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A Basic Study on the Analysis of Spatial Hierarchy in the Elderly Care Facility

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Abstract

Recently, perceptions of the elderly in the modern era are changing from weak and isolated to healthy seniors seeking to resume normal social activities. In keeping with this, elderly care facilities have a circulating flow system and are trying to provide social functions to elderly patients. However, there have been few studies on elderly care facilities, and the existing studies have the problem of taking an approach based on the outdated concept of weak elderly people. As such, the objective of this study is to provide basic data for use in the design of future elderly care facilities by analyzing the hierarchy and cognition of a circulating flow system of elderly care facilities. This study applied spatial syntax for the analysis, and the conclusions reached are as follows. 1) When analyzing connectivity, it was found to be high, with major corridors and elevator halls. However, it was low with the common spaces, such as a lounge, which is intended to attract people. This is an undesirable result in terms of community activation, and needs to be improved. 2) Although a nurse station requires a relatively high degree of control, its degree of control was actually low. To improve this, it is necessary to connect it to a convex space with a high degree of control, or to increase its cognition. 3) The local integration for common spaces excluding corridor spaces was relatively low, which means that it is difficult for elderly patients with low cognition to use.

Keywords: *Elderly, Elderly facility, Circulating traffic, Space syntax, Space hierarchy*

1. Introduction

In recent years, while there has been cultural development along with the development of medical technologies, the number of mentally healthy elderly people who are also physically healthy is increasing as the cultural level of a society has improved. [1] These elderly people want to continue their social activities; at the same time, an increasing number of elderly people are trying to return to social activities. In this respect, the elderly are not just people to be treated or passive people maintaining their status quo, but are changing to the extent that they should be thought of as active people having rehabilitation treatment so they can return to social life after treatment. [2] Due to the characteristics of the elderly, general hospitals or elderly care facilities focused on medical care alone cannot provide the functions described above, so it is expected that demand will increase for elderly care facilities that have the characteristics of

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both treatment and medical care. Although the number of elderly care facilities for the elderly with such complex characteristics is increasing, they are not available to most people because their price is high. Even if this problem is resolved, there is a significant difficulty in the spatial planning of elderly care facilities because the characteristics of the elderly and the characteristics of a special hospital must be reflected at the same time in terms of space. When considering the elderly's re-entry into social life, unlike most elderly care facilities that maintained a one-way movement system by treating the elderly as physically, socially, and psychologically weak, more and more of the recently-opened elderly care facilities are introducing circulating flow systems. [3] However, as this circulating flow system may have a negative effect on the use of space by the elderly in the ward of an elderly care facility, studies should be conducted on this issue.

Therefore, the purpose of this study is to perform a quantitative evaluation of a ward in an elderly care facility which has a circulating flow system, in order to build basic data that can be used when planning elderly care facilities in the future.

2. Review of elderly care facility and analysis method

2.1. Main characteristics of the elderly

This study classified the characteristics of various elderly people in elderly care facilities. More specifically, this study classified the characteristics of the elderly in consideration of accessibility and cognition in a space. As a result, the characteristics of the elderly can be classified into physical, psychological, and cognitive characteristics. The detailed factors reflecting these characteristics are the characteristics related to aging, and these typically involve decreased physical strength, vision, adaptability and intellectual ability. Due to these, the elderly experience symptoms of emotional anxiety such as depression, alienation, and loneliness. Therefore, the elderly tends to stay longer in a specific space, exhibiting introversion and passivity, and there is a possibility that the indoor environment will become their main living area. [4]

2.2. Concept and components of elderly care facilities

According to the Ministry of Health and Welfare, an elderly care facility in Korea is a facility that can accommodate 30 or more nursing patients, and it includes doctors, etc. dedicated to elderly medical care. According to the Senior Welfare Act, it plays the role of a facility to promote the welfare of the elderly as well as their health.

