



The Neighborhood Environment Walkability Scale for the Republic of Korea: Reliability and Relationship with Walking

Hyunshik KIM¹, Younglae CHOI², Jiameng MA¹, Kuam HYUNG³, Masashi MIYASHITA⁴, *Sunkyoung LEE⁵

1. Faculty of Sport Medicine, Sendai University, Miyagi, Japan
2. Dept. of Physical Education, Konkuk University, Seoul, Republic of Korea
3. Dept. of Sports in Life, Jangan University, Gyeonggi, Republic of Korea
4. Faculty of Education, Tokyo Gakugei University, Tokyo, Japan
5. Dept. of Life Physical Education, Myongji University, Seoul, Republic of Korea

*Corresponding Author: Email: iamlsk@mju.ac.kr

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Abstract

Background: The aim of the study was to analyze the reliability of the Korean version of the NEWS and to investigate the relationship between walking and environmental factors by gender.

Methods: A total of 1407 Korean adults, aged 20-59 yr, participated in the study. Data were collected between Sep 2013 and Oct 2013. To examine the test-retest reliability, 281 of the 1407 participants were asked to answer the same questionnaire (Korean NEWS-A scale) after a 7-d interval.

Results: The ICC range of the entire questionnaire was 0.71-0.88. The item on land use mix-diversity had the highest ICC, and that on physical barriers had the lowest. In addition, presents the partial correlation coefficients for walking and the NEWS-A score, adjusted for social demographic variables. Overall, land use mix-diversity ($P<0.034$) and land use mix-access ($P<0.014$) showed a positive relationship with walking.

Discussion: Examination of the reliability of the Korean NEWS-A scale based on Korean adults who reside in large cities showed that all items had statistically satisfactory reliability. Korean NEWS-A scale may be a useful measure for assessing environmental correlates of walking among population in Korea.

Keywords: Environment, Physical activity, Korean NEWS-A, Reliability

Introduction

Although regular physical activity can provide health benefits (1), not many adults in Korea seem to participate regularly in physical activities. The Korea National Health and Nutrition Survey 2011 showed that only about 22.8% of male and 15.8% of female adults participated in moderate-vigorous intensity physical activity for at least 30 min a day, for at least 5 d a week. Additionally, 41.3% of male and 34.8% of female adults participated in recreational and commuting walking for at least 150 min (2). Several interventional studies are based on utilizing social-psychological

factors to increase physical activity (3); however, many such interventions have shown disappointing results, particularly with regard to the long-term maintenance of physical activity (4). Some recent reports have highlighted the importance of constructing an effective population strategy, which considers environmental factors that affect adults' behaviors, to stimulate physical activity at the national level (5, 6).

Therefore, studies that review environmental factors related to enhancing physical activity are prevalent in the United States (7), Austria (8), and

Europe (9-11). As documented in numerous reviews, neighborhood walkability (a construct that includes intersection density, mixed land use, and residential density) and access to recreational resources (such as parks and recreation centers and programs) have been related to overall physical activity, as well as to walking for transportation and recreation (12-14). Researchers use Geographic Information Systems (GISs) (15) or surveys to assess walking environments. One such survey is the Neighborhood Environment Walkability Scale (NEWS), (16) and its abbreviated version (NEWS-A) (17). These surveys use simple and wide-ranging investigations to assess a neighborhood's walking environment. The validity and reliability of these tools have been examined in many countries, especially regarding various self-administered perceived/subjective environmental factors related to walking such as residential density, land use mix-diversity, land use mix-access, street connectivity, infrastructure and safety for walking aesthetics, traffic hazards, and crime (18-21).

Due to its relationship to physical activity, studies on walking environment originated in the United States, Australia, and multiple European countries, and this trend has affected East Asian countries such as Japan, China, Hong Kong. Korea has unique city planning systems, traffic networks, and maintenance situations. Therefore, in the present study, we expected to find significantly unique physical patterns in Koreans (22, 23). However, no study has examined neighborhood-walking environments in Korea. Therefore, it is crucial to review the relationship between walking and physical activities to enhance the walking behaviors of and increase physical activities in Koreans.

The reliability of the survey tools must be analyzed in order to examine neighborhood-walking environments more accurately. Specifically, it is important to edit questions developed in foreign countries to accommodate for cultural and social differences. Therefore, the present study aimed to analyze the reliability of the Korean version of the NEWS and to investigate the relationship between walking and environmental factors by gender.

