The Effect of the Built Environment on Pedestrian Volume in Microscopic Space  
- Focusing on the Comparison Between OLS (Ordinary Least Square) and Poisson Regression  

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Abstract
This study is aimed at establishing a correlation between microscopic factors and pedestrian volume in the urban environment, focusing on microscopic factors that stimulate pedestrian volume, such as density, diversity, network structure, accessibility, the form of lots and buildings, and the form of building façades. In particular, factors already known to boost pedestrian volume include density, diversity and accessibility, which are three variables highly related to the concept of 3Ds (Density, Diversity, Design) proposed by Cervero and Kockelman (1997) and the additional 2Ds (Distance to Transit, Destination Accessibility) suggested by Ewing et al. (2008). The analysis in this study is based on the 2010 survey of the floating population in Seoul, particularly on the data from Seocho-gu in the Gangnam area. Data was established by analyzing microscopic factors within the 500m radius around each of the 616 spots from which the pedestrian volume in Seocho-gu was measured. This study compared and analyzed two methods: OLS, which is featured in multiple studies of pedestrian volume, and Poisson Regression, which is the most common statistical analysis method of abnormal count data such as pedestrian volume. The analysis results showed that density, diversity and accessibility, three factors that were already known to be effective in increasing pedestrian volume, also proved to have the same effect in the Gangnam area. Moreover, the form of the ground level and facade of buildings were found to have a significant effect on pedestrian volume. These findings are expected to serve as basic data for the development of sustainable and resilient cities through higher pedestrian volume.

Keywords: urban design; OLS (Ordinary Least Square); Poisson Regression; pedestrian volume; 5Ds (density, diversity, design, distance to transit, destination accessibility); building form

1. Introduction
The sharp increase in automobile usage since World War II has led modern cities to center their transformation around cars. This trend has been a global phenomenon, and the propensity for car-centric urban development was particularly pronounced among cities in developing countries such as Korea, due to the influence from the U.S. and American urban planning. Cars had suddenly become the fastest and most convenient mode of transportation, and welcomed as a means to maximize the freedom of personal mobility.

Since the 1970s, however, cars have begun to be regarded as a necessary evil of the urban environment, due to their part in negative externalities arising from air pollution, energy crisis, global warming and climate change. Furthermore to environmental issues as mentioned above, the negative effects of cars on city communities is broadening the popular recognition that the car-centric structure of urban areas requires reform.

In this context, a topical research subject has been derived from the positive effect of walking on personal health, environment, society and economy. Through such research, it was discovered that walking has the effect of improving personal health and the urban environment, thereby invigorating the urban economy as well as communities.

Urban researchers are interested in deducing the aspects of urban structure and features that encourage more people to walk and people to walk for longer. In particular, most relevant studies have been carried out in the context of microscopic space. Although macroscopic urban structures also play a substantial role in pedestrian volume, aforementioned studies instead focus on the microscopic perspective in relation

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to the correlation between buildings and streets, as well as the correlation between streets and form of streets.

This study was conducted on microscopic space, in keeping with the same viewpoint as existing studies. In particular, this study focused on exploring the effect exerted by characteristics of micro-spaces such as buildings and urban streets on pedestrian volume, centering around urban lots as the most basic spatial unit.

This study highlights problems in the methodology and data used by existing studies and aims to supplement existing work, conducting a methodological review in order to ensure greater objectivity and accuracy in comparison. The results of this study are expected to serve as basic data for the development of sustainable and resilient cities, which is a recently emerged issue.

2. Literature Review
2.1 Literature Review

Multiple studies found that a variety of urban spatial factors affect the propensity for walking among urban residents, with the main focus on socioeconomic and physical factors (built environment and urban structure).

Cervero (1996) studied the U.S. to analyze the effect of mixed land use on commuting mode preferences, and found that the presence of more amenities within a 300ft radius of residences lead to less commuting by car and more commuting by public transportation, walking or cycling. Cervero and Kockelman (1997) classified urban form planning factors based on the 3Ds (Density, Diversity, Design) system, which they concluded to be greatly effective in reducing automobile use. In terms of car travel time, Ewing (1995) conducted a study on areas in the U.S. and discovered that commuting time in suburban areas with low population density is longer than in urban areas. Meanwhile, Michael and Marlon (2001) studied Portland, U.S. to conclude that an area with higher population and employment density has a higher pedestrian volume and lower automobile traffic. Frank et al. (2008) established that a dependent variable following a Poisson distribution is a classic example of abnormality.

