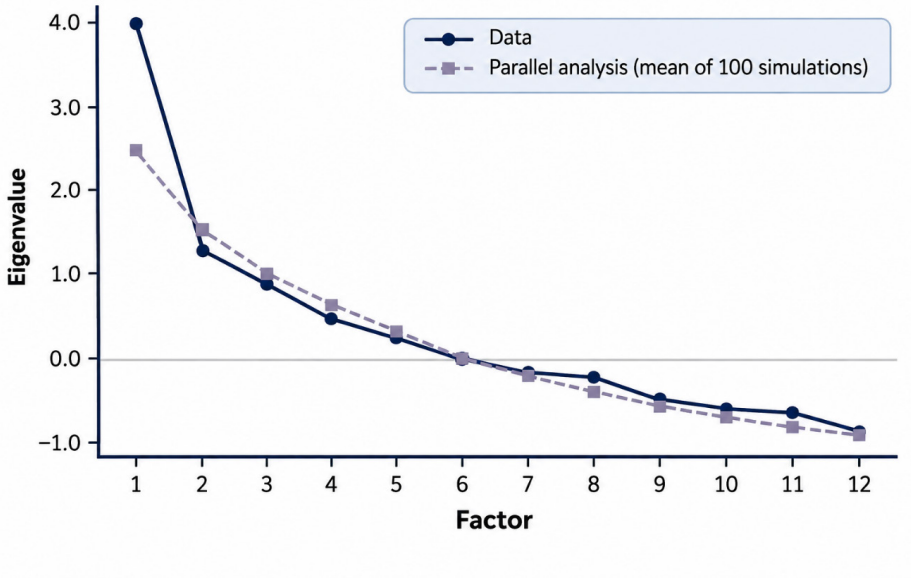


Table 6. Variance explained by the factors.

Factor	Sum of squared loadings	% of variance	Cumulative %
1	3.95	32.92	32.92

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 authors using analisis_psicometrico.py 1.0 (Python 3.13.16), dataset DST-0042_FZ_HAB_0001. Preliminary data cut: n = 13 of a target of 100, with data collection ongoing.

Table 7. Factor loadings from the exploratory factor analysis.

	Factor		
Item	1	h^2	MSA
R1	.888	.789	.471
R2	.573	.328	.192
R3	.802	.644	.355
R4	.244	.060	.110
R5	.296	.088	.142
R6	-.036	.001	.077
R7	-.026	.001	.064
R8	.163	.027	.076
R9	.704	.496	.210
R10	.649	.422	.180
R11	.555	.308	.174
R12	.888	.788	.285

Note. KMO = .190; Bartlett's test of sphericity: $\chi^2(66) = 123.94$, $p < .001$. Number of factors by parallel analysis: 1. Source: Prepared by the authors using analisis_psicometrico.py 1.0 (Python 3.13.16), dataset DST-0042_FZ_HAB_0001. Preliminary data cut: n = 13 of a target of 100, with data collection still ongoing.

Table 8. Correlations between dimensions.

Dimension pair	n	ρ	IC 95 %	p
Thermal comfort and Humidity	13	.302	[-.311, .738]	.316

Note. Pattern matrix. Minimum residual extraction and oblimin rotation (γ = 0) on the Pearson correlation matrix; 13 complete cases. h^2 = communality; MSA = measure of sampling adequacy per item. All loadings are shown. Source: Prepared by the authors using analisis_psicometrico.py 1.0 (Python 3.13.16), dataset DST-0042_FZ_HAB_0001. R1 to R6 = Thermal comfort in the dwelling; R7 to R12 = Humidity control in the dwelling. With a single retained factor, there is no rotation to apply. The dimension and observation columns are omitted; the program flagged low MSA for all twelve items, insufficient loadings for R4, R5, R6, R7 and R8, and opposite signs for R6 and R7. Preliminary data cut: n = 13 out of a target of 100, with data collection still ongoing.

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DISCUSSION OF RESULTS

This study examined the preliminary psychometric properties of a hygrothermal habitability scale in social housing in Mazatlán, based on a data cut of 13 cases. The first finding is descriptive: respondents rated the thermal performance of their dwellings less favorably than humidity control, and coolness during the hottest hours of the day was the lowest-rated aspect.

