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Walkability and the built environment: validation of the Neighborhood Environment Walkability Scale (NEWS) for urban areas in Mexico

Oscar A. Martínez-Martínez[1] · **Araceli Ramírez-López**[1]

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Abstract The article gives the results of adjusting an abbreviated version of the Neighborhood Environment Walkability Scale to the situation in Mexico. The results were obtained through the application of 156 instruments to individuals selected through a probability sampling in the metropolitan area of Monterrey, in the state of Nuevo León, Mexico. The validation process was done over four stages; in the first stage, the questions were analyzed and the sampling was adjusted. In the second stage, a factor analysis was carried out; as the questions were Likert-scale type, we use principal components with a matrix of polychoric correlations. In the third stage, the ordinal and non-ordinal Cronbach Alpha coefficients were determined, as were the ordinal and non-ordinal McDonald Omega coefficients, showing that the non-ordinal ones tend to underestimate the level of reliability, as they assume that it is a continuous scale when in this case it is not; however, the literature shows that these coefficients have been the most used in the validation of this scale. Finally, the intervals of trust were calculated with the bootstrap method, with the goal of incorporating the sensitivity that the coefficients could imply in aspects such as the number of questions, intercorrelations between the questions, and the size of the sample. The results show that the ordinal Alpha and Omega coefficients for the three factors, as well as for the entire scale, will have robust values 95% of the time that the questionnaire is used.

Keywords Walkability · Scale validation · Omega coefficients · Bootstrap method · Urban areas · México

✉ Oscar A. Martínez-Martínez
oscar.martinez@ibero.mx

[1] Department of Social and Political Sciences, Universidad Iberoamericana, Prolongación Paseo de la Reforma 880, Lomas de Santa Fe, Delegación Álvaro Obregón, 01219 Mexico City, Mexico

1 Introduction

The physical and social aspects of a neighborhood and its perception have been studied from several different perspectives. Theoretical models of quality of life indicate the importance of the surrounding environment in measuring this concept (Shafer et al. 2000); therefore, the perception of the surroundings has been integrated as a dimension in the construction and validation of quality-of-life scales (Fleury-Bahi et al. 2013; Hassine et al. 2014). Similarly, there is an interest in determining the congruence between the physical and social characteristics of the surroundings in a neighborhood and people's perception of these aspects (Marans 2003). For example, studies have been carried out to evaluate the perception of local problems such as inconveniences linked to the use of public transport, environmental pollution, overcrowding, and lack of access to services, among others (Robin et al. 2007). Additionally, an increasing number of studies record empirical evidence of how surroundings have an impact on the level of physical activity (walking and cycling) of those living in a given neighborhood (Oyeyemi et al. 2013; Gebel et al. 2007; Saelens and Handy 2008; Owen et al. 2004).

These studies show the importance of measuring the concept of a neighborhood's environment with appropriate scales. One of the most-used scales is the Neighborhood Environment Walkability Scale (NEWS), designed to measure residents' perceptions of the environmental attributes of their local area (Saelens and Handy 2008). The items that make up the scale are grouped a priori into subscales that seek to assess the constructs of residential density, proximity to shops and facilities, perception of access to stores and facilities, street connectivity, infrastructure and safety for walking and cycling, aesthetics of the surroundings, traffic hazards, and perception of crime.

The NEWS scale has been validated in several countries, and multiple versions of it have been developed (Cerin et al. 2006). The original version was developed for the United States; the test–retest reliability of the subscales was reported, and the intraclass correlation coefficients (ICC) ranged from 0.58 to 0.80 (Saelens et al. 2003). A later adaptation was identified for Australia, for which the ICC values ranged between 0.62 and 0.88 (Leslie et al. 2005). An abbreviated version of the scale for China showed ICC reliability values of between 0.57 and 0.99 (Cerin et al. 2007). More recently, the adaptation and validation carried out for Nigeria (Oyeyemi et al. 2013) showed acceptable reliability coefficients, between 0.59 and 0.91, and Cronbach's Alpha coefficient values ranging from 0.64 to 0.86.