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Poisson Regression is a generalized linear model. Like other generalized linear models, Poisson Regression also conducts its analysis by verifying the normality and distribution of dependent variables. In other words, linear equations are established in a similar way to OLS, but the distribution model that defines functions is different from that of OLS. In particular, a dependent variable following a Poisson distribution is a classic example of abnormality. Due to this method of utilization, it is called Poisson Regression. This can be expressed into equation (1) by assuming that a dependent variable follows a Poisson distribution and then using a linear link. When $Y_i$ follows a Poisson distribution, the likelihood function can be expressed into equation (2).

$$E(Y_i) = s_i \cdot \lambda(x_i) = s_i \cdot exp \left( \beta_0 + \sum_{j=1}^{k} \beta_j x_{ij} \right) \ldots (1)$$

$$L(y ; \beta) = \prod_{i=1}^{n} \frac{s_i \cdot \lambda(x_{ij})^{y_i} \cdot exp \left[-s_i \cdot \lambda(x_{ij}) \right]} {y_i!} \ldots (2)$$

The research efforts mentioned above mainly explored regional characteristics, features of buildings and accessibility to public transit. Other studies revealed the correlation of pedestrian volume with road network or urban spatial structure. Hillier et al. (1993) explored the effect of road networks on pedestrian volume; Having found the correlation between pedestrian volume and spatial structure, the study demonstrated that local integration is a major factor in determining pedestrian patterns. J. Peponis et al. (1990) also found that pedestrian volume is highly related to the local integration of road networks.

Unlike the majority of existing research, the specific works mentioned in the previous paragraph study microscopic spaces. Considering the average walking distance, most deal with distances of around 500m or 800m (0.5mi). This is a ground-breaking approach, marking a great advancement from existing studies on pedestrian patterns. Further significance in these studies can be ascribed to the systematic organization of major socioeconomic factors (i.e. density, diversity, accessibility) and major physical factors (i.e. design, urban structure, road network).

Nonetheless, such studies also face limitations, which can be divided into the following two categories. First, due to the lack of statistical data available, they largely rely on observational research or limit the scope of research to only a few target areas, thus failing to generalize the study results. Second, they are likely to use flawed statistical methods or research methods. It is quite often that, because of flawed methods, statistical analysis reaches an erroneous conclusion. In particular, they frequently make the error of choosing the general method of OLS (Ordinary Least Square) without considering the features of the dependent variable pedestrian volume.

Overcoming the limits of existing works, this study utilized a broad range of statistical data, while performing research based on a more accurate statistical method.

2.2 Poisson Regression

Poisson Regression is a generalized linear model. Like other generalized linear models, Poisson Regression also conducts its analysis by verifying the normality and distribution of dependent variables. In other words, linear equations are established in a similar way to OLS, but the distribution model that defines functions is different from that of OLS. In particular, a dependent variable following a Poisson distribution is a classic example of abnormality. Due to this method of utilization, it is called Poisson Regression. This can be expressed into equation (1) by assuming that a dependent variable follows a Poisson distribution and then using a linear link. When $Y_i$ follows a Poisson distribution, the likelihood function can be expressed into equation (2).

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Count data variables such as pedestrian volume, are included in categorical data of discrete count with high skewness, and thus have an extremely low level
of normality, which makes it impossible to apply OLS. Instead, they should be analyzed with Poisson Regression in order to avoid type 1 and 2 errors. There are various Poisson Regression models including a generalized Poisson model and a zero-inflated Poisson model (Gupta et al., 1996; Ridout et al., 1998).

A number of studies that deal with pedestrian volume as a dependent variable conduct analysis based on OLS, without conducting a normality review of the dependent variable, which is methodologically inadequate due to the greater probability of type 1 and 2 errors. This study will therefore firstly compare the analysis results of OLS with results of Poisson Regression with the latter using the models of equation (1) and (2), and then prove that Poisson Regression is a more appropriate analysis method. This will be followed by the reexamination of factors found by previous studies to have an effect on pedestrian volume, and then execute the Poisson Regression method. Finally, this study will reveal the factors that influence pedestrian volume in microscopic space and the degree of their effect.

3. Analysis System
3.1 Hypothesis

Based on the limitations of existing studies, the following problems were identified with regards to research methodology.

First, carrying out both OLS and Poisson Regression using the variables from existing studies can lead to different results.

Second, OLS-based analysis can yield more credible results than with Poisson Regression.

Third, pedestrian volume is highly likely to be affected by the design of lots and other public spaces, a variable not specifically addressed in existing studies.