Methods

Participants and Data Collection

A total of 1407 adults, aged 20-59 yr, participated in the study. Participants were approximately balanced by gender and age group, as shown in Table 1. Seoul was divided into four regions namely: East, West, South, North, and the data was collected from 4 wards (Gangnam-Gu, Yangcheon-Gu, Songpa-Gu, and Nowon-Gu) out of 25, selected by stratified sampling. Individuals interested in participating in the survey received a study consent form and a completed set of self-administered questionnaires from volunteers. The questionnaire was meant to be self-administered, but, if required, the volunteers were present to clarify the meaning of the questions. The volunteers were recruited from their universities and received several training sessions. To examine the test-retest reliability, 281 of the 1407 participants were asked to answer the same questionnaire after a 7-d interval. Written informed consent was obtained from all the participants. Data were collected between Sep 2013 and Oct 2013.

Socio-Demographic Variables

Data on participants' sex, age (20-29, 30-39, 40-49, and 50-59 yr), marital status (married or not married), employment status (full time, part time, or unemployed), educational level (below high school or higher than a two-year college degree), household income (less than 1 million won, 1-2 million won, 2-3 million won, or more than 3 million won), and presence of children in the household (yes or no) were obtained from self-report. Additionally, body mass index (BMI) was calculated by dividing body weight in kilograms by height in meters squared (kg/m^2). The participants then classified their BMI themselves, into normal (<25), overweight (25-30), and obese (>30), according to the criterion of WHO (24). These socio-demographic variables were based on the International Physical Activity and the Environment Network study design.

Table 1: Sociodemographic characteristics of participants

Variable	Overall		Women		Men	
	n	%	n	%	n	%
Age (yr)						
20-29	67	23.8	34	20.5	33	28.7
30-39	83	29.5	48	28.9	35	30.4
40-49	62	22.1	41	24.7	21	18.3
50-59	69	24.6	43	25.9	26	22.6
Mean±SD	38.3±11.9		39.5±11.7		36.6±12.2	
Marital status						
Married	116	41.6	59	35.8	57	50.0
Not married	163	58.4	106	64.2	57	50.0
Employment status						
Full time	151	54.3	85	52.1	66	57.4
Part time	108	38.8	65	39.9	43	37.4
Not employed	19	6.8	13	8.0	6	5.2
Educational status (years)						
<high school graduate (-12)	126	45.0	69	41.6	57	50.0
≥college or university (13-)	154	55.0	97	58.4	57	50.0
Annual household income (KRW)						
<1,000,000	81	28.8	46	27.7	35	30.4
1,000,000-1,999,999	74	26.3	51	30.7	23	20.0
2,000,000-2,999,999	60	21.4	35	21.1	25	21.7
>3,000,000	66	25.5	34	20.5	32	27.8
Children in household						
Yes	153	55.2	98	59.0	55	49.5
No	124	44.8	68	41.0	56	50.5
BMI (kg/m ²)						
<24.9	177	64.8	135	83.9	42	37.5
25-29.9	51	18.1	14	8.7	37	33.0
30.0-	45	16.5	12	7.5	33	29.5

The Neighborhood Environment Walkability Scale-Abbreviated (NEWS-A)

The NEWS-A, a globally used tool, was translated into Korean and used to evaluate walking environment in the present study. This scale was used to evaluate how the environment surrounding the participants' residence affects their walking behavior and physical activities. NEWS-A comprises a set of survey questions developed in the United States based on previous studies on physical activities, city planning, city traffic, etc. This scale is widely used to evaluate walking,

physical activities, and related environmental factors (17).

This study consisted of three stages: 1) the development and translation of the survey after receiving permission from the original author to use it, 2) a pilot study, including cognitive testing, and 3) reliability testing after the survey questions were edited to accommodate them to the Korean culture, based on the results of the pilot study.

The original NEWS-A is a 54-item questionnaire that assesses perceived neighborhood environment characteristics. These are grouped into subscales including perceived residential density,

proximity to non-residential land (land use mix-diversity), ease of access to non-residential land (land use mix-access), street connectivity, and infrastructure for walking and cycling, aesthetics, traffic safety, and safety from crime. The items on residential density use a 5-point rating scale (from 1=none to 5=all), whereby ratings are weighted relative to the average residential density that a specific item represents, which are 1, 12, 10, 25, 50, and 75 (16). Land use mix-diversity is assessed by the perceived walking proximity from home to 23 different types of destinations, with responses ranging from 1-5 min walking distance (coded as 5, indicative of high walkability) to >30 min walking distance (coded as 1, indicative of low walkability). Four single items assess hilly streets, lack of parking, lack of cul-de-sacs, and physical barriers to walking. All subscales and single items, with the exception of residential density and land use mix-diversity, are rated on a 4-point Likert scale (from 1=strongly disagree to 4=strongly agree). Higher scores on this scale indicate closer average proximity.