This pattern is consistent with residents' own description of social housing in northwestern Mexico as hot (Barraza-Bracamontes et al., 2022) and with evidence of unfavorable energy performance of social-interest housing in the region (Muñoz López et al., 2023). However, with 13 cases from housing developments selected by the project leader, the means cannot be used to estimate the conditions of social housing in the city.

The relatively favorable ratings of humidity, with higher means for ease of breathing and for the pleasantness of the indoor environment during the rainy season, are open to two interpretations. These may be dwellings in which indoor humidity is not perceived as a problem, or the ratings may reflect an attenuated perception of a parameter that remains relatively constant, as described in rural dwellings in southwestern China (Wei et al., 2022). The concentration of responses to R9 and R11 at a single value, with high skewness and kurtosis, is compatible with both interpretations and limits the ability of these items to discriminate between dwellings.

The second finding concerns internal consistency. The two dimensions had alphas of .684 and .671 and omegas of .743 and .745, values that should be interpreted with caution because of the sample size: the simulation literature on alpha and omega has been developed using much larger samples (Malkewitz et al., 2023).

The behavior of each item is more informative than the overall coefficient. In Thermal Comfort, air drafts (R6) were not related to the rest of the dimension, and comfort when sleeping on summer nights (R2) was weakly related; in Humidity Control, the two reverse-scored items (R7 and R8) had the lowest item-total correlations. In all three cases, deleting the item would increase alpha, but that decision cannot be made with 13 cases or on that criterion alone.

The case of drafts illustrates the difference between a characteristic of the dwelling and an appraisal of its environment. Air circulating indoors does not guarantee that the dwelling stays cool: in a trial involving rural African houses, cross-ventilated houses did not differ from controls in indoor heat index, whereas cool-roof houses had the lowest index (Abong'o et al., 2026); in Guangzhou, fan use was associated with indoor relative humidity but not with air temperature (Tian et al., 2022).

Something similar could apply to the damp stains on the walls (R8), which describe visible deterioration of the building rather than a sensation. From a measurement perspective, these items could behave as formative indicators, which make up hygrothermal habitability without having to covary with the overall ratings, and for which internal consistency is not the appropriate criterion (Bollen and Diamantopoulos, 2017).

The third finding is structural. Parallel analysis suggested a single factor, on which the direct items of the two dimensions loaded strongly, whereas the three reverse-worded items and the items on drafts and on the coolness of the bedrooms at night loaded weakly. This pattern admits at least two interpretations.

The first concerns content: the items with high loadings express an overall appraisal of how pleasant the dwelling is during hot weather and the rainy season, whereas those with low loadings refer to specific conditions or to visible deterioration. The second concerns method: that the three reverse-worded items are among those with the lowest loadings is compatible with a wording-related bias, one documented in scales with items keyed in both directions (García-Batista et al., 2021; Steinmann et al., 2022).

With an overall measure of sampling adequacy of .190 and item-level measures below .50 in all cases, neither interpretation can be supported with this data cut, and the one-factor solution should not be read as evidence against the two-dimensional structure proposed by the project.

The correlation between the dimensions likewise points to uncertainty. A coefficient of .302 with an interval from -.311 to .738 is compatible with both nearly independent and strongly related dimensions. In the literature on humid heat, indicators that combine temperature and humidity describe the associations of humid heat with health better than temperature alone does (Gao et al., 2025), and thermal sensation in tropical households has been associated with both air conditions and housing characteristics (Prima et al., 2026). A positive relationship between the two dimensions can therefore be expected; its magnitude will need to be estimated with the final data cut.

The results suggest several adjustments for the next stage. Regarding the instrument, it

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would be advisable to revise the wording of the reverse-worded items or to balance their number in each dimension so that the variance associated with item wording can be modeled. It would also be worth examining whether drafts and damp patches should be retained as indicators of housing conditions, separate from the appraisal of the indoor environment.

For the procedure, it would be useful to supplement the scale with indoor temperature and relative humidity measurements in a subsample of dwellings, as in field studies that combine thermal sensation votes with calculated indices (Gong et al., 2025; Prima et al., 2026); this would make it possible to gather validity evidence based on relations to other variables.

CONCLUSIONS

The study examined the preliminary psychometric properties of a 12-item hygrothermal habitability scale among people living in social housing in Mazatlán, using a preliminary data cut of 13 cases out of a target of 100. Respondents rated the thermal comfort of their homes less favorably than humidity control; coolness during the hottest hours was the lowest-rated aspect.