Based on the above research problems, this study has formulated the following hypotheses.

1. OLS and Poisson Regression will yield different results.
2. Poisson Regression will be more explanatory than the OLS model or the results from OLS will be flawed to an extent.
3. Previously identified variables such as density, diversity and accessibility will be in a positive correlation with pedestrian volume.
4. Besides the known variables, the design of lots and other public spaces will also have a significant effect on pedestrian volume.

3.2 Analysis Models and Variables

With a view to verifying the four hypotheses above, this study compared and analyzed the research results from OLS and Poisson Regression, as discussed previously.

The analysis was performed by using the 3Ds (Density, Diversity, Design) proposed by Cervero and Kockelman (1997) and the additional 2Ds (Distance to transit, Destination accessibility), which are two planning factors proposed by Ewing et al. (2008) in relation to accessibility to public transport. The road network variable presented by Hillier (1996) was also included in the analysis.

Furthermore, this study specifically defined design-related variables, which were then keenly examined through the use of building form and public space form as additional variables that can be derived from the lot unit.

For the analysis, it used the Stata 13.0 program and set the minimum significance level at 5%. The definitions of variables are shown in Table 1.

| Table 1. Definition of the Variables |
|-------------------------------------|
| **Operational Definition**          |
| Density (m²/m²)                     | Total floor area/0.19km² (0.19km²: 0.25x0.25x3.14) |
| Diversity                           | $1 - \sum_{i=1}^{N} p_i^2$ (pi: the proportion of total residential areas against residential or business areas in i zone) |
| Global Integration                  | $\log N \bar{D} (\nu)$ (N: No. of nodes, $\bar{D} (\nu)$ : mean of distance degree sequens) |
| Local Integration                   | $\log N \bar{D} (\nu)$ ($\bar{D} (\nu) \leq 3)$ |
| Direction of bus operation          | 0: Outside of city, 1: Inner city |
| Dist. to bus stop (m)               | Distance to the closest bus stop |
| Dist. to subway station (m)         | Distance to the closest subway station |
| No. of bus stops                    | - |
| No. of subway stations              | - |
| Land value (10 thousand won)        | - |
| Floor area (m²)                     | Average floor area of adjacent buildings |
| Building height                     | Number of floors |
| Transparency of the ground floor (m) | Total length of show windows |
| No. of existing openings            | - |
| Depth of the ground floor (m)       | - |
| Sidewalk width (m)                  | - |
| No. of cars parked above ground     | - |
| Open space area (m²)                | - |
| Pedestrian volume (person)          | - |
Descriptive statistics data of each variable used in this study are shown in Table 2.

Table 2. Descriptive Statistics by Variables

| Variable                        | Ave.    | SD      | Min.   | Max.   |
|--------------------------------|---------|---------|--------|--------|
| Density                        | 12.35   | 53.85   | 0.14   | 706    |
| Diversity                      | 0.40    | 0.03    | 0.17   | 0.61   |
| Global Integration             | 0.82    | 1.28    | 0      | 6      |
| Local Integration              | 0.83    | 2.11    | 0      | 11     |
| Direction of bus operation     | 0.47    | 0.50    | 0      | 1      |
| Dist. to bus stop              | 85.22   | 38.05   | 0      | 200    |
| Dist. to subway station        | 70.65   | 89.46   | 0      | 300    |
| No. of bus stops               | 24.68   | 8.35    | 0      | 50     |
| No. of subway stations         | 1.19    | 0.75    | 0      | 3      |
| Land value                     | 42315.39| 17905.02| 3600   | 196561 |
| Floor area                     | 36.70   | 214.88  | 4      | 3068   |
| Building height                | 15.93   | 10.73   | 2      | 58     |
| Transparency of the ground floor| 20.43  | 23.03   | 4      | 300    |
| No. of existing openings       | 6.17    | 8.67    | 0      | 90     |
| Depth of the ground floor      | 4.48    | 4.97    | 0      | 10     |
| Sidewalk width                 | 2.72    | 3.05    | 0      | 8.1    |
| No. of cars parked above ground| 1.97    | 3.31    | 0      | 14     |
| Open space area                | 14.52   | 35.27   | 0      | 100    |
| Pedestrian volume              | 3115.25 | 5491.36 | 40     | 113606 |

3.3 Data and Subject of Analysis

In order to collect data for the variables outlined above, this study conducted a survey analysis on Seocho-gu, a district in Seoul with a large floating population. To gather pedestrian volume data, the study utilized data from the 2010 floating population survey, in which the Seoul Institute was commissioned by the Seoul Metropolitan Government to analyze pedestrian volume across 10,000 spots in Seoul between 2009 and 2010. Among the target spots, 650 were located in Seocho-gu, although only 616 spots were used in the actual analysis after 34 spots were excluded due to data error or because they were underground passages. The study set the dependent variable as the mean values of pedestrian volume data which were measured in those spots by time and day of the week.

