The Relationship Between Pedestrian Environments and Sense of Community in Apartment Complexes in Seoul, Korea

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Abstract

This study aims to explore the relationship between physical environments and sense of community in high-rise and high-density apartment complexes in Seoul, Korea. This relationship in apartment complexes has not been adequately researched so far. To do this, this study compared a pedestrian-oriented neighborhood (PON) and an auto-oriented neighborhood (AON). Survey results showed that residents of PON were more likely to feel a sense of community in their neighborhood than were residents of AON. The results also revealed that social interaction factors and walkability among pedestrian environment factors positively influence a sense of community. In particular, the findings did support the hypothesis that a well-designed pedestrian environment in apartment complexes can contribute to the enhancement of a sense of community.

Keywords: physical environment; pedestrian environment; high-rise and high-density apartment complex; sense of community

1. Introduction

The relationship between physical environments and a sense of community in residential areas has drawn the attention of many researchers with the increasing interests in quality of life. Researches on enhancing the sense of community have become a growing topic in urban planning, environmental psychology, and urban design. In particular, researches on the relationship between the physical environments of New Urbanist-type residential developments and sense of community are being carried out since the advent of New Urbanism (Audirac, 1999; Kelbaugh, 1997; Lund, 2002; Lasar, 2003; Kim and Kaplan, 2004; Rodriguez et al., 2006; Kim, 2007). Their research findings showed that physical environments in residential areas could influence the sense of community. In the literature, the following domains have been identified as leading to a sense of community: physical environment characteristics (Jacobs, 1961; Gans, 1967; Michelson, 1976), socio-demographic characteristics (Davidsson and Cotter, 1986; Campbell and Lee, 1992; Nasar and Julian, 1995; Wilson and Baldassaare, 1996) and social interaction characteristics (Nasar and Julian, 1995; Skjaeveland, Garling, and Maeland, 1996; Kim and Kaplan, 2004).

With the advent of New Urbanism in Korea as well, there is now more interest in studying high-rise and high-density Korean apartment complexes, which as of 2013 accounted for 71% of the housing types in Korea. Apartment complexes have been preferred until now because they provide residents with privacy, neighborhood security and asset value, but because their very exclusive physical environments also sever interaction between the inside and outside of neighborhoods as well as between them, they result in the loss of a sense of community. Gye and Cheon (2000) have argued that in apartment complexes in Korea, the close feeling of solidarity between residents and a sense of community have become weak, and it is difficult to expect community living. In these complexes, the culture of "Good Neighbors," which previously existed in Korea's traditional single-family housing communities, has disappeared and they have become a housing type that loses the advantages of community life and values (Seoul, 2011). In Korea, therefore, various efforts for improving physical environments of apartment complexes are under way. For example, "Neighborhood Residential Street" is being introduced to apartment complexes in order to encourage more walking and increase interaction among neighbors, thus enhancing the quality of the neighborhood environment (Kim et al., 2008).
interesting discovery about existing Western research on pedestrian environment and sense of community, however, is that there are conflicting research results. Lund (2002) and Kim (2007) insist that there is a positive relationship between the two, whereas Talen (1999) and Nasar (2003) argue that no significant relationship exists. Another significant issue about these studies is that they have examined mostly low-density neighborhoods, but such research has not been adequately carried out on high-rise and high-density apartment complexes. The purpose of this paper, therefore, is to explore the relationship between physical environments and sense of community in apartment complexes. In particular, this study focuses on the influence occurring in neighborhood pedestrian environments among physical environments. There are three objectives in this study. 1) We will examine whether there is a difference in the sense of community among residents residing in a pedestrian-oriented neighborhood of an apartment complex with neighborhood residential streets and those residing in an auto-oriented environment of an apartment complex. 2) If there is a difference, we will extract the factors by conducting factor analysis on each domain. Then, through regression analysis, we will analyze which factors influence the sense of community. 3) Lastly, we will identify whether residential neighborhood streets influence the sense of community and which pedestrian environmental factors are affecting them. We hypothesize that in Korean apartment complexes, residents of a pedestrian-oriented neighborhood (PON) will have a greater sense of community than those in an auto-oriented neighborhood (AON).