Since NEWS was developed for the United States, its applicability in other regions can be limited due to cultural differences and specific aspects of the environment. The adaptation to the Mexican context is important because in recent decades there has been a migration from rural areas to cities and a rapid growth of the urban population (ENADID 2014). As a result, the institutions responsible for supervising urban development are facing complex challenges. Contrasting predetermined environments can be observed, where housing areas for low- and lower-middle income families have less public space, sectors lacking in services, narrower sidewalks, and less green space, and where space for trade and services emerges in a disorderly fashion with a hodgepodge of business types (González-Palomares and Sánchez-Vela 2014).

This paper shows the adaptation of the scale to the Mexican context, as well as its psychometric properties and its validity in measuring the environment's attributes. Given that NEWS is a relatively long questionnaire and that the response rate can be affected negatively by the questionnaire's length (Biner and Kidd 1994), an abbreviated version of the original scale has been proposed.

2 Materials and method

2.1 Participants

According to the National Institute of Statistics and Geography (INEGI 2011), Nuevo León has the eighth-largest population in the country and ranks 15 out of 32 states in terms of population density; its metropolitan area is composed of ten municipalities (Apodaca, Cadereyta Jimenez, Garcia, General Escobedo, Guadalupe, Juarez, Monterrey, San Nicolas de los Garza, San Pedro Garza Garcia, and Santa Catarina), where 84.79% of the total state population lives (INEGI 2015). It is also the third in the use of private cars, with 31.2 cars per 100 inhabitants, and is in first place nationwide for car accidents (INEGI 2014), entailing a strong demand for services and urban infrastructure.

Using a probability sampling, 156 questionnaires were given to residents of the metropolitan area of the city of Monterrey in Nuevo León, Mexico. The size can be justified because the literature (Gorsuch 1983; Guilford 1954; Lindeman et al. 1980; Loo 1983) recommends between 100 and 200 observations, based on the argument that the correlation coefficient in the sample is an adequate estimator of the population correlation coefficient when the sample reaches this size (Guadagnoli and Velicer 1988). Following this logic, the sample size depends on the number of questions in the scale; in this case the ratio between the number of questions and the size of the sample needed is at least 1:4 (Rumel 1970) to 1:10 (Schwab 1980).

The sample size of this study is also justified by the results obtained in scale simulations (Guadagnoli and Velicer 1988), where it was found that if in a factor analysis the components have four or more questions with factor loadings above 0.60, the results are valid regardless of the sample size; likewise, if the factors are made up of many questions (10–12) with low factor loadings, the results are valid for a sample size of at least 150. Furthermore, if the results of the factor analysis show that the construct has a small number of factors, as well as moderate and high communalities—as would probably be obtained in a sample of between 100 and 200 entries—the population factors are represented adequately (MacCallum et al. 1999). Our sample size is adequate, as it complies with these characteristics.

The colonies for gathering the information were chosen randomly, with a probability proportional to the number of homes they contained. In each of these colonies, the home to be interviewed was chosen randomly, and all the homes had the same probability of being chosen. The information was obtained from 129 different colonies located in 10 municipalities of the metropolitan area of Nuevo León, Mexico. This information-gathering process allows us to assure enough variance in the informants' responses and to avoid an idiosyncratic effect of the context; it also allows for an appropriate analysis later.

Of the participants, 55.56% come from a nuclear-family home, 23.53% come from an extended nuclear family, 16.99% come from a compound family, 2.61% come from a one-person household, and 1.31% come from a co-resident home. On average, the homes of those surveyed are made up of four people.

According to the methodology to determine socioeconomic level (AMAI 2008), 64.86% of those surveyed came from a high socioeconomic level, 14.41% from a middle-high level, 6.31% from a middle level, 8.11% from a middle-lower level, and 6.31%, from a lower level. No homes from the lowest socioeconomic level were reported. Of those families surveyed, 75% had a male head of household and 25% had a female head of household; they were on average 47 years old and had 11 years of schooling; 31.26% have undergraduate studies, 25% have high school, 40.63% have elementary and junior high education, and 3.13% of heads of household have no schooling.

Based on these sociodemographic data, we were able to make sure that the sample was approximately proportional to the universe studied.

2.2 Data and measurements

The NEWS was developed at the University of California, San Diego in 2002, to measure the perception of the residents of a local area regarding the correlation between urban and transport aspects of a neighborhood and residents' walking and cycling habits (Saelens et al. 2003). The original version has 98 questions, but it is rarely used. Abbreviated versions have been applied in countries including Australia, Belgium, Brazil, Colombia, Spain, the United Kingdom, and Korea, because the shorter version is better adjusted to the data and is slightly more valid in determining the relationship between the characteristics of the neighborhood and the variable of the amount of time people take to move around by foot (Cerin et al. 2013; Hyunshik et al. 2016).