The study set its range of analysis object as the radius of 500m, which is expected to affect pedestrian volume. All variables, except count data including the number of bus stops and subway stations, were averaged by calculating values within a 500m range.

2010 GIS data of Seocho-gu were employed to establish the data of various variables. As for other data, especially data related to the ground floor of buildings, the data was collated following investigations by technical researchers. ArcGIS 10.1 and DepthMap 10.14 were employed in data.

4. Analysis Results

4.1 OLS versus Poisson Regression

To compare the results of OLS and Poisson Regression analyses, this study compared the $R^2$ values of each model. As a result, the value of OLS was 0.1558 and Poisson Regression's result was 0.6588. Based on these figures, it can be concluded that the Poisson Regression model performs better than OLS does for the purpose of data analysis.

In particular, when using the OLS method, not only did the model yield low explanatory credibility in terms of its data, but the significance in its variables was revealed to be far different from existing theories. Furthermore, OLS yielded results quite different from the Poisson Regression model, which found all variables to be significant. This indicates the dangers of using OLS in works of research that presuppose pedestrian volume as a dependent variable.
Based on Poisson Regression, whose competence was demonstrated through the above comparison of analysis models, the results can be interpreted as follows:

Firstly, while density, a domain attribute, has a negative correlation with pedestrian volume, diversity has a positive correlation. This shows that higher density does not increase the pedestrian volume while higher diversity does, which stands in line with the arguments of Jane Jacobs and others.

The process of interpreting the study's result of showing a negative correlation between density and pedestrian volume may yield the following two questions. First, a negative correlation was found between the density and pedestrian volume of Seocho-gu in the Gangnam area as the subject area of this study, possibly due to the evenly high level of density across the district of Seocho-gu. In other words, the result might have been different if the study was performed on older urban areas with a wide variation in density, such as Jongno-gu, a traditional downtown area of Seoul.
The basic analysis method of Poisson Regression does not differ significantly from other ordinary regression models, except that its premise includes a Poisson distribution. The following is a more specific explanation based on statistical analysis. Assuming the premise of spots A and B, the Poisson Regression analysis investigates how the difference in the average floor areas of buildings adjacent to each of A and B correlates with the difference in pedestrian volumes of the two spots. In other words, when the difference between the two variables is negligible, the analysis result on the relation between the variables is likely to be insignificant or entirely different from results yielded by conventional models. As mentioned previously, this study's subject area of Seocho-gu is a district densely occupied with office buildings even amidst the high-density city of Seoul, which signifies its considerably high density of floor area. This aspect of the subject area allows the acceptance of the fact that this study yielded a different result from existing studies with regards to density. It is also in line with the results of the study conducted by De Bourdideaujui et al. (2003) on Belgium. According to his research, a study on an area where the density is already high may reveal that the variables previously found to show correlation with pedestrian volume and walking time are instead insignificant, or produce a totally different relationship between such factors.

The second question is whether or not an aggregate variable that uses the total average and sum for a specific areal unit is an effective variable. Indeed, this study uses the floor area variable of lots and buildings attributes category to calculate the density. The only difference is that the density variable in the domain attributes part drew an average for the gross area of all buildings within the radius of 0.19 km², while the floor area variable in the lot/building part averaged the floor areas of buildings adjacent to the examined spots to calculate pedestrian volume, which represents an even smaller area. As such, the two variables that were calculated for a completely different areal unit did not cause the problem of multicollinearity. A matter of particular interest is that the two variables were found to have opposite correlations with pedestrian volume. Geological terminology refers to this difference in results caused by the differences in the areal unit used to calculate variables as MAUP (Modifiable Areal Unit Problem), which is a critical issue for further research.

Therefore the two aforementioned questions can be raised through the analysis of the correlation between density and pedestrian volume. In relation to these questions, more advanced study results can be obtained if the research incorporates greater detail in its data and a greater variety of subject areas. This study is planning a follow-up study that compares the two disparate areas of Gangnam and Gangbuk. It is expected that the comparison of this study's subject area of Gangnam and the older district of Gangbuk can help resolve the first question. In addition, there are plans afoot to conduct an empirical study on MAUP and a follow-up study using more detailed data to resolve this problem. These studies are expected to solve the second question of verifying the actual existence of MAUP and to facilitate a more advanced study subsequent to the solution of this problem.