2. Literature Review

'Community' and 'sense of community' are terms used in various ways in society at large. The interest in the subject started when the traditional communities of 19th century Europe began to weaken or dissolve and people began to feel estranged. In the late 19th century, German sociologist Ferdinand Tönnies (1887) drew a distinction between gemeinschaft, or 'community', and gesellschaft, usually translated as 'society'. In this seminal work, community is the expression of a spontaneous and natural organic will, whereas society, on the contrary, is the outcome of an arbitrary will arising from a rational cost and benefit calculation. It seems unlikely, however, that there can be a unified definition of the concept of community (Elias, 1974; Gusfield, 1975; Hill, 1996).

There have been many studies concerning sense of community, but research findings by McMillan and Chavis (1986) are mostly accepted as theory. They define "sense of community" as a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members' needs will be met through their commitment to be together. Studies on this topic have progressed with research aiming to analyze and explicate the componential elements of sense of community (Chavis and Pretty, 1999; Talen, 1999) and to develop a Sense of Community Index (SCI) (Nasar and Julian, 1995; Zaff and Devlin, 1998; Kim and Kaplan, 2004; Tartaglia, 2006). The research on the elements of sense of community began with studies by Doolittle and MacDonald (1978) and Glynn (1981), and many studies have followed since (Bardo, 1976, Glynn, 1981; Rifer and Lavrakas, 1981; McMillan and Chavis, 1986; Buckner, 1988). Research on SCI as undertaken by McMillan and Chavis (1986) has been composed of such elements as the Reinforcement of Needs, Membership, Influence, and Shared Emotional Connection. Long and Perkins (2003) and Obst and White (2004), however, have raised questions as to the appropriateness of the SCI. Moreover, Stefano Tartaglia (2006) developed a multifactor structure for the Italian Sense of Community Scale for his country. Accordingly, Chavis, Lee, and Acosta (2008) have presented SCI-2, a revised form of the existing SCI.

Of the domains influencing the sense of community, studies have expressed different opinions regarding the influence of each domain and the level of its effect, but as stated above, these domains have been shown to be socio-demographic characteristics, social interaction characteristics, and physical environment characteristics. With socio-demographic characteristics, a sense of community was shown to develop more easily when there are children, more women, homeowner-occupied housings, elderly, and households with a long length of residency in the neighborhood (Unger and Wandersman, 1982; Chavis, Hogge, and McMillan, 1986; Nasar and Julian, 1995; Skjaeveland, Garling, and Maeland, 1996). Residents identified as married couples, high-income households, or those with a high level of education were also shown to form stronger social ties and solidarity within the neighborhood than those identified as being poor or of low education (Campbell and Lee, 1992). With social interaction characteristics, the number of neighbors who are close and the level of participation in neighborhood organizations or activities were shown to be criteria influencing the sense of community (Nasar and Julian, 1995; Skjaeveland, Garling, and Maeland, 1996; Saegert and Winkel, 1996). Kim and Kaplan (2004) also identified that social interaction consists of neighboring, casual social encounters, community participation and social support. As for the relationship between physical environments and sense of community, which is of primary interest to urban planners and designers, Nasar and Julian (1995) stated that the sense-of-community values were shown to be different in line with the diversity of land use. Langon (1997) also discovered that neo-traditional types of neighborhoods had a more active sense of community, social interaction and exchanges among neighbors. Not all studies, however, support the importance of physical
environments. Hur and Morrow-Jones (2008) revealed that while for new residents of a neighborhood, physical exterior was an important consideration in determining the satisfaction level of their residential location, for long-term residents, social factors such as strained relations between neighbors, income level, communicating with neighbors, racial discrimination and crime were considered more important.

Among studies on physical environments and sense of community, some have examined the relationship between the residential pedestrian environment and sense of community, but their results are very contradictory. Lund (2002) confirmed by comparing traditional residential neighborhoods and modern suburban areas how pedestrian environment quality affects residents’ sense of community. In addition, Kim (2007) also stated that pedestrian paths correlate with social activities and thus increase social interaction. On the other hand, Talen (1999) conducted a literature review to show that there is no clear correlation between a neighborhood’s physical environment and sense of community, as the new urbanists claim. Nasar (2003) also argued that no significant correlation was discovered between pedestrian-oriented mixed-use development and sense of community.