When the Elderly Welfare Act was enacted in 1981, the term "elderly care facility" included free nursing homes and paid nursing homes, but with the revision of the Elderly Welfare Act in 1997 these were classified into five types: free nursing homes, medium-price nursing homes, paid nursing homes, medium-price welfare housing for the elderly, and paid welfare housing for the elderly. With the subsequent revision of the Elderly Welfare Act in 2007, elderly care facilities were divided into nursing homes, senior citizens' public homes, and senior citizens' welfare housing. Since then, as the number of elderly people has increased, medical welfare facilities for the elderly have been defined as being dedicated to elderly care only. Accordingly, elderly care facilities were expanded to provide meals, nursing care, and other conveniences necessary for daily life by admitting the elderly who are in need of assistance due to a significant mental and physical disability caused by senile diseases such as dementia and stroke. To differentiate these facilities from existing welfare facilities for the elderly, long-term care level determination is required to enter those elderly care facilities. Elderly care facilities can

be classified into senior hospitals built based on the Paid Senior Welfare Facility Loan Fund, municipal and provincial dementia specialty nursing hospitals, general hospitals converted to senior hospitals, or general hospitals operating an elderly ward. This can be understood as an intermediate positioning between an elderly care facility focusing on nursing and a general hospital focusing on treatment. The classification of components in an elderly care facility may differ depending on the researcher, but usually includes the outpatient department, central treatment department, ward, examination department, management department, supply department, and condolences department. [5] The ward, which is the main focus in this study, is a place to accommodate patients who need to be hospitalized for long-term treatment, and consists of a patient space, nursing space, and common space.

2.3. Review of spatial hierarchy analysis methodology

This study evaluates the accessibility and cognition of an indoor space through spatial hierarchical analysis in the form of a circulating flow system in the ward of an elderly care facility. To achieve this objective, spatial syntax was selected as the analysis methodology. Spatial syntax is a kind of technology that reveals the arrangement of spaces, and it can be considered to be suitable for this study as a method of quantitatively analyzing usability, accessibility, and cognition by subdividing a unit space to form a connection relationship. The key indicators of spatial syntax include connectivity, control, integration, and spatial structure clarity; detailed explanations of these are as follows. [6] Connectivity refers to the number of times a specific space is connected to its surrounding unit spaces. A space with high connectivity can be said to be located at the center of the entire traffic line, or a space with high frequency of use. Control refers to an extended variable including connected spaces and spaces that affect the surroundings. It is an index that quantitatively indicates the extent to which a specific unit space affects its surrounding spaces. Third, while the total integration represents the relationship of the overall spatial arrangement, the local integration can be said to be an integration including only a few perceived spaces within a certain adjacent range. According to prior studies, when a person perceives a space, they consider three different spaces on average in a designated space; for this reason, only three spaces are usually considered. However, in some cases, it is applied differently depending on the characteristics or circumstances of a research subject. The spatial structure clarity of this study is an index representing the correlation between connectivity and integration; a value of 0.6 or more is defined as a clear space in terms of social psychology. [6]

3. Analysis target overview and analysis results

3.1. Analysis target selection and overview

When selecting the analysis target, this study narrowed it down to Korea, which became a super-aged society due to its rapid increase in the elderly population, and then narrowed it down again to local areas with relatively poor conditions compared to the capital region. As a case used in related research, [8] a facility which has more than 100 beds was selected as the analysis target. As a result, as shown in [Table 1], two analysis targets were selected and the flow system of the ward shows a circulating type. In particular, this study focused only on the lowest floor of the ward for analysis.

3.2. Analysis method

This study was performed through the following method for hierarchical analysis of the circulating flow system of the ward in the elderly care facility. As shown in [Figure 1], this study analyzed the zoning of sub-spaces for each component based on the plane of the analysis target, and divided them into convex spaces. When dividing the convex spaces, this study defined spaces of the same kind as one-unit space even when there are physically and visually blocked parts, with the exception of corridors. This study used the S3 Convex program for spatial hierarchical analysis.

Table 1. Overview of the analysis target

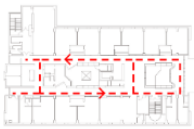
Facility Name	Opening Year	Location	Size			Flow System of Ward
			Beds	Total Area (m^2)	Floors	
Old town elderly care facility	2002	Daegu, Korea	160	4977.2	7	
Gyeongnam Provincial Tongyeong elderly care facility	2007	Gyeongnam, Korea	155	6763.1	7	

