Physical Environmental Correlates of Walking to Commute, Exercise, and Purchase food

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ABSTRACT

The physical environment is an important factor when promoting walking among people. This paper investigates the characteristics of physical environments that support or hinder walking. The aim is to analyze the physical environment affecting residents' walking for different purposes. It focuses on the physical environment including pedestrian environment perception and neighborhood environment.

A survey on the frequency of walking, pedestrian environment and travel time was conducted with 302 residents in Chang-won, Korea. The neighborhood environment was examined using Geographic Information System (GIS). Linear regression analyses identified three demographic variables, age, occupation, and residential type as having a statistically significant association with walking for commuting and exercise but not for food purchase. Travel time variable was found significant in walking to commute and purchase food but not walking to exercise. The three walking models provide useful frameworks to conceptualize physical environment-walking by purpose.

Keywords: Walkability, Physical activity, Health, Neighborhood environment

1. Introduction

Recent health promotion efforts have adopted an ecological paradigm (Duhl and Sanchez, 1999, Lee and Ahn, 2008) accepting that both individual and physical environmental determinants play a role in the performance of health behaviors and the resulting health outcomes (Christopher, 2006). Among health behaviors, walking has always been a natural part of human culture and health (Lee, 2004).

The study's aim is to understand how walking behaviors are associated with physical environment variables. Particular emphasis is given to comparing the environmental influences on three different purposes of walking i.e. to commute, exercise, and purchase food, identifying similarities and differences. The research examines details of the physical environment and its roles in promoting walking for the three different purposes. This dissertation contributes to a better understanding of the relationship between the physical environment and walking for specific purposes.

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2. Methods

This paper considered demographics and physical environment as potentially associated with walking. The physical environment was the focus of this paper, and it was divided into pedestrian and neighborhood environments and travel time to examine their potential differences in promoting or hindering walking for three general purposes. All data, except neighborhood environmental data, were collected from a survey. A total of 302 survey participant were recruited from Seongsan-gu, Uichang-gu in Chang-won, Korea in 2006. The survey was administered as an individual face-to-face interview or as a small group activity (Park, 2006, Park *et al.*, 2007). The questions were grouped into three sections addressing the topics of walking for specific purposes, perceptions of the pedestrian environment in neighborhoods, and demographics.

Measurement of neighborhood environment variables such as Land use mix, proportion of commercial area, residential area and park area within a 1km network buffer from each respondent's home were measured.

The dependent variables were the number of participants walking to commute, exercise and purchase food per week. The independent variables were the pedestrian environment and travel time based on the

survey and objective neighborhood environment variables that constituted the network areas within a 1km radius of the respondents' homes from GIS.

Once the variables were selected and descriptive analyses were completed, walking models were estimated. All three types of final models followed the same modeling process described. The first step, factor analysis, was performed only once, as it produced the latent factor variables from pedestrian environment variables that were commonly included in all final models.

Seventeen pedestrian environment perception variables including path width, path slope, path material sidewalk condition, path obstructions, buffers between road and path, crossing aids in segment, posted traffic speed, traffic volume, crosswalk signal waiting time, path lighting, street furniture, trees shading walking area, traffic noise, natural landscape, building features, crime rate captured from surveys were analyzed using factor analysis. Based on the factor analysis, a total of four factors including structural, risk, landscape, and safety were identified for this study.

The three walking models were estimated by linear regression analysis. For three models, frequency of walking is categorized into six categories: zero, one, two, three, four, and five or more walking trips per week.

Most demographic variables considered factored strongly in explaining how many walks were taken regardless of the purpose, with an expected direction of association.

For setting the final walking model, the base model was developed from independent variables in the survey including demographic variables. Variables were selected for the base model first based on their theoretical significance and second based on whether they have a statistically significant association with a walking dependent variable (at the 0.l level) using linear regression analysis. Then, physical environmental variables were added to the Base Model one at a time. The goal was to systematically compare and select variables that are most likely associated with walking for commuting, exercising and food purchase.

3. Findings

3.1 Descriptive statistics from survey

Among the 302 respondents, 37.1% were students, 34.8% were office workers and a few (9.9%) were self-employed (Table 1). Almost half (49.4%) said they lived in apartments, and 26.8% in detached houses. Over half (50.3%) of respondents were under the age of twenty, and 25.2% were in their thirties. Only 18 people (6%) were in their 50s or older.