3. Method

3.1 Neighborhood Selection

To examine the influence of pedestrian environment on sense of community, apartment complexes located in Seoul with similar conditions such as building stories, accessibility to parks and creeks, and accessibility to subway but with different pedestrian environments were selected and compared. In addition, to control for housing price, apartment complexes were limited to those located in the northern part of Seoul. The selected neighborhoods were 6, 7, and 8 blocks in the Sanglim Apartment Complex located within Eunpyeong New Town and 17, 18, and 19 blocks in the Changdong Apartment Complex and 1 block in Donga Apartment Complex. Site plans and typical sidewalks are shown in Fig. 1 and Fig. 2 and an overview of the two sites is summarized in Table 1. The buildings in the Sanglim Apartment Complex are placed in mixed shapes (such as ‘-’, ‘|’, ‘□’ shapes or tower type), and retail shops are placed linearly along the roadsides, occupying the lower floors of the buildings. Parking lots are mainly underground. The Sanglim Apartment Complex was referred to as a PON (Lee, 2007; Maeil Business News, 2007). On the other hand, the buildings in the Changdong Apartment Complex are in ‘-’ or ‘X’ shapes, and retail shops are located in only one building at the center of the complex. Parking lots are generally located on the ground level, although there are a few underground parking lots. The Changdong Apartment Complex was referred to as an AON (KNHC, 1990; HRI 1996). In this study, the Sanglim Apartment Complex in Eunpyeong New Town will be referred to as E-Town and the Changdong Apartment Complexes as C-Town.

Table 1. Overview on Study Sites

|                  | E-Town                  | C-Town                  |
|------------------|-------------------------|-------------------------|
| Location         | Eunpyeong-gu, Seoul     | Dobong-gu, Seoul        |
| Year opened      | 2008                    | 1988 - 1989             |
| Stories          | 6 - 15                  | 5 - 15                  |
| Block            | 6, 7, 8 block           | 17, 18, 19 block and Donga apt |
| Size of unit     | 72.46m² - 228.29m²      | 45.2m² - 128.93m²       |
| Household        | 2,429                   | 5,154                   |
| Street network   | Pedestrian-oriented     | Auto-oriented           |
| Subway           | Close to Line 3         | Close to Line 1 and Line 4 |
| Pedestrian and vehicle segregation | Yes | Yes |
| Building layout  | Mixed shapes (such as ‘-’, ‘|’, ‘□’ shapes or tower type) | ‘-’ or ‘X’ shapes |
| Neighborhood residential street | Yes | No |
| Parking lot      | Mostly underground parking | Mostly ground level parking |
3.2 Survey Method
The survey was carried out using both mail surveys and face-to-face interviews. Respondents were limited to adult females in order to control the gender gap. The survey resulted in obtaining valid data from 102 respondents for E-Town and 110 respondents for C-Town, totaling 212 respondents. The survey content included questions on socio-demographic characteristics, perception of pedestrian environment, social interaction, and questions on sense of community using SCI-2.

4. Results
4.1 Descriptive Statistics
With regard to family life cycle, in E-Town the percentage for the primary education period (27.5%) was the highest, whereas in C-Town, secondary education period (28%) was the highest. However, the percentage of two children as the number of children was the highest in both complexes, but C-Town always had higher percentages for two or more children than E-Town. Regarding monthly household income, in E-Town the percentage for 5 to 10 million won (39.2%) was the highest, whereas in C-Town, 3 to 5 million won (38.9%) was the highest. Moreover, the percentage for home ownership was the highest in both complexes (50.0% and 79.1%). As to the length of residency, in E-Town the percentage for 2 to 3 years (36.3%) was the highest, whereas in C-Town, 5 or more years (64.5%) was the highest. Car ownership in E-Town was 63.7%, whereas the percentage in C-Town was lower at 54.5%.