The abbreviated version of the NEWS includes 8 subscales (Cerin et al. 2006). The first one measures residential density and includes 6 Likert-type questions (never, rarely, sometimes, usually, always). The second subscale is made up of 23 time-interval questions (1–5; 6–10; 11–20; 21–30 min; more than 30 min) that measure the proximity to stores and facilities. The third to eighth subscales are Likert-type responses (agree strongly, disagree somewhat, agree somewhat, agree strongly), and they measure the perception of access to stores and facilities (4 questions); how connected the streets are (3 questions); pedestrian infrastructure (10 questions); the image of the neighborhood (6 questions); perception of traffic (6 questions); and finally, the perception of neighborhood safety (4 questions).

For this research, an abbreviated version of the NEWS was adjusted and validated. The main reason this version is shorter is that, according to Böckenholt and Lehmann (2015), scales with several questions can lead to error when those interviewed become tired or irritated, which could lead to more-superficial responses, made evident when the underlying suppositions in the measurement error (random and independent) are not met. Along these lines, De Jong et al. (2012) show that long scales might lead the interviewees to give the same answer to questions asked together, so the responses would be artificially consistent, which would alter the confidence measurements of the Alpha coefficient.

The Spanish version of the scale went through different stages. First, the questions were translated and six of them were adjusted to the situation in Mexico; modifications were made to the response options in the case of some items. The first version of the instrument was discussed and a consensus reached in case of disagreements. A pilot test was carried out to evaluate the participants' understanding of the items and possible difficulties when responding to the instrument. After this pre-test, some questions were corrected and a second questionnaire was created. Another pilot test was carried out with the second version, and no difficulties in answering the questions were observed. The data were collected from May to October 2015.

The final version of NEWS-Mexico consists of 24 items, 13 of which examine proximity to stores and facilities, and the others describing the infrastructure available for accessing services and the image of the neighborhood. The complete scale can be seen in Appendix and is comprised of 6 items with dichotomous answers, 14 Likert-type items with 5 possible answers, and 4 items with 4 possible answers.

The participants were informed of the voluntary nature, anonymity, and confidentiality of the responses to the survey, which was approved by the ethical commission of the Iberoamericana University in Mexico.

2.3 Method

The validation process of the NEWS-Mexico scale went through four phases.

2.3.1 Phase I

With the information gathered, the means, standard deviations, skewness, and kurtosis of each of the 24 items were calculated; this process allowed us to verify that no item had problems in being included in the factor analysis.

2.3.2 Phase II

Next, basic sample adequation tests were carried out to verify that the factor analysis techniques had been applied correctly to the gathered information. Basic tests assess the suitability of the correlation matrix of the questions with two statistics, Bartlett's sphericity test and the Kaiser–Meyer–Olkin test (KMO). Bartlett's sphericity test allows us to contrast the null hypothesis that the correlation matrix is an identity matrix, in which case there would be no significant correlations between the items and a factorial-analysis model would not be pertinent. Bartlett's test's statistic is

$$B = -\left(n - 1 - \left(\frac{2p + 5}{6}\right)\ln|R^{*}|\right) \quad (1)$$

Under the null hypothesis, it is distributed as a Chi squared variable with $\left(\frac{p^2 - p}{2}\right)$ degrees of freedom; n is the sample size, p is the number of questions, and $|R^{*}|$ is the determinant of the correlation matrix. If the null hypothesis is accepted (low test value linked to a high significance level), there would be little or no correlation among the questions, and any type of factor analysis should be questioned.

Meanwhile, the KMO test quantifies the suitability of the information to carry out a factor analysis; it compares the values of the correlation coefficients observed between the variables with the partial correlation coefficients between the variables (Cerny and Kaiser 1977). The KMO statistic is calculated with

$$KMO = \frac{\sum\sum_{i \neq j} r_{ji}^2}{\sum\sum_{i \neq j} r_{ji}^2 + \sum\sum_{i \neq j} a_{ji}^2} \quad (2)$$

where r_{ji} is the correlation coefficient observed between the i and j variables, and a_{ji} is the partial correlation coefficient between variables i and j, meaning that it measures the correlation between variables i and j once the influence on them of the other variables has been eliminated. In general, a KMO > 0.7 value indicates high correlation between the questions and the suitability of applying a factor analysis to the data.