TABLE 1. Characteristics of respondents

Demographic characteristics		N	%
Occupation	Student	112	37.1
	Housewife	42	13.9
	Office worker	105	34.8
	Self-employee	30	9.9
	Etc.	13	4.3
Residential type	Detached house	81	26.8
	Multi-family house	33	10.9
	Row house	39	12.9
	Low-rise apartment	38	12.6
	High-rise apartment	111	36.8
Age	Teenagers	33	10.9
	Twenties	119	39.4
	Thirties	76	25.2
	Forties	56	18.5
	Fifties	16	5.3
	More sixties	2	0.7

The difference in "not walking" for exercising and food purchase was small, with 18.5% and 34.4% respectively (Table 2). In contrast, more than half of the respondents reported no walking for commuting on a weekly basis. Only 23.8%, 22.8% and 13.9% of respondents reported walking more than 5 times a week to commute, exercise and purchase food.

TABLE 2. Frequency analysis of dependent variable

Frequency of walking	Commute		Exercise /walk		Food purchase	
	N	%	N	%	N	%
None	177	58.6	56	18.5	104	34.4
Once	12	4.0	51	16.9	45	14.9
Twice	22	7.3	59	19.5	49	16.2
3 times	7	2.3	47	15.6	46	15.2
4 times	12	4.0	20	6.6	16	5.3
More 5 times	72	23.8	69	22.8	42	13.9
Total	302	100	302	100	302	100

Based on t-test, the frequency of walking for the three purposes showed significant differences at the 0.1 level. The finding generally did support being distinguished from each walking pattern for three purposes.

TABLE 3. T-test between walking by purpose

Variables	t	Sig
Commute - Exercise	-5.591	0.000
Commute -Purchase food	7.334	0.000
Exercise - Purchase food	2.972	0.003

3.2 Walking model for commuting

Age, occupation, and residential types were selected to be included in the base model, on the significance at the 0.1 level (Table 4). The findings showed that younger people are more likely to walk for commuting. Housewives and office workers reported less frequent walking for commuting than students. Those who live in low-rise and high-rise story apartments showed a lower tendency to walk than those living in detached houses.

TABLE 4. Base model for commuting

BASE MODEL	Variables	B	S.E.	t	Sig.
		3.673		9.318	0.000
	Age**	-0.346	-0.177	-2.143	0.033
Occupation	Student	reference			
	Housewife***	-1.541	-0.250	-3.271	0.001
	Office worker***	-1.165	-0.260	-3.511	0.001
	Self-employee	-0.501	-0.070	-0.899	0.369
	etc.	-0.592	-0.056	-0.974	0.331
Residential type	Detached house	reference			
	Multi-family house	-0.388	-0.057	-0.953	0.341
	Row house	-0.348	-0.055	-0.907	0.365
	Low-rise apartment***	-1.006	-0.156	-2.610	0.010
	High-rise apartment**	-0.611	-0.138	-2.136	0.033

*P≤0.1, **P≤0.05, ***P≤0.01

The findings support that having a higher percentage of commercial area in a neighborhood and more travel time to destination decreased the likelihood of walking to commute (Table 5).

TABLE 5. One by one test for commuting

	Variables	B	S.E.	t	Sig
Pedestrian environment	Structural factor	-0.100	-0.047	-0.841	0.401
	Risk factor	0.044	0.020	0.384	0.701
	Landscape factor	0.154	0.072	1.346	0.179
	Safe factor	0.024	0.011	0.212	0.832
Neighborhood environment	Land use mix	-0.634	-0.083	-1.561	0.120
	Residential area (%)	0.006	0.043	0.810	0.419
	Commercial area (%)**	-0.052	-0.128	-2.337	0.020
	Park area (%)	0.003	0.014	0.255	0.799
	Travel time***	-0.029	-0.408	-6.703	0.000

*P≤0.1, **P≤0.05, ***P≤0.01

These findings suggest the need to lessen commercial areas in residential neighborhoods in order to promote walking. Pedestrian environment perceptions variables, all significant at the 0.1 level, didn't hold an association with the frequency of walking to commute. It was found that walking to commute was not influenced by the pedestrian environment.

3. 3 Walking model for exercising

Regression analysis of demographics found all variables associated with the frequency of walking for exercising (Table 7). The findings support the hypothesis that older people are more likely to walk for exercising.