Table 2. Analysis of Pedestrian Environments in Study Sites

| No | Items | E-Town | C-Town |
|----|-------|--------|--------|
| 1  | Number of lanes | Two-way, Two-lane road | Two-way, Four-lane road |
| 2  | Form of Streets | Sidewalk+Bike lane+Road | Sidewalk+Road |
| 3  | Extent of separation between Sidewalk and Road; Buffer | Installed buffers with low-height trees and fences | Installed buffers with medium-height trees and fences |
| 4  | Installation of Speed Bump | 14 Total (1 Bump per 90m) | 8 Total (1 Bump per 140m) |
| 5  | Width of Pedestrian Path | 3m ~ 9m, Average of 5m | 1.5 ~ 2m |
| 6  | Number of entrances from streets | 29 Total | 18 Total |
| 7  | Accessibility from streets to APT | Allowed | Not Applicable |
| 8  | Height of sidewalk curb | Low (3~5cm) | Average (10cm) |
| 9  | Installation of benches, garbage bins, public phones, etc | Benches and rest areas are located near bus station | Not Applicable |
| 10 | Surface of pedestrian paths (street pavement materials) | Composed of 3 materials, separated from bike lane t | Composed of 1 material |
| 11 | Cleanliness of pedestrian paths | Cleaned very well | Trash in some spots |
| 12 | Ratio of green tracts | Few street trees and not a lot of green tracts | Lots of trees, creating green tracts along pedestrian paths |
| 13 | Height of apartment buildings | All low story (5~8 stories) | Some 5 stories, Mostly 15 stories |
| 14 | Designs and styles of apartment buildings near pedestrian paths | European street building style | Typical apartment design with standardized and desolate styles |
| 15 | Presence of sculptures | Some sculptures | Not Applicable |
| 16 | Use of lower parts of apartment buildings near pedestrian paths | Stores, Community Institutions | Trees and grass |
| 17 | Presence of resident participation program near pedestrian paths | Marketplace opens every week | Marketplace opens every week |

○ (Applicable), x (Not Applicable), ● (More Favorable), ○ (Less Favorable)

4.2 Comparison and Perception of Pedestrian Environments
To ascertain and compare the setting of pedestrian environments, a field survey was conducted. As shown in Table 2., 13 criteria in E-town are more favorable than those in C-Town except the separation between sidewalk and road (#3) as well as ratio of green tracts (#12). In view of the presence of street furniture, sculptures, benches, garbage bins and others are placed on the pedestrian walkway in E-Town along with stores and community institutions on either side of the main street. Trees and grass are grown closely together and uniformly along car lanes in C-Town. The market place as one of the community activities is observed every week respectively. As this study expected, survey results on the respondents' attitude concerning pedestrian environments reveal that there are differences. As seen in Table 3., the scores on average in E-town are higher than those in C-Town except Q2, Q4, Q6 and Q9. This difference could be due, at least in part, to better pedestrian friendly environments in that respondents in C-Town disagree somewhat concerning the quality of their pedestrian environments.

4.3 Comparison of Sense of Community
To verify the existence of differences between E-Town and C-Town's sense of community, a t-test was conducted. The reliability analysis showed Cronbach's alpha value to be 0.932 (>0.6), signifying that the measurement was reliable and the respondents' answers were consistent. E-Town's average sense of community was 3.0196, while C-Town's was 2.8572, thus showing
Table 3. Attitude on Pedestrian Environments