Figure 1. Deriving space syntax

3.3. Analysis results and discussion

This study performed a quantitative analysis of a ward having a circulating flow system in an elderly care facility, and the results are as follows. First, as shown in [Table 2], this study analyzed the connectivity for the selected target, and the analysis results are as follows. A convex space with maximum connectivity includes the corridor and elevator hall. This shows that the characteristics of a circulating flow system with a high social function are well reflected, and that communication is likely to occur in the corridor. However, these functions may be rather inappropriate in a corridor due to the physical characteristics of the elderly, and a space that creates such community activities should be changed to another place. Otherwise, furniture should be arranged in the middle of the corridor, so that the elderly can sit while moving and have community activities naturally. On the other hand, the community space is expected to fail to fulfill their social functions because its connectivity is below average. This means that the community space is not a major location in the flow system of the ward due to its low connectivity, which is the result of failing to maximize the characteristics of the ward with a circulating flow system. Second, the analysis results of control for the selected analysis targets in this study are as shown in [Table 3], and the details of the analysis are as follows. The control is an index indicating how much a specific unit space controls adjacent unit spaces,

and a nurse station should have a high value. However, through analyzing the convex spaces corresponding to the top three with a maximum value, it was found that the main corridor and elevator hall were included. These are common spaces and control is well reflected, but a nurse station where the purpose of treatment and patient management should be reflected in a ward is not included, and its average value is derived below the average of overall control, so its accessibility is problematic. On the other hand, the common space of Gyeongnam Provincial Tongyeong Elderly Care Facility has a control value above average. The reason for this difference appears to be that a unit space corresponding to the main corridor with a high control is directly connected. To increase the accessibility of the common space for communication and that of a nurse station in a ward of an elderly care facility in the future, they can be located adjacent to a main corridor which has a high control, and then their accessibility issue can be resolved. Third, the results of an analysis of local integration for the analysis targets are shown in [Table 4]. Local integration is an index to determine the spatial arrangement that increases cognition in consideration of the characteristics of the elderly. The results of an analysis local integration for the analysis targets are as shown in [Table 4], and the top three spaces with maximum values all include the main corridors. This is because a unit space corresponding to a main corridor with high local integration appears to be directly connected to other unit spaces. However, values below average are derived for common spaces with the exception of main corridors, which are difficult for elderly patients with low cognition to use. This is because there was not proper consideration given to a circulating flow system in the initial design of an elderly care facility. In summary, a ward with a circular flow system is effective in that it can give the elderly, who use the system, the autonomy and sociality of movement selection, but it was designed to have low accessibility and cognition to common spaces for community activities. This is believed to be the result of insufficient consideration of spatial cognition when planning elderly care facilities.

Table 2. Analysis results of connectivity

Facility Name	Min.	Max.	Avg.	Avg. of Common Space
Old town elderly care facility	1	18	2.425	1.000
Gyeongnam Provincial Tongyeong elderly care facility	1	17	2.250	1.358

Table 3. Analysis results of control

Facility Name	Min.	Max.	Avg.	Common Space	Nursing station
Old town elderly care facility	0.055	10.750	1.027	0.395	0.618
Gyeongnam Provincial Tongyeong elderly care facility	0.058	11.450	1.028	3.558	0.642

Table 4. Results of analysis of local integration

Facility Name	Min.	Max.	Avg.	Common Space
Old town elderly care facility	0.422	3.540	1.759	1.300
Gyeongnam Provincial Tongyeong elderly care facility	0.780	3.637	1.585	0.981

4. Conclusions

This study analyzed the spatial structure and cognition of a ward with a circulating flow system in an elderly care facility, and the results are as follows. First, through a connectivity analysis, it was determined that the convex spaces with the maximum value include a corridor and an elevator hall. This reflects the characteristics of a circulating flow system that supports a high social function, but these functions may be rather inappropriate in a corridor due to the physical characteristics of the elderly. A space for community activities should be adjusted to another place or it should be furnished such that the elderly can rest in the middle of the corridor. Second, when analyzing control, the top three convex spaces with maximum values also included corridors and elevator halls. These are common spaces with a high degree of control, but the nurse station has a low control, leading to poor accessibility. To resolve this problem, it is possible to construct a space adjacent to a main corridor with a high degree of control. Third, the top three spaces that have the maximum values for local integration are all major corridors. However, values below average have been derived for common spaces excluding corridors, which means that they are difficult for elderly patients with low cognition to use. This is because there was not proper consideration given to a circulating flow system in the initial design of an elderly care facility. This study is effective in that the spatial composition of elderly care facilities was analyzed using a spatial hierarchy analysis methodology to analyze the accessibility and cognition of indoor spaces in a ward with a circulating flow system, which was designed to help the elderly return to social activities. However, the spatial syntax presented as a research methodology in this study does not reflect the physical size of a unit space, and this may be pointed out as a limitation of this study. Future research in this area should use more diverse methodologies.

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