2.3.3 Phase III

The next step was the factor analysis to identify the number of underlying factors that the designed instrument was attempting to measure. The principal component analysis with Varimax rotation method was used. The factors identified by this method correspond to the eigenvectors of correlation matrix. The Varimax rotation allows us to identify more clearly and easily the underlying factors, because in this type of rotation, the correlation of each of the variables is the closest to 1 with only one of the factors obtained, and close to zero with all other factors identified. The number of factors chosen responds to the criteria of eigenvalues greater than one.

To carry out the factor analysis, the ordinal character of the scale was considered. The standard procedure of estimation used by the statistical packages is to carry out the factor analysis based on Pearson's correlation matrix; it is correct when talking about continuous scales, but Pearson's correlations are product-moment correlations that do not take into account the ordinal character of some scales. Therefore, in ordinal scales, Pearson's correlations matrix can be a distorted matrix (Oliden and Zumbo 2008). Theoretically, if the instrument designed has ordinal-type scales, the matrix used in the analysis must be the polychoric-correlations matrix, which estimates the linear relation between two unobserved continuous variables that lie beneath two observed ordinal variables that are manifest indicators of the latter (Flora and Curran 2004). Therefore, the factor analysis was done with the help of the free R software, which allows us to deal adequately with the ordinal character of the scale.

2.3.4 Phase IV

The goal of this phase was to show the validity and reliability of the scale developed. The validity refers to the instrument's ability to measure the construct it attempts to quantify, and reliability refers to the property to show similar, error-free results in repeated measurements (Kaplan and Saccuzzo 2006).

To determine the reliability of the instrument, two internal consistency measurements were used, Cronbach's Alpha coefficient (1951), and McDonald's Omega coefficient (1970), given these names because they refer to the degree at which the items on a scale correlate among themselves, and they explore the magnitude to which they measure the same construct (Streiner 2003).

Cronbach's Alpha coefficient is defined by the elements of the factor analysis (Gadermann et al. 2012), as

$$\alpha = \left[\frac{p}{p-1}\right]\left[\frac{p\gamma_{prom}^2 - h_{prom}^2}{p\gamma_{prom}^2 + u_{prom}^2}\right] \quad (3)$$

where p is the number of items that make up the factor, γ_{prom} is the average of the factor loadings, and h_{prom}^2 is the average of the communalities of the items that make up a factor; u_{prom}^2 is the average of the uniquenesses, where communality h^2 and uniqueness u^2 of an item add up to 1. We should mention that communality is the proportion of the variance explained by factors identified in a variable. There are other equivalent definitions in terms of the correlations between the items (Cronbach 1951; Li et al. 1996; Osburn 2000; Van-Zyl et al. 2000).

Meanwhile, the Omega coefficient (McDonald 1999; Tejedor et al. 2009) is calculated as:

$$\Omega = 1 - \frac{n - \sum h_j^2}{n + 2\sum r_{jh}} \quad (4)$$

where n is the number of items that make up the factor, h_j is the estimated communality of items, and r_{jh} represents the correlation between items j and h (Tables 1, 2).

Table 1 Mean, standard deviation, skew, and kurtosis of items. *Source*: Authors' elaboration