| Items                                                                 | *E-Town | C-Town |
|----------------------------------------------------------------------|---------|--------|
| Q1 It is safe to walk.                                              | 3.95    | 3.74   |
| Q2 Cars do not disturb pedestrians, and it is safe to cross the streets. | 3.54    | 3.66   |
| Q3 It is safe to walk at night.                                     | 3.55    | 3.45   |
| Q4 It is safe for children to commute to school.                    | 3.62    | 3.75   |
| Q5 Roads and sidewalks are clearly separated.                       | 4.02    | 4.02   |
| Q6 It is a pedestrian friendly environment                          | 4.00    | 4.11   |
| Q7 It is convenient to walk into the complex.                       | 4.05    | 3.97   |
| Q8 It is convenient to walk to nearby park.                         | 4.06    | 4.01   |
| Q9 It is convenient to walk to nearby stores.                       | 3.62    | 3.99   |
| Q10 Pedestrian paths are linked consecutively.                      | 3.95    | 3.84   |
| Q11 It is easy to visit green spaces.                               | 4.25    | 3.75   |
| Q12 Pedestrian paths are clean and pleasant.                       | 3.96    | 3.50   |
| Q13 Benches and surrounding rest areas are arranged properly.       | 3.91    | 3.18   |
| Q14 Sidewalk pavements and street trees are arranged properly.      | 3.77    | 3.48   |
| Q15 Landscape is in a good condition and beautiful.                 | 4.02    | 3.55   |
| Q16 It feels free when walking.                                     | 4.08    | 3.35   |
| Q17 There are various attractions on the streets, and it feels energetic. | 3.38    | 2.83   |
| Q18 There is a lot of vehicle traffic on the streets.               | 3.31    | 3.10   |
| Q19 There are a lot of pedestrians on the streets.                   | 3.51    | 3.41   |
| Q20 Height of apartment buildings around pedestrian paths is appropriate. | 4.12    | 3.44   |
| Q21 Generally, the outside roads of the complex are a pedestrian-oriented environment. | 4.14    | 3.65   |

* Likert scale: strongly agree=5, strongly disagree=1

only a slight difference. In accordance with the t-test result, however, the significance probability (p-value) was 0.033 (<0.05), as in Table 4., thus showing that this difference was statistically significant.

4.4 Factor Analysis

Socio-demographic Characteristics

Eight variables were calculated five times by varimax rotation and three factors were extracted. The KMO measurement was 0.608 with the p-value at 0.000, and thus variable selection for factor analysis was deemed appropriate. The three questions on family life cycle, age, and number of children were extracted as Factor 1 and named "lifecycle." The three questions on household monthly income, car ownership, and household occupation were extracted as Factor 2 and named "personal economic status." The two questions on home ownership and the length of residence were extracted as Factor 3 and named "residence condition." The results of conducting reliability analysis on each factor showed that only Factor 1 had Cronbach's alpha value of over 0.6. Therefore, only "lifecycle" was deemed to be reliable. However, as socio-demographic characteristics such as housing income, car ownership, occupation, type of residence, and length of residence were shown to affect sense of community in existing literature, Factor 2 (personal economic status) and Factor 3 (residence condition) were used as independent variables in the regression analysis in Table 5.

Social Interaction Characteristics

In the first round of factor analysis on social interaction characteristics, five factors were extracted from 22 questions. The KMO measurement was 0.879 with the p-value at 0.000, and thus variable selection for factor analysis was deemed appropriate. However, because the absolute value for factor loading was below 0.4 for the questions "Do you think there is good interaction among the residents?" "Where do you think is the boundary of your neighborhood?" and "A good neighbor is better than a brother far awa," they were judged to be inappropriate variables and thus were eliminated, and the factor analysis was conducted again. The results showed that the absolute value for factor loading was below 0.4 for the question "In the place you live, what do you think is the proper boundary for neighbors?" and it was also eliminated. Lastly, the variables were rotated six times by the varimax rotation and three factors were extracted for social interaction characteristics. The KMO measurement was 0.879 with the p-value at 0.000, and thus variable selection for factor analysis was deemed appropriate. Accordingly, Factor 1 was designated "participation in community activity," Factor 2, "supportive act of neighboring," and Factor 3, "willingness to participate in community activity." The results of conducting reliability analysis on each factor showed in Table 5. that all factors had a Cronbach's alpha value of over 0.6 and were deemed reliable.

Pedestrian Environment Characteristics

In the first round of factor analysis on pedestrian environment characteristics, five factors were extracted from 20 questions. The KMO measurement was 0.912 with the p-value at 0.000, and thus variable selection for factor analysis was deemed appropriate. However, because the absolute value for factor loading was below 0.4 for the questions "There is not much traffic on the road" and "There are many people walking on the streets,” they were eliminated and the factor analysis was carried out again. After repeatedly rotating 18 questions five times, three final factors

Table 4. T-Test

| Items                          | t       | df    | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval Lower | 95% Confidence Interval Upper |
|-------------------------------|---------|-------|-----------------|-----------------|-----------------------|--------------------------------|--------------------------------|
| Sense of Community            |         |       |                 |                 |                       |                                |                                |
| Equal variances assumed       | 2.144   | 210   | .033            | .16241          | .07577               | .01305                         | .31177                         |
| Equal variances not assumed   | 2.149   | 209.972 | .033          | .16241          | .07558               | .01342                         | .31141                         |