Self-Reported Physical Activity

The short form of the Korean version of the International Physical Activity Questionnaire (IPAQ) was used to estimate the levels of physical activity (25). The IPAQ short form (IPAQ-SV) asks respondents to rate the frequency and duration of walking, and of moderate- and vigorous-intensity activities performed for at least 10 min per session (26). Weekly minutes of walking, and moderate- and vigorous-intensity activities were calculated separately by multiplying the number of days per week by the average daily duration. The reliability and validity of the Korean version of the IPAQ-SV were confirmed in many studies. Additionally, the Test-retest reliability for total physical activity on the Korea IPAQ-SV was adequate (Spearman's rho = 0.54). Further, validity was reported to have a positive relationship with the amount of energy consumption for 1 day, calculated from the physical activity data (Spearman's rho = 0.27). The tool was modified to accommodate each country (12 countries in total). Further, in comparison with

the outcome of the physical activity study, which confirmed its validity and reliability, these modified tools demonstrate similar results (26).

Statistical Analyses

Descriptive statistics, i.e., mean and percentage, were used to describe the socio-demographic characteristics of the participants. Further, the test-retest reliability of each of the environmental factors was analyzed overall, and by gender, using interclass correlation coefficients (ICCs) with a 95% confidence interval. Ratings suggested by Landis and Koch 1.0-0.8 (almost perfect), 0.8-0.6 (substantial agreement), 0.6-0.4 (moderate agreement), 0.4-0.2 (fair agreement) and 0.2-0.0 (poor agreement) were used to interpret the results (27). A partial correlation analysis was conducted to confirm the relationship between walking based on gender and the environmental factors of NEWS-A using demographic variables as covariance. Significance level was considered at $P < 0.05$. All analyses were conducted using SPSS version 20.0 for Windows (SPSS Inc., Chicago, IL, USA). This study received prior approval from the Ethics Committee of Tokyo Gakugei University.

Results

Characteristics of Participants

A total of 281 respondents completed the test-retest questionnaires. Table 1 shows the socio-demographic characteristics of the overall sample. Of the respondents, 23.8% were aged 20-29 yr, 29.5% were aged 30-39 yr, 22.1% were aged 40-49 yr, and 24.6% were aged 50-59 yr. The mean ages for men and women were 39.5 ± 11.7 and 36.6 ± 12.2 yr, respectively. Compared to men, more women who participated in this study were single (64.2%), and the education level of most respondents was college or university (58.4%). Further, 83.9% women had a BMI of 24.9 or below, and 62.5% men had a BMI of 25 or above.

Test-retest reliability

The results of the test-retest reliability for respondents, and those by gender, are presented in

Table 2. The ICC range of the entire questionnaire was 0.71-0.88.

Table 2: Intraclass correlation coefficients of characteristics of the Neighborhood Environment Walkability Scale-Abbreviated South Korea Version

Subscales/single items	Overall		Women		Men	
	ICC (95%CI)	P	ICC (95%CI)	P	ICC (95%CI)	P
Residential density (range 173-865)	0.82 (0.80 - 0.83)	<0.001	0.83 (0.81 - 0.85)	<0.001	0.79 (0.76 - 0.81)	<0.001
Land use mix-diversity (range 1-5)	0.88 (0.87 - 0.86)	<0.001	0.87 (0.86 - 0.88)	<0.001	0.88 (0.87 - 0.89)	<0.001
Land use mix-access (range 1-4)	0.81 (0.78 - 0.83)	<0.001	0.77 (0.73 - 0.80)	<0.001	0.85 (0.82 - 0.88)	<0.001
Street connectivity (range 1-4)	0.75 (0.71 - 0.78)	<0.001	0.75 (0.69 - 0.79)	<0.001	0.74 (0.68 - 0.79)	<0.001
Infrastructure and safety for walking (range 1-4)	0.83 (0.81 - 0.84)	<0.001	0.83 (0.81 - 0.85)	<0.001	0.82 (0.79 - 0.84)	<0.001
Aesthetics (range 1-4)	0.85 (0.83 - 0.86)	<0.001	0.85 (0.83 - 0.87)	<0.001	0.83 (0.81 - 0.86)	<0.001
Traffic hazards (range 1-4)	0.77 (0.74 - 0.80)	<0.001	0.77 (0.74 - 0.80)	<0.001	0.77 (0.72 - 0.81)	<0.001
Crime (range 1-4)	0.83 (0.80 - 0.85)	<0.001	0.81 (0.78 - 0.84)	<0.001	0.85 (0.82 - 0.88)	<0.001
Lack of parking (single item : range 1-4)	0.79 (0.74 - 0.83)	<0.001	0.77 (0.70 - 0.83)	<0.001	0.83 (0.76 - 0.88)	<0.001
Lack of cul-de-sacs (single item : range 1-4)	0.78 (0.73 - 0.82)	<0.001	0.68 (0.59 - 0.75)	<0.001	0.89 (0.86 - 0.93)	<0.001
Hilliness (single item : range 1-4)	0.86 (0.83 - 0.89)	<0.001	0.84 (0.79 - 0.88)	<0.001	0.87 (0.82 - 0.91)	<0.001
Physical barriers (single item : range 1-4)	0.71 (0.65 - 0.76)	<0.001	0.68 (0.59 - 0.75)	<0.001	0.73 (0.63 - 0.81)	<0.001