Item	Mean	SD	Skewness	Kurtosis
Value range 1–5				
Item 1	4.96	0.178	−3.22	10.46
Item 2	3.88	0.983	−0.87	0.63
Item 3	4.23	1.002	−1.39	1.61
Item 4	3.17	1.316	−0.28	−1.01
Item 5	4.48	0.976	−2.02	3.39
Item 6	3.63	1.215	−0.65	−0.32
Item 7	4.41	1.075	−1.36	0.63
Item 8	3.09	1.426	−0.18	−1.19
Item 9	3.95	1.095	−0.79	0.21
Item 10	3.89	1.077	−0.90	0.37
Item 11	3.39	1.337	−0.45	−0.92
Value range 1–2				
Item 12	1.73	0.445	−1.05	−0.91
Value range 1–5				
Item 13	3.05	1.023	−0.19	−0.15
Item 14	4.52	0.689	−1.38	1.51
Value range 1–2				
Item 15	1.94	0.235	−3.73	10.98
Value range del 1–5				
Item 16	3.68	1.044	−0.76	0.01
Value range 1–2				
Item 17	1.88	0.314	−2.46	4.09
Item 18	1.63	0.483	−0.55	−1.71
Item 19	1.64	0.492	−0.45	−1.40
Item 20	1.67	0.468	−0.76	−1.43
Value range 1–4				
Item 21	2.79	0.782	−0.65	0.25
Item 22	2.90	0.926	−0.50	−0.61
Item 23	2.83	0.825	−0.38	−0.36
Item 24	3.05	0.762	−0.72	0.52

Because it is an ordinal scale, we recommend using the polychoric correlations matrix to calculate the internal consistency coefficients; in this case they are called Alpha ordinal and Omega ordinal. These are unbiased estimators of theoretical reliability of ordinal data and tend to estimate reliability more exactly (Gadermann et al. 2012). To calculate them, the *Psych* and *Rcmdr* packages of the R software were used (Tables 3, 4).

One of the main problems in scale validation studies is to report only the point estimate of Alpha and Omega coefficients (Raykov 2002; Terry and Kelley 2012) and very rarely the level of confidence of the values that the coefficients show, to incorporate the sensitivity that they present to the number of items, the sample size, and the intercorrelations of the items (Iacobucci and Duhachek 2003). With the goal of obtaining a level of confidence in the point estimator, confidence intervals on the possible values of ordinal Alfa and Omega were estimated.

Table 2 Loadings factor, communalities, eigenvalues, and variance explained. *Source*: Authors' elaboration

Item	Factor 1	Factor 2	Factor 3	Communalities
1			0.73	0.53
2			0.56	0.46
3			0.69	0.58
5			0.71	0.53
6			0.69	0.52
7			0.30	0.22
10			0.50	0.53
11			0.50	0.52
14			0.45	0.30
4	0.38			0.31
8	0.54			0.39
9	0.42			0.33
12	0.69			0.48
15	0.72			0.55
17	0.50			0.44
18	0.78			0.63
13		0.52		0.32
16		0.49		0.29
19		0.54		0.47
20		0.62		0.54
21		0.65		0.48
22		0.51		0.33
23		0.81		0.77
24		0.79		0.73

	Factor 1	Factor 2	Factor 3	Accumulated
Eigenvalues	4.863	2.285	1.263	
Variance explained	0.3462	0.2517	0.1703	0.7682

Table 3 Point and intervals estimation of Cronbach's alpha coefficient. *Source*: Authors' elaboration

	Non-ordinal alpha coefficient α_{NO-ORD}	Ordinal alpha coefficient α_{ORD}	95% CI α_{ORD}	Attenuation percentage (%)
Factor 1	0.66	0.76	(0.67, 0.85)	13
Factor 2	0.76	0.80	(0.73, 0.86)	5
Factor 3	0.74	0.80	(0.72, 0.87)	7.5
Full scale	0.83	0.87	(0.82, 0.91)	4.5

The confidence interval expresses the range of possible values for Alpha and Omega associated with a level of confidence. All the values that make up the interval are statistically possible. There are several methods for building confidence intervals of Cronbach's Alpha; one of them is the bootstrap method (Iacobucci and Duhachek 2003). This method involves repeated resampling with replacement from a sample to obtain an empirical

Table 4 Point and intervals estimation of McDonald's omega coefficient. *Source*: Authors' elaboration

	No-ordinal omega coefficient Ω_{NO-OR}	Ordinal omega coefficient Ω_{ORD}	95% CI Ω_{ORD}	Attenuation percentage (%)
Factor 1	0.67	0.77	(0.69, 0.85)	12.98
Factor 2	0.77	0.80	(0.73, 0.87)	3.75
Factor 3	0.74	0.81	(0.74, 0.88)	8.6
Full survey	0.84	0.87	(0.82, 0.92)	3.44

distribution of an estimator such as ordinal Alpha and ordinal Omega. Once the distribution has been obtained, the confidence interval can be built directly from the empirical distribution. The estimation of the confidence intervals was done with the *MBESS* package of the R software (Tables 3, 4).