TABLE 7. Base model for exercising

BASE MODEL	Variables	B	S.E.	t	Sig.
		0.072		6.109	0.000
	Age***	0.530	0.324	3.815	0.000
Occupation	Student	reference			
	Housewife***	-1.093	-0.211	-2.697	0.007
	Office worker***	-1.552	-0.413	-5.440	0.000
	Self-employee***	-2.325	-0.389	-4.850	0.000
	Etc.***	-2.374	-0.269	-4.537	0.000
Residential Type	Detached house	reference			
	Multi-family house**	-0.863	-0.150	-2.463	0.014
	Row House	0.249	0.047	0.756	0.450
	Low-rise apartment	-0.223	-0.041	-0.672	0.502
	High-rise apartment	0.126	0.034	0.513	0.609

*P≤0.1, **P≤0.05, ***P≤0.01

The analysis results showed that the landscape factor and park area variables were significantly related to the frequency of walking for exercising (Table 8). This finding confirms that walking for exercising tends to be more frequent if there is a better pedestrian environment and a lot of park areas in a neighborhood.

TABLE 8. One by one test for exercising

	Variables	B	S.E.	t	Sig.
Pedestrian environment	Structural factor	-0.016	-0.009	-0.157	0.875
	Risk factor	0.075	0.042	0.765	0.445
	Landscape factor**	0.208	0.116	2.124	0.035
	Safe factor	-0.042	-0.024	-0.426	0.671
Neighborhood environment	Land use mix	-0.116	-0.018	-0.330	0.742
	Residential area (%)	0.002	0.014	0.254	0.799
	Commercial area (%)	0.004	0.012	0.204	0.838
	Park area (%)**	0.025	0.124	2.185	0.030
	Travel time	0.002	0.004	0.444	0.657

*P≤0.1, **P≤0.05, ***P≤0.01

3.4 Walking model for food purchase

Among demographic characteristics, occupation and residential type variables associated with walking for food purchase (Table 9).

TABLE 9. Base model with for food purchase

BASE MODEL	Variables	B	S.E.	t	Sig.
		1.828		5.245	0.000
	Age	0.160	0.099	1.123	0.262
Occupation	Student	reference			
	Housewife	-0.665	-0.130	-1.596	0.112
	Office worker***	-1.198	-0.323	-4.086	0.000
	Self-employee**	-1.138	-0.193	-2.309	0.022
	Etc.**	-1.297	-0.149	-2.412	0.016
Residential Type	Detached house	reference			
	Multi-family house	0.054	0.010	0.151	0.880
	Row house	0.336	0.064	0.991	0.322
	Low-rise apartment	0.268	0.050	0.785	0.433
	high-rise apartment*	0.466	0.127	1.843	0.066

P≤0.1, **P≤0.05, ***P≤0.01

TABLE 10. One by one test for food purchase

	Variables	B	S.E.	t	Sig.
Pedestrian environment	Structural factor	0.129	0.073	1.237	0.217
	Risk factor*	-0.173	-0.098	-1.723	0.086
	Landscape factor	0.158	0.089	1.565	0.119
	Safe factor	-0.087	-0.049	-0.851	0.395
Neighborhood environment	Land use mix*	-0.657	-0.103	-1.831	0.068
	Residential area (%)	0.010	0.084	1.464	0.144
	Commercial area (%)	-0.030	-0.089	-1.499	0.135
	Park area (%)	0.008	0.038	0.641	0.522
	Travel time***	-0.030	-0.412	-7.472	0.000

P≤0.1, **P≤0.05, ***P≤0.01

In walking for food purchase, three variables were found significant at the 0.1 level including risk factor in the pedestrian environment, land use mix and travel time to destination (Table 10). It means that the risk factor variable is important to promote walking for food purchase. A high level of land use mix in the neighborhood resulted in more walking to purchase food. Also, the closer people are to a food seller, the more likely they will be to walk for food purchase.

4. Conclusions

All three demographic variables: age, occupation, and residential type, had a statistically significant association with walking to commute and exercise but not to purchase food. An especially interesting difference is the effects of age variable, where directions of association change between walking to commute and exercise. Being younger is associated with an increase in the frequency of walking for commuting, but with decreased frequency of walking for exercising.

Travel time variable is found to be a significant factor in walking to commute and purchase food but not exercise. Interesting are the differences in the pedestrian environment perception variables that influence walking for exercising and food purchase versus commuting.

Except travel time, no variable is found to be significant for both purposes of walking. This suggests a correlation between different physical environments and walking purpose. For example, pedestrian environments with better landscape and neighborhoods with more park areas increase the frequency of walking for exercising, while the frequency of walking for food purchase is affected by risk factors in the pedestrian environment.

Lastly, the three walking models provide useful frameworks to conceptualize physical environment-walking by purpose research. Even though not all of the constructs are proven to be significant in the models, the models effectively frame the research and selected variables which comprehensively capture the determinants and correlates of walking, while considering the different purposes.

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