Both dimensions showed moderate internal consistency (α = .684 and .671; ω = .743 and .745), with low-contributing items in each: drafts and sleeping comfort in Thermal Comfort, and the two reverse-scored items in Humidity Control. Exploratory factor analysis suggested a single factor on which the positively worded items of both dimensions loaded, but sampling adequacy was very low (KMO = .190), and the results document only the initial functioning of the items.

The study has limitations that should be borne in mind when reading all of its results. The first is 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, above all, factor structure with precision; the factor structure results should not be interpreted as evidence regarding the structure of the scale.

The second concerns the sample: the housing developments were selected at the discretion of the project leader, the sampling method has yet to be documented, and the characteristics of the respondents are not available, so the results cannot be generalized to social housing in Mazatlán. The third concerns measurement: the floor and ceiling percentages reported by Factoriza appear to be calculated from the observed values, a point that must be verified, and the scale was not accompanied by physical measurements of the indoor environment. The fourth concerns the design: because the study is cross-sectional, it does not allow causal inferences, and no confirmatory factor analysis was performed.

Directions for future work follow from these limitations. Once the final data cut is available, it will be advisable to repeat the exploratory factor analysis and, if sampling adequacy permits, to examine whether the two-dimensional structure holds; the resulting structure should then be tested by confirmatory factor analysis in an independent sample.

It will also be advisable to decide, on content-based rather than solely statistical grounds, what to do with the low-contribution items, to review the wording of the reverse-keyed items, and to consider separating indicators of housing conditions from appraisals of the dwelling's environment. Finally, combining the scale with indoor temperature and relative humidity recordings would make it possible to gather validity evidence based on relations to other variables and to determine the extent to which occupants' perceptions reflect the conditions of their dwellings; this information would be useful for guiding the design and adaptation of social housing in a warm-climate coastal city.

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REFERENCES

Abong'o, B., Kwaro, D., Bange, T., Moshi, V., Simwero, J., Otima, J., Mendt, S., Ochomo, E., y Maggioni, M. A. (2026). Housing modifications for heat adaptation, thermal comfort and malaria vector control in rural African settlements. *Nature Medicine*, *32*(2), 518–526. https://doi.org/10.1038/s41591-025-04104-9

Barraza-Bracamontes, C., Íñiguez-Ayón, Y. P., Íñiguez-Sepúlveda, C. D., y Bojórquez-Morales, G. (2022). Habitabilidad de la vivienda social. Caso: Fraccionamiento Urbi Villa del Cedro, Culiacán, Sinaloa. *Revista de Ciencias Tecnológicas*, *5*(4), 387–406. https://doi.org/10.37636/recit.v54387406

Bartlett, M. S. (1950). Tests of significance in factor analysis. *British Journal of Statistical Psychology*, *3*(2), 77–85. https://doi.org/10.1111/j.2044-8317.1950.tb00285.x

Bollen, K. A., y Diamantopoulos, A. (2017). In defense of causal-formative indicators: A minority report. *Psychological Methods*, *22*(3), 581–596. https://doi.org/10.1037/met0000056

Bonett, D. G., y Wright, T. A. (2000). Sample size requirements for estimating Pearson, Kendall and Spearman correlations. *Psychometrika*, *65*(1), 23–28. https://doi.org/10.1007/BF02294183

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297–334. https://doi.org/10.1007/BF02310555

Espinoza Gallego, N. B., González Lomelí, D., Ochoa de la Torre, J. M., y Corral Verdugo, V. (2014). Ambiente térmico y bienestar psicológico en viviendas de interés social en clima cálido seco. *Psicumex*, *4*(2), 4–23. https://doi.org/10.36793/psicumex.v4i2.273

Ferrando, P. J., Lorenzo-Seva, U., Hernández-Dorado, A., y Muñiz, J. (2022). Decalogue for the factor analysis of test items. *Psicothema*, *34*(1), 7–17. https://doi.org/10.7334/psicothema2021.456

Galindo-Borbón, C., Borbón-Almada, A., Ochoa-de-la-Torre, J. M., y Marincic-Lovriha, I. (2024). Análisis costo-beneficio de estrategias para eficiencia energética en vivienda, aplicando la normatividad vigente en el Noroeste de México. *Revista Hábitat Sustentable*, *14*(2), 32–47. https://doi.org/10.22320/07190700.2024.14.02.03