Secondly, both total and local integration, which are network attributes, turned out to have a positive correlation with pedestrian volume. As Hiller theorized, local integration was particularly credible in explaining the effect on pedestrian volume than global integration. This confirms that, while total concentration of network is important, local concentration of network has a greater impact on the increase in pedestrian volume. This result shows that pedestrian volume is influenced more by microscopic spatial structure than by the macroscopic. This also implies that further research on pedestrian volume may identify more significant results by utilizing microscopic variables, rather than macroscopic ones.

Thirdly, regarding access to downtown and mass transportation, better accessibility to CBD boosts pedestrian volume, while accessibility to mass transportation also has a positive correlation with pedestrian volume. Moreover, the subway was found to have a greater effect on pedestrian volume than the bus. This result is highly related to the fact that the modal share of the subway is extremely high in Korea, particularly in Seoul. As of 2009, the modal share of the bus and the subway systems in Seoul are 28.8% and 33.8% respectively, which means the rate of the subway is 1.17 times higher than that of the bus system. This indicates that pedestrian volume in Korea is more influenced by whether or not the area studied has a subway system.

Fourthly, variables of lot and building attributes showed the tendency to have a positive correlation with pedestrian volume. On the other hand, land value has a positive correlation with pedestrian volume, but with insignificant effect. Furthermore, pedestrian volume was also influenced to a considerable degree by the total ground area and whether the space had an opening to the adjacent street. This finding is expected to support the arguments suggested in recent studies that the analysis of microscopic spatial structure should consider the additional variables of existence of openings and transparency of the ground floor, not to mention the network structure and accessibility to mass transit. This study dealt with the width and depth of ground floor buildings as additional variables. Since the width of a building's ground floor is highly related to the total floor area within the building and multicollinearity was identified by the VIF index at the high number of 17, the relevant variables were removed. However, this suggests that the width of the ground floor also has a positive correlation with pedestrian volume. In contrast, the depth was shown to have a negative correlation with pedestrian volume.

These findings showed that, in relation to urban
design, pedestrian volume on the streets can be increased through enhanced transparency into the ground floor using show windows or other means, establishment of more openings and the increased width of the ground floor. In particular, this is supported by the fact that the width of the ground floor is a crucial factor in determining the rent.

Although land value is known to have a close and positive correlation to pedestrian volume, it can also be speculated this is the effect of the number of openings and the width of the ground floor. This assumption cannot be verified, since this study designated land value as a parameter and did not conduct separate modeling. However, the correlation between land value and pedestrian volume is an important research topic and requires further study, along with follow-up studies to verify the feasibility of land value as a parameter.

Fifthly, this study also examined the attributes of the building façade. The width of the sidewalk had a negative correlation with pedestrian volume, but the degree of significance indicates that the correlation is quite weak. Nonetheless, it is necessary to examine the cause behind the negative correlation. There can be two explanations as follows. First, it can be assumed that urban planning for the Gangnam area designed pedestrian space without accurate projections of pedestrian volume. At the time of the initial design for the Gangnam area, there was a practice of calculating automobile volume as the first priority and then determining the hierarchy of street usage according to the area of traffic lanes, which failed to consider the predicted pedestrian volume. Likewise, the area of pedestrian space in the Gangnam area was designed according to the hierarchy of street usage, which led to the results of this study. This indicates the method of urban planning at the time.

The second explanation is that the hierarchy and usage of space have changed over the 30 years since the design and development of the Gangnam area. At the time of initial design, areas with broader sidewalks had a higher priority in street usage. At present, however, such areas are generally occupied by older and shorter buildings. On the other hand, it is also possible that areas with high pedestrian traffic at present were initially low-priority streets with narrow sidewalks and low levels of land value, which subsequently became the target of new investments over the period of 30 years and underwent high-density development. Therefore, it can be deduced from such explanations that it is not that areas with high pedestrian volume have broader sidewalks, but rather the opposite in that areas with less pedestrian volume do in reality.

The area of open space turned out to have a considerable impact on the increase in pedestrian volume, which confirms the importance of open space in the building façade. A matter of particular interest is the number of cars parked above ground. While most previous studies had argued that ground parking had a negative effect on pedestrian volume, it is only recently that new urbanists have begun to argue that its effect on pedestrian volume and walking safety may in fact be positive, a hypothesis that may be given significant proof by the results of this study.