3 Results

Table 1 presents the mean, standard deviation, skew, and kurtosis of each item; all items show negative skew, in other words, the values tend to be found more toward the right of the mean. In terms of magnitude, apart from 1 and 15, they all show a skew lower than 3 in their absolute value, and therefore they satisfy the assumption of normality (Marôco 2010). In terms of kurtosis, items 1, 2, 3, 5, 7, 9, 10, 15, 16, 17, 21, and 24 have positive values, leptokurtic distribution, and—with the exception of items 1 and 15—each shows a kurtosis lower than 10 in terms of absolute value, hence it is correct to assume normality in the data (Marôco 2010).

The analysis of adequation of the sample produces a value of $KMO = 0.747$, which indicates a high correlation between the items and suggests that a factor analysis of the data should be done. The Bartlett's sphericity test statistic produces a value of $B = 900.73$, with 276 degrees of freedom and a significance level of $p < 0.0000$, and therefore we must reject the null hypothesis that the correlation matrix is the identity matrix, indicating the goodness of subjecting the data to a factor analysis.

The principal component with Varimax rotation for the polychoric correlation matrix produces a three-factor solution that explains 76.82% of the variance (Table 2). The first factor has an eigenvalue of 4.86, explaining 34.62% of the variance and including 7 items relating to infrastructure for access to services; the factor loadings range from 0.42 to 0.78, with a single item with a 0.38 factor loading. The second factor grouped the items on the neighborhood image; it had an eigenvalue of 2.28, explaining 25.17% of the variance, and includes 8 items with high factor loadings ranging from 0.49 to 0.81.

The third factor includes 9 items about proximity to stores and facilities, with factor loadings between 0.45 and 0.73 and with a single item with a loading of 0.30; this factor explains 17.03% of the variance and has an eigenvalue of 1.26. In general, each item in its respective principal factor reaches a saturation of over 0.40, except for 2 items, which is in line with a conventional criterion in this type of analysis.

Table 3 shows the values of the non-ordinal and ordinal Alpha coefficients, as well as the confidence intervals. The non-ordinal Cronbach Alpha values range from 0.66 for the first factor (infrastructure for access to services), 0.76 for the second factor (image of the neighborhood), 0.74 for the third factor (proximity to stores and facilities), of 0.83 for the complete scale. The values of the second and third factors indicate an adequate reliability level (Nunnally and Bernstein 1994); the complete scale presents a good level (George and Mallery 2003).

The ordinal Alpha gives a more exact estimate of reliability, given that this instrument has Likert-type scales. This coefficient's values are higher in relation to non-ordinal Alpha, as is established in the theory (Gadermann et al. 2012); factor 1 has an adequate coefficient of 0.76; factors 2 and 3 have a good coefficient of 0.80, and the complete scale has good coefficient of 0.87. The final column establishes the attenuation percentage, in other words the correction percentage of the estimate's error between the non-ordinal Alpha and the ordinal Alpha. The most significant percentages occur in factors 1 and 3, with 13 and 7.5%, respectively.

Using the bootstrap method (Dunn et al. 2014; Iacobucci and Duhachek 2003), with $B = 1000$ simulations, confidence intervals of ordinal Alpha were obtained (Table 3). When carrying out the sampling of the instrument repeatedly, 95% of times the ordinal Alpha coefficient values will be included in the interval, respectively; in other words, in 95% of cases the three factors will have adequate or good values in the ordinal Alpha coefficient, and in 95% of cases the complete scale will have good or excellent values (George and Mallery 2003).

Table 4 shows the non-ordinal Omega coefficient and confidence intervals. Factors 1 and 3 and the complete scale show values of one-hundredth greater than the non-ordinal Alpha (Table 3); for factor 2 the values are the same. In terms of the ordinal Omega coefficient, the first and third factors have an ordinal Omega one-hundredth greater than the ordinal Alpha, and the values are the same for the second factor and the complete scale. The confidence intervals of the ordinal Omega coefficient are slightly better than those of the ordinal Alpha. On 95% of the occasions that the sampling is repeated in this population and according to the parameters established for that test (George and Mallery 2003), the ordinal Omega coefficients will have adequate and good values, and the complete scale will have good and excellent values. It is worth mentioning that the length of the intervals can be reduced when the sampling size is increased; as such, 95% of the times the new interval to be obtained would be contained in the intervals of Table 4.