Gao, Y., Lin, L.-Z., Bao, W.-W., He, W.-T., Zhang, Y.-T., Dong, G.-H., y He, S. (2025). Humid heat's nonlinear impact on school-age children' sleep health: Evidence from Guangdong, China. *Environmental Research*, *285*(Pt 2), Artículo 122360. https://doi.org/10.1016/j.envres.2025.122360

García-Batista, Z. E., Guerra-Peña, K., Garrido, L. E., Cantisano-Guzmán, L. M., Moretti, L., Cano-Vindel, A., Arias, V. B., y Medrano, L. A. (2021). Using constrained factor mixture analysis to validate mixed-worded psychological scales: The case of the Rosenberg Self-Esteem Scale in the Dominican Republic. *Frontiers in Psychology*, *12*, Artículo 636693. https://doi.org/10.3389/fpsyg.2021.636693

Gong, X., Yu, Y., Lai, S., Wang, X., Duan, X., Liu, J., y Wang, W. (2025). A field investigation on summer thermal comfort of occupants of rural houses in the north area of hot summer and warm winter zone, China. *Buildings*, *15*(5), Artículo 715. https://doi.org/10.3390/buildings15050715

Goretzko, D., Pham, T. T. H., y Bühner, M. (2021). Exploratory factor analysis: Current use, methodological developments and recommendations for good practice. *Current Psychology*, *40*(7), 3510–3521. https://doi.org/10.1007/s12144-019-00300-2

Groot, J., Nielsen, E. T., Nielsen, T. F., Andersen, P. K., Pedersen, M., Sigsgaard, T., Loft, S., Nybo Andersen, A.-M., y Keller, A. (2023). Exposure to residential mold and dampness and the associations with respiratory tract infections and symptoms thereof in children in high income countries: A systematic review and meta-analyses of epidemiological studies. *Paediatric Respiratory Reviews*, *48*, 47–64. https://doi.org/10.1016/j.prrv.2023.06.003

Harris, C. R., Millman, K. J., van der Walt, S. J., Gommers, R., Virtanen, P., Cournapeau, D., Wieser, E., Taylor, J., Berg, S., Smith, N. J., Kern, R., Picus, M., Hoyer, S., van Kerkwijk, M. H., Brett, M., Haldane, A., Fernández del Río, J., Wiebe, M., Peterson, P., . . . Oliphant, T. E. (2020). Array programming with NumPy. *Nature*, *585*(7825), 357–362. https://doi.org/10.1038/s41586-020-2649-2

Hartinger, S. M., Palmeiro-Silva, Y. K., Llerena-Cayo, C., Blanco-Villafuerte, L., Escobar, L. E., Diaz, A., Sarmiento, J. H., Lescano, A. G., Melo, O., Rojas-Rueda, D., Takahashi, B., Callaghan, M., Chesini, F., Dasgupta, S., Posse, C. G., Gouveia, N., Martins de Carvalho, A., Miranda-Chacón, Z., Mohajeri, N., . . . Romanello, M. (2024). The 2023 Latin America report of the Lancet Countdown on health and climate change: The imperative for health-centred climate-resilient development. *The Lancet Regional Health - Americas*, *33*, Artículo 100746. https://doi.org/10.1016/j.lana.2024.100746

Hernández Ilizaliturri, A. A., Graciano Casas, L., y Haces Atondo, G. (2025). La efectividad de la política de vivienda social en México. *Ciencias Administrativas Teoría y Praxis*, *21*(1), 62–82. https://doi.org/10.46443/catyp.v21i1.467

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis. *Psychometrika*, *30*(2), 179–185. https://doi.org/10.1007/BF02289447

Jaimes Torres, M., Aguilera Portillo, M., Cuerdo-Vilches, T., Oteiza, I., y Navas-Martín, M. Á. (2021). Habitability, resilience, and satisfaction in Mexican homes to COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, *18*(13), Artículo 6993. https://doi.org/10.3390/ijerph18136993

Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, *39*(1), 31–36. https://doi.org/10.1007/BF02291575

Li, D., Zhang, Y., Li, X., Zhang, K., Lu, Y., y Brown, R. D. (2023). Climatic and meteorological exposure and mental and behavioral health: A systematic review and meta-analysis. *Science of the Total Environment*, *892*, Artículo 164435. https://doi.org/10.1016/j.scitotenv.2023.164435