4.3 Hypothesis Verification

Based on the above analysis results, the hypotheses of this study as described in Chapter 2 can be verified as follows: Firstly, OLS and Poisson Regression yielded considerably different results. Secondly, the Poisson Regression model was more credible than OLS. The subsequent connotation that the former model was more adept at analyzing a given set of data than the latter led to the conclusion that Poisson Regression was more appropriate for analyzing count data such as pedestrian volume. Thirdly, known variables such as density, diversity, and accessibility were shown to have significant correlations with pedestrian volume. In particular, all of the above variables had a positive correlation with pedestrian volume, with the exception of density. This indicates that the hypotheses of existing studies can be applied to the case of Seocho-gu, Korea. In relation to density, however, the result was slightly different. It is conceivable that most cities in Korea have reached a significant level of density, which may explain the negligible extent of differences among the examined spots. Fourthly, in addition to the previously known variables, variables related to lots, buildings, and building façade also had a significant relation with pedestrian volume. Factors of particular note included the width and depth of the ground floor which represent the building form, transparency of the ground floor, and the existence of an opening.

5. Conclusions and Discussions

The results of this study suggest the following deductions. Firstly, research efforts into urban architecture require a more sophisticated methodology. With the advancement and increased necessity of information technology, the overall volume of data is continuing to rise. In particular, urban architecture is a field closely related to large-scale social surveys. However, many urban architecture researchers continue to regard statistical analysis as a mere instrument of analysis, while some actually lack the adequate skill at dealing with statistical analysis. Despite the vital importance of selecting an analysis model, which may be decisive in determining the research outcome, the traditional method of OLS continues to be the sole method of analysis. This study found that using OLS for specific data that may not be conducive to its use can pose a serious problem. Particularly regarding the research into pedestrian volume, it is crucial to employ analysis methods for abnormal data such as Poisson Regression.

Moreover, most of the factors that were previously found to affect pedestrian volume conform to circumstances unique to South Korea, particularly those of Gangnam, Seoul. This implies that existing pedestrian volume theories can be largely applied
to Seoul, or at least to Gangnam. Based on these research results, it became possible to establish policy alternatives to increase pedestrian volume, an important energy element in the urban environment. In particular, subway access and local street network remain valid factors in increasing pedestrian volume. In other words, it can be concluded that it is necessary to focus urban space management policies on the establishment of more pedestrian passages and enhanced accessibility to the subway system. However, since this study is limited in scope to the Gangnam area of Seoul, its results naturally require verification in line with further studies by integrating both Gangnam and Gangbuk or comparing Gangnam with Gangbuk.

Lastly, the importance of form factors that affect pedestrian volume should not be overlooked. The importance of form factors in the urban space, such as the road network, has already been discussed in previous sections. As this study found, the form factors of a building entail substantial significance and, more prominently, the form factors of a building's ground floor exert a considerable effect on pedestrian volume. Further findings indicated the importance of the space form of a building's façade. This can be explained through the influence of a building's form factor upon the structure of microscopic spaces. While this study employed simple form factors, but further study is needed to identify more sophisticated elements of construction and façade forms, to be used for future research in their correlation with pedestrian volume.

This study reveals the following limitations and significance as part of the history of research. This study is meaningful in that it identified certain problems in the OLS analysis method, which has been the main method in studying pedestrian volume, and instead suggesting the alternative option of Poisson Regression, which is useful in frequency data analysis. Also, unlike existing research, this study set the microscopic spatial range as its subject of study, focusing more on building and façade form, and thereby broadening the horizon of research. In particular, this study is meaningful in that it identified the significance of declaratory research results based on observations of urban space and that it suggested the need for further specific research on this field in the future.

However, this study faced its own shortcomings in that its research scope was restricted by the problem of data acquisition to only Seocho-gu, a representative district in the Gangnam area of Seoul. Based on the results of this study, it is necessary to conduct a further study that covers a more extensive range of districts. In addition, there is a need for a more complex analysis model, based on Poisson Regression as suggested in this study. In particular, since pedestrian volume is affected by the area-wide attributes of the subject area, this effect must be taken into further consideration. Moreover, future studies must be conducted on an analytical model that utilizes time series analysis to examine changes in accordance with days of the week and specific times of the day. The results of this study are expected to broaden the horizon of related research by encouraging the development of a greater variety of analysis models.

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