Table 5. Factor Analysis

Socio-demographic Characteristics

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Pedestrian Environment Characteristics

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were extracted. Factor 1 was designated "amenity," Factor 2, "safety," and Factor 3, "walkability." The results of reliability analysis on each factor showed that all factors had Cronbach's alpha value of over 0.6 and were deemed reliable. The results showed that the absolute value for factor loading was below 0.4 for the question "In the place you live, what do you think is the proper boundary for neighbors?" and it was also eliminated. Lastly, the variables were rotated six times by the varimax rotation and three factors were extracted for social interaction characteristics. The KMO measurement was 0.879 with the p-value at 0.000, and thus variable selection for factor analysis was deemed appropriate. Accordingly, Factor 1 was designated "participation in community activity," Factor 2, "supportive act of neighboring," and Factor 3, "willingness to participate in community activity" in Table 5. The results of conducting reliability analysis on each factor showed that all factors had Cronbach's alpha value of over 0.6 and were deemed reliable.

4.5 Regression Model

The independent variables used were "lifecycle," "personal economic status," "residence condition," community activity," "amenity," "safety," and "walkability." The status of neighborhood residential streets was used as a dummy variable. For the value of sense of community, used as a dependent variable, the average of the sum of Q1 to Q24 was used as suggested by Chavis, Lee, and Acosta (2008). The results of reliability analysis showed in Table 5 that since Cronbach's alpha value for SCI-2 at 0.932 was greater than 0.6, the measurement was reliable and the respondents' answers were consistent.

Correlation analysis to test for multicollinearity among the independent variables used in the regression analysis is conducted. As the Pearson correlation coefficients for all variables were below 0.7, no multicollinearity exists among them and they were all used in the regression analysis. A stepwise method was used for the analysis, and the results are reported in Table 6. First, the "participation in community activity" variable was introduced to the model, followed by the "supportive act of neighboring," "neighborhood residential street," "willingness to participate in community activity" and "walkability" variables. With additional variables introduced into the model, the coefficient of determination (R^2) value in the final model 5 was shown to be 0.497, thus increasing the explanatory power of the model to 49.7%. Next, in the ANOVA table for each model, the F value of the final model 5 was 40.636 and, with its p-value at 0.000, it can be deemed statistically significant. Also, in the regression coefficient, the VIF (variation inflation factor) values for independent variables were between 1 to 1.5, clearly smaller than 10 and thus showing there was no multicollinearity among the variables. Looking at the final model, it can be seen that all variables showing the socio-demographic characteristics have been eliminated and therefore do not have any significant influence on the sense of community. Next, the variables that came under social interaction characteristics, "participation in community activity," "supportive act of neighboring," "willingness to participate in community activity" characteristics have been eliminated and therefore do not have any significant influence on the sense of community. Next, the variables that came under social interaction characteristics, "neighborhood residential street" and "walkability," were included in the model, thus showing that they significantly affected sense of community. Lastly, the variables that come under pedestrian environment characteristics, "neighborhood residential street" and "walkability," were included in the model, thus showing that they also affected sense of community. The results of general linear regression analysis on sense of community, therefore, demonstrated that the variables affecting sense of community, "participation in community activity," "supportive act of neighboring," "status of neighborhood, act of neighboring," "status of neighborhood residential street," and "walkability,"

| Independent Variables | Reliability analysis |
|-----------------------|---------------------|
| Variable name         | Cronbach's Alpha    |
|                       | Cronbach's Alpha Based on Standardized Items |
| Lifecycle             | 0.628               |
| Personal economic status | 0.305             |
| Residence condition  | 0.334               |
| Participation in community activity | 0.914 |
| Supportive act of neighboring | 0.886 |
| Willingness in community activity | 0.772 |
| Amenity               | 0.914               |
| Safety                | 0.887               |
| Walkability           | 0.812               |
| Residential neighborhood street (1 = yes, 0 = no) | - |
| Sense of community    | 0.932               |

Table 5. Research Variables and Reliability Analysis
were statistically significant. In addition, the regression coefficient was positive for all variables, signifying their positive relationship with sense of community.