4 Discussion

This document has shown the validity of adjusting the NEWS to the Mexican cultural context; the abbreviated scale is different from abbreviated versions used in other countries (Cerin et al. 2006; Leslie et al. 2005; Cerin et al. 2007; Oyeyemi et al. 2013) and has higher psychometric properties than previous ones. It is important to mention that, unlike in this work, most studies where the NEWS scale has been validated use only the intraclass correlation coefficient as the indicator of reliability (Saelens et al. 2003; Leslie et al. 2005; Cerin et al. 2007), and others show also the Cronbach Alpha coefficient, without making it clear if it was calculated using the Pearson or polychoric correlation matrix (Oyeyemi et al. 2013). Meanwhile, other studies to validate scales of the quality of surroundings as part of the quality-of-life scales use Cronbach Alpha coefficients calculated based on Pearson correlations, even when the scale contains items with Likert-type responses (Fleury-Bahi et al. 2013; Hassine et al. 2014).

Although the NEWS-Mexico scale could have been validated only with the Cronbach Alpha coefficient, we considered that the estimator had some problems when making various assumptions of the tau-equivalent models (McDonald 1999), which are difficult to check and where, by violating these assumptions, the reliability level is underestimated. In other words, a bias exists (Dunn et al. 2014), hence the importance of applying other techniques that are more robust in showing the scale's reliability.

To discard possible biases in estimating reliability, we chose to use congeneric models. These models are less restrictive; hence, they make fewer assumptions and, unlike the tau equivalents, they admit that the variance of each item in the scale might be different (Dunn et al. 2014; Jöreskog 1971). The statistical description of the items (Table 1) corresponds to the use of a congeneric model such as McDonald's Omega coefficient.

As was already mentioned, in previous studies to validate the NEWS scale, McDonald's Omega coefficient is not included. However, in studies we can find that it is a more-precise estimator of reliability, as it makes fewer and more-realistic assumptions than Cronbach's Alpha, making it very useful to consider the information that it provides (Dunn et al. 2014; Graham 2006). In our case, although the differences between these coefficients turned out to be rather subtle, they are congruent with the literature; the Omega value was found to be greater than the Alpha value, which makes it possible to reaffirm the results obtained (Zinbarg et al. 2005). In addition, including confidence intervals for Alpha and Omega coefficients made it possible to add significance to the estimations made.

The factor analysis applied to the data made it possible to reaffirm the multidimensional aspect of the perception of the surroundings construct; three factors were identified (infrastructure for access to services, neighborhood image, and proximity to stores and facilities) in line with other studies (Fleury-Bahi et al. 2013; Hassine et al. 2014). The aspects of validity and psychometric properties are appropriate not only as related to the criteria found in the literature (Nunnally and Bernstein 1994; Iacobucci and Duhachek 2003; Cortina 1993) but also to other studies that have evaluated similar categories (Fleury-Bahi et al. 2013; Hassine et al. 2014; Saelens et al. 2003; Leslie et al. 2005; Cerin et al. 2007).

For that reason, we have emphasized the importance of checking assumptions made when carrying out factor analyses of the data from the sampling of a scale, as well as of the indicators to determine the instrument's reliability. The main aspects to be considered are the kinds of continuous or ordinal responses assumed by the scale items; the violation of assumptions of tau-equivalent models, Cronbach Alpha; and the loss of information when only the point estimation of reliability coefficients are reported.

5 Conclusions

The perception-of-surroundings construct is a concept that is gaining importance, due to its implications on people's quality of life, particularly if the purpose of the study is the perception of the surroundings and its implications on aspects such as the physical activity of the population and quality of life and public insecurity, among other things. Therefore, the indicators that encompass the three identified factors must be considered—infrastructure for access to services, image of the surroundings, and proximity to stores and services.

These considerations are of top priority, especially in urban contexts, due to the increase of internal migration to large urban centers in search of employment and studies (ENADID 2014). One example of this phenomenon is the metropolitan area of Monterrey, where almost 85% of the population of the state of Nuevo Leon is concentrated (INEGI 2015). In this sense, the validation and adaptation of the NEWS scale is the first step in studying the situation in terms of public health, due to the high usage rate of automobiles and high levels of auto accidents and to the high level of urban development in roadways for traffic (INEGI 2014) but little development for other types of mobility (walking, bicycling, and others). It means a huge challenge in the creation of public policy on urban mobility that could bring about positive effects on health.