ICC: Intraclass correlation coefficient 95%, CI : confidence interval, ICC: Intraclass correlation coefficient, 95% CI : confidence interval.

Table 3: Scores of characteristics of Neighborhood Environment Walkability Scale-Abbreviated (NEWS-A) by sex

Subscales/single items	Overall	Women	Men	F	P
Residential density (range 173-865)	575±141	578±146	569±133	0.204	0.616
Land use mix-diversity (range 1-5)	3.69±0.70	3.80±0.61	3.52±0.77	7.463	0.001
Land use mix-access (range 1-4)	3.22±0.61	3.23±0.63	3.20±0.58	1.137	0.639
Street connectivity (range 1-4)	2.69±0.55	2.71±0.57	2.68±0.52	1.251	0.674
Infrastructure and safety for walking (range 1-4)	2.77±0.48	2.77±0.53	2.76±0.39	5.634	0.933
Aesthetics (range 1-4)	2.55±0.60	2.60±0.61	2.49±0.58	0.328	0.124
Traffic hazards (range 1-4)	2.38±0.42	2.32±0.44	2.47±0.37	0.391	0.005
Crime (range 1-4)	1.95±0.55	1.90±0.54	2.02±0.56	0.118	0.081
Lack of parking (single item : range 1-4)	2.58±0.80	2.54±0.82	2.64±0.77	0.974	0.299
Lack of cul-de-sacs (single item : range 1-4)	2.56±0.70	2.60±0.67	2.52±0.74	2.300	0.373
Hilliness (single item : range 1-4)	2.05±0.66	1.95±0.61	2.20±0.70	9.447	0.002
Physical barriers (single item : range 1-4)	1.77±0.62	1.68±0.59	1.91±0.64	3.254	0.002

Values are expressed as means ± SD except for percentage. Values are expressed as means ± SD except for percentage.

Further, the item on land use mix-diversity had the highest intraclass correlation coefficient, and that on physical barriers had the lowest. By gender, the ICC ranged from 0.68-0.87 for women

and from 0.73-0.89 for men. For both genders, the item on physical barriers had the lowest ICC. Further, for women, the item on land use mix-diversity had the highest ICC, and that on lack of cul-de-sacs had the highest ICC for men.

Table 3 shows the mean scores and SD for the environmental variables. We found that, as compared to men, women had higher scores for traffic hazards, crime, lack of parking, hilliness, and physical barriers. In addition, there was a significant relationship between these two gender groups in terms of land use mix-diversity, traffic hazards, hilliness, and physical barriers.

Partial correlation coefficients between NEWS-A and walking

Table 4 presents the partial correlation coefficients for walking and the NEWS-A score, adjusted for social demographic variables. Overall, land use mix-diversity ($P < 0.034$) and land use mix-access ($P < 0.014$) showed a positive relationship with walking. In addition, there was a correlation between walking and street connectivity

($P < 0.024$) and hilliness ($P < 0.042$) among women, whereas for men, there was a correlation with land use mix-access ($P < 0.036$), infrastructure for walking and cycling ($P < 0.026$), aesthetics ($P < 0.007$), and traffic safety ($P < 0.050$).

Discussion

The present study confirmed the reliability of the Korean NEWS-A, based on Korean adults who reside in Seoul, and the relationship between environment walkability and walking behavior. Land use mix-diversity had the highest reliability and, similar to previous studies (28), relatively objective items such as residential density and land use mix-access showed high reliability.