5. Discussion

Community as a sociological term has a long history and sense of community is a popular research subject. Socio-demographic, social interaction, and physical environment characteristics that influence the sense of community have been relatively well laid out by previous research, but there are several contradictions in the literature. In this study, we explored closely the relationship between pedestrian environments and sense of community and in two high-rise and high-density apartment complexes of varying physical designs. We evaluated the residents' sense of community using the SCI-2 developed by Chavis, Lee, and Acosta (2008). Factors were extracted through factor analysis and regression analysis and variables affecting residents' sense of community were identified.

The study findings are as follows. Firstly, it was verified that there were differences in the two subject locations' sense of community. The average sense of community values for E-Town and C-Town showed only a slight difference of about 0.15%. However, the difference was statistically significant. In other words, this implies that a pedestrian friendly environment in an apartment complex can influence sense of community.

Secondly, it was identified that the factors from individual socio-demographic characteristics do not significantly affect sense of community. As a result of conducting the general linear regression analysis, none of the three factors, "lifecycle," "personal economic status," and "residence condition," was included in the regression model. This is similar to the research results by Lund (2002), that when traditional residential neighborhoods and modern suburban areas were compared, there was no significant difference in their sense of community in terms of individual attributes.

On the other hand, this finding runs counter to the research results of Kim (2007) that socio-demographic characteristics influence sense of community. Further research is needed on the relationship between socio-demographic characteristics and sense of community.

Thirdly, social interaction characteristics were shown to significantly influence sense of community. All three factors, "participation in community activity," "supportive act of neighboring," and "willingness to participate in community activity," were all included in the model. In addition, each of the regression coefficients for the three factors demonstrated a positive relationship with sense of community, and were thus deemed to exert a positive influence. This finding coincides with the claims made by prior researches (Monicaj, 2001; Lund, 2002; Lee, 2009; Park, 2010). They insisted that social interaction opportunities among residents contributed to a significant influence on their sense of community. What is needed, therefore, is a program that will continually create community activities that residents can voluntarily participate in so that interaction among neighbors will be revitalized, and encourage them to share their community resources so that strong ties can be formed.

Lastly, the "neighborhood residential street" variable showed a positive relationship with sense of community. In other words, a pedestrian-oriented environment with residential neighborhood streetscan be seen as contributing to a positive influence on sense of community. Of the three pedestrian environment factors, only "walkability" was included in the model and was shown to be statistically significant. Although the "walkability" factor showed a positive relationship with sense of community, when it was compared to the regression coefficients of variables belonging to social interaction characteristics, its influence was deemed to be rather slight. However, the result can also be seen as similar to the results carried out by Lund (2002) and Kim (2007), that when a better pedestrian environment was provided to local residents, it encouraged more frequent walking, which in turn provided more opportunities for interaction among neighbors and led to a greater sense of community among them. In particular, the study by Kim and Kaplan (2004) provides support for the role that a good pedestrian environment plays in enhancing sense of community in terms of pedestrianism consisting of walkability, pedestrian propinquity, public transit and pedestrian-scale and street-side activities.

Hence, if a pedestrian-oriented environment is planned focusing more on walkability, which would enable residents to interact in their apartment complex; it will likely contribute to enhancing the residents' sense of community.

The results of this study supported the hypothesis that the PON residents have a higher sense of community than those of the AON. Although the
difference in their sense of community was shown to be rather slight, when we take into consideration the fact that there is a gap of about 20 years between when residents started moving into the locations, the effect of recently implemented plans for neighborhood residential streets and residential designs focusing on pedestrians and sense of community is judged to be very significant.

As we studied only two selected sites and obtained responses from only 3% of the total households, these results are not necessarily representative. However, this study showed that a well-designed pedestrian environment in an apartment complex can contribute to the enhancement of sense of community and coincides with those of studies carried out in Western countries. The significance of this study can be seen in the way it has used SCI-2 and applied it to high-rise and high-density neighborhoods. Further research analyzing the relationship between pedestrian environments and sense of community would help develop design techniques for enhancing sense of community.

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