Lorenzo-Seva, U., y Ferrando, P. J. (2021). MSA: The forgotten index for identifying inappropriate items before

computing exploratory item factor analysis. *Methodology*, *17*(4), 296–306. https://doi.org/10.5964/meth.7185
Malkewitz, C. P., Schwall, P., Meesters, C., y Hardt, J. (2023). Estimating reliability: A comparison of Cronbach's α, McDonald's ωt and the greatest lower bound. *Social Sciences & Humanities Open*, *7*(1), Artículo 100368. https://doi.org/10.1016/j.ssaho.2022.100368
May-Tzuc, O., Jiménez-Torres, M. A., Cruz y Cruz, A. del R., Canul-Turriza, R., Andrade-Durán, J. E., y Noh-Pat, F. (2023). Viabilidad del modelo de confort térmico adaptativo bajo condiciones de clima cálido subhúmedo: ahorro energético en refrigeración en Campeche, México. *Revista Hábitat Sustentable*, *13*(1), 120–131. https://doi.org/10.22320/07190700.2023.13.01.10
McDonald, R. P. (2013). *Test theory: A unified treatment*. Psychology Press. https://doi.org/10.4324/9781410601087 (Obra original publicada en 1999)
Muñoz López, M. T., Gutiérrez Sánchez, L. M., y Quintana Pacheco, J. (2023). De lo ideal a lo real en eficiencia energética de la vivienda tipo interés social: caso Hermosillo, Sonora, México. *Contexto. Revista de la Facultad de Arquitectura de la Universidad Autónoma de Nuevo León*, *17*(26), 51–70. https://doi.org/10.29105/contexto17.26-373
Obeidat, B. (2026). Dwelling form and heat-related well-being in a semi-arid city: A cross-sectional survey of apartment and detached-house residents in Irbid, Jordan. *Journal of Urban Health*, *103*(1), 182–200. https://doi.org/10.1007/s11524-025-01056-w
Prima, R. R., Geater, A. F., Chongsuvivatwong, V., Taweekun, J., y Djafri, D. (2026). Thermal comfort in relation to housing and tuberculosis status among individuals aged ≥15 years in Padang, West Sumatra Province, Indonesia. *Frontiers in Public Health*, *14*, Artículo 1868280. https://doi.org/10.3389/fpubh.2026.1868280
Python Software Foundation. (2026). *Python* (Versión 3.13.16) [Software]. https://www.python.org/
Richards, G. C., Carpenter, J., Okpalugo, E., Howard, D. J., y Heneghan, C. (2023). Assessing housing exposures and interventions that impact healthy cities: A systematic overview of reviews. *Perspectives in Public Health*, *145*(5), 272–276. https://doi.org/10.1177/17579139231180756
Steinmann, I., Strietholt, R., y Braeken, J. (2022). A constrained factor mixture analysis model for consistent and inconsistent respondents to mixed-worded scales. *Psychological Methods*, *27*(4), 667–702. https://doi.org/10.1037/met0000392
Tian, J., Liu, L., Liu, L., y Gao, Y. (2022). Características de la conducta de adaptación térmica y diferencias individuales de las personas mayores en zonas rurales de clima cálido y húmedo. *Journal of Guangdong University of Technology*, *39*(6), 90–97, 122. https://doi.org/10.12052/gdutxb.210087
Treviño Hernández, R., y Hernández Rejón, E. M. (2026). Análisis documental de la temperatura en las viviendas en México: Implicaciones sociales, energéticas y de salud. *Vivienda y Comunidades Sustentables*, *10*(20), 33–42. https://doi.org/10.32870/rvcs.v0i20.338
Virtanen, P., Gommers, R., Oliphant, T. E., Haberland, M., Reddy, T., Cournapeau, D., Burovski, E., Peterson, P., Weckesser, W., Bright, J., van der Walt, S. J., Brett, M., Wilson, J., Millman, K. J., Mayorov, N., Nelson, A. R. J., Jones, E., Kern, R., Larson, E., . . . Vázquez-Baeza, Y. (2020). SciPy 1.0: Fundamental algorithms for scientific computing in Python. *Nature Methods*, *17*(3), 261–272. https://doi.org/10.1038/s41592-019-0686-2
Wei, D., Zhao, G., Liu, S., y Yang, L. (2022). Indoor thermal comfort in a rural dwelling in southwest China. *Frontiers in Public Health*, *10*, Artículo 1029390. https://doi.org/10.3389/fpubh.2022.1029390