Table 4: Partial correlation coefficients between Neighborhood Environment Walkability Scale-Abbreviated (NEWS-A) and walking

Variable	Overall	P	Women	P	Men	P
Walking						
Residential density	0.039	0.523	0.020	0.804	0.068	0.488
Land use mix-diversity	-0.020	0.746	0.115	0.147	0.116	0.234
Land use mix-access	0.130	0.034	0.071	0.372	0.203	0.036
Street connectivity	0.150	0.014	0.179	0.024	0.105	0.280
Infrastructure and safety for walking	0.054	0.377	-0.036	0.651	0.216	0.026
Aesthetics	0.070	0.253	-0.056	0.484	0.261	0.007
Traffic hazards	-0.059	0.333	-0.012	0.883	-0.190	0.050
Crime	-0.057	0.352	-0.014	0.856	-0.129	0.186
Lack of parking	0.063	0.301	0.074	0.356	0.038	0.699
Lack of cul-de-sacs	-0.012	0.844	-0.095	0.233	0.090	0.354
Hilliness	0.039	0.528	0.162	0.042	-0.142	0.146
Physical barriers	0.032	0.607	0.057	0.477	-0.020	0.840

Adjusted for marital status, employment status, education status level, income level.

Significant correlation coefficients ($P < 0.05$).

Adjusted for marital status, employment status, education status level, income level.

Significant correlation coefficients ($P < 0.05$)

On the other hand, while previous studies on environment walkability demonstrated low reliability levels in objective items such as crime and aesthetics, these items exhibited high reliability in the present study. Further, similar results were

found when these were reviewed by gender, indicating that the different genders view environment walkability differently (29). An examination of the reliability of the Korean NEWS-A showed an ICC range of 0.71-0.88, which was higher than

the reliability level of the original NEWS-A (16). This reliability level is relatively satisfactory compared to the results of the other studies conducted in Asian countries, with similar social and cultural environments, such as Japan (ICC: 0.76-0.96) (29) and Hong Kong (ICC: 0.57-0.99) (30). Meanwhile, previous studies reported that amongst the factors that affect reliability, a smaller correlation coefficient was observed with an increase in the reviewing period (31). The present study conducted in Korea, the studies conducted in Japan (29), and Hong Kong (30) obtained similar results compared to those conducted in the United States. Further, similar to the findings of previous studies (32, 33), the present study revealed relationships between recreational and commuting walking behaviors and environment factors. Women showed a high correlation, especially for the item on street connectivity. Street connectivity, with respect to intersection widths and various paths to the destination, has been confirmed to affect walking behaviors. Therefore, this result suggests that street connectivity can negatively affect walking behaviors and physical activities in Western cultures as well.

Items such as residential density and land use mix-diversity were highly related to walking (32). However, the present study did not demonstrate any significant relationships between these items and walking. We expect this to be because, in contrast to previous studies conducted on mostly homemakers, 80% of the subjects in the present study were women who had at least part-time employment (32). Environmental factors and walking had different characteristics based on gender (33). For men, walking was related to land use mix-diversity, infrastructure and safety for walking, and aesthetics, while women showed different results. These results were similar to the results of the study conducted in Western countries, which have very different living environments (14). Therefore, this result implies that the surrounding aesthetics or infrastructure and safety for walking may significantly affect pedestrian behaviors in Korea as well, due to improvements in the economic level of Seoul residents. The present study originally aimed to analyze the re-

liability of the Korean NEWS-A scale and review the relationship between environment walkability and behaviors based on gender. However, we must consider that Koreans have very different residential environments and lifestyles compared to people in Western countries. Therefore, we must confirm the relationship between walking and environmental factors appropriate in Korea, to enhance physical activities at the national level. This study has the following limitations, however. First, we cannot infer any causal relationships from the data because this is a cross-sectional study. Second, the environmental scales for walking and residence investigated in this research included subjective evaluation factors. Future studies should be conducted with objective evaluation using physical activity (accelerometer) and environmental factor (geographical information system) assessments. Third, this study used only data from residents of large cities. Since such data may be affected by population density, crime rates, traffic, etc., various regions should be taken into account.

Conclusion

Examination of the reliability of the Korean NEWS-A scale based on Korean adults who reside in large cities showed that all items had statistically satisfactory reliability. The relationship between walking and environmental factors by gender generally matched the results of previous studies conducted in many other countries. Based on the results of the present study, we expect that the Korean NEWS-A scale can be used as an appropriate method to collect environmental data for planning programs to improve the physical activities of Koreans.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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