Regarding public insecurity, it is important to note that the states with the largest urban areas in the country, such as Mexico City, the State of Mexico, Jalisco, Nuevo León, Puebla, and Chihuahua, show high rates of victims of crime and percentages above 60 in the perception of insecurity in the colony or neighborhood (ENVIPE 2016). It does not mean that states with medium-sized or small urban areas are exempt from these types of problems. The NEWS-Mexico provides variables that can explain the perception of public insecurity and even of crime.

One of the study's limitations is that the instrument was applied in a single city, and the heterogeneity of other contexts was not captured; however, the robustness of the tests used shows solid construct. Applying the instrument in other regions would make it possible to capture a wider variety of information and to construct a valid scale for the entire population. Therefore, it could be possible to evaluate the implications of the perception of the surroundings on local inhabitants' physical activities, to record any significant differences of this impact across the country's various regions, and to determine the perception of the environment for urban and rural populations, as well as at the socioeconomic-status level.

The socioeconomic levels of the homes that make up the sample show another limitation of the study, because even though almost every level was showed (high, middle-high, middle, middle-low, and lower), no very-low-level homes were reported. It can be explained because Nuevo León is the state with the lowest percentage of poverty, including extreme poverty, just as it is the fourth in income inequality as calculated by the Gini coefficient (CONEVAL 2015).

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Appendix: NEWS-Mexico questionnaire

Questionnaire applied to test the scale

For questions 1 through 11:

From 1 to 10 min… (1)/From 11 to 20 min… (2)/From 21 to 30 min… (3)/From 31 to 40 min… (4)/More than 40 min… (5)

Item 1. How long does it take you to walk from your house to the store?
Item 2. How long does it take you to walk from your house to the supermarket?
Item 3. How long does it take you to walk from your house to the fruit and vegetable market?
Item 4. How long does it take you to walk from your house to the computer and accessories store?
Item 5. How long does it take you to walk from your house to the bus stop, metro, or Metrobus station, etc.?
Item 6. How long does it take you to walk from your house to a bank?

Item 7. How long does it take you to walk from your house to a park or recreation center?
Item 8. How long does it take you to walk from your house to a bookstore?
Item 9. How long does it take you to walk from your house to the gym?
Item 10. How long does it take you to walk from your house to the laundromat?
Item 11. How long does it take you to walk from your house to the café?

For question 12:

No… (1)/Yes… (2)

Item 12. Do you do most of your shopping at stores in your neighborhood?

For question 13:

Very good… (5)/Good… (4)/Regular… (3)/Bad… (2)/Very bad… (1)

Item 13. How would you rate the public transport you use?

For question 14:

From 1 to 30 min… (5)/From 31 to 60 min… (4)/From 61 to 90 min… (3)/From 91 to 120 min… (2)/More than 2 h… (1)

Item 14. How long does it take you to reach your school or workplace?

For question 15:

Yes… (2)/No… (1)

Item 15. Are there sidewalks on most of the streets of your neighborhood?

For question 16:

Very easy… (5)/Easy… (4)/Neither easy nor difficult… (3)/Difficult… (2)/Very difficult… (1)

Item 16. Given the quality of the sidewalks in your neighborhood, how easy is it to walk on them?

For questions 17 through 20:

Yes… (2)/No… (1)

Item 17. Are there trees or green areas along the streets in your neighborhood?

Item 18. In your neighborhood, are there pedestrian crosswalks and traffic lights that help you cross busy streets?

Item 19. Are the streets in your neighborhood well-lit at night?

Item 20. Generally speaking, is there no trash left on the streets in your neighborhood?

For questions 21 through 24:

Dissatisfied … (1)/Not really satisfied … (2)/Somewhat satisfied… (3)/Very satisfied… (4)

Item 21. How satisfied do you feel with the number of pedestrian crosswalks in your neighborhood?
Item 22. How satisfied do you feel with access to public transport?

Item 23. How satisfied do you feel with the neighborhood as somewhere good to raise children?
Item 24. How satisfied do you feel with the neighborhood as somewhere good to live?

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