Study Of Community Facility Spatial Structure In Japanese Nursing Home

Lin Bai, Satoshi Nasu

Abstract—With the accelerating evolution of aged society worldwide, more attention has been paid to the improvement of elderly quality of life(QoL) after their retirement.The Community facility, a common space in nursing home for residents' social activity, is believed to play an important role in improving residents' QoL in nursing home.However, there is no generally acknowledged method to quantitatively evaluate common space spatial structure in nursing home. In this paper, the spatial characteristics of community facility in 62 nursing homes which were built in the year from 1978 to 2014 are analyzed by using space syntax theory to develop an understanding of quantitative spatial structure characteristics of community facility, how they have been transited, and what inherent spatial structure quantitative difference exist in community facilitiesin different scale care unit nursing homes, so as to provide a reference for future community facility spatial structure design. The selection of nursing homes in this article is from Japanese architecture publications because Japan is in the front of aging society on the world, the data and resultfrom Japanese nursing home can be expected to be a good examplefor other countries.The analysis shows there were uptrend in allocating community facility in Japanese nursing home to place with both higher spatial integration and higher connectivity value in the past 35 years.The comparison between classical large scale care and modern unit care nursing homes confirms that the spatial integration, connectivity of community facility was increased by about 13%, and the mean depth to access community facility is decreased.This spatial structure transition actually reflects a culture of connect to greater community in modern Japanese nursing home design, that is, to make community facility easily accessed and gathered together by nursing home residents and local visitors.

Index Terms—Community facility, Elderly facility, Space syntax, DepthMap, Integration, Japanese Nursing Home

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1 INTRODUCTION

ALONGwith the development of modern Japanese economy, nursing home in Japan has also been evolved. In 1963, when the first welfare law for the elderly was issued, Japan was experiencing high economic growth, urbanization, and women's social advancement. The household function was also under changes at that time, making it difficult for elderly to take care of themselves at home, which led to high market needs of senior facilities. Consequently, lots of large-scale nursing homes with big shared room for more than 10 residents were built up. This solved the problem of senior facility shortage, but the collective living in such a large scale care nursing home also brought residents the difficulty in receiving care service. With the improvement of living standards, slightly smaller group living type nursing home came out in 1980s. Unlike the big shared room living, a smaller group of 4~6 people sharing living room became the main style, but the nursing care was still provided collectively though the scale was a little smaller than before. Later, by the influence of realizing home alike living style and having individual care service, nursing home with private living room and unit care living space appeared in 1996. This is so-called modern unit care nursing home, and is now the main senior facility in Japan[1].

By the transition of nursing home from large scale nursing

care to unit care, the common space structure has also been changed(Fig.1). In large scale care nursing home, the common space is mainly concentrated in one location, where eating, recreation, and rehabilitation etc. daily activities are taken place. On the other hand, with the changes to unit care style, the dining room and day activity are gradually separated, a living space is designed and shared by several private rooms for day activities, and further connects to place with higher publicity (Fig. 1).

Toyama investigated the effectiveness of social and care service by introducing private room and small scale care unit in Japanese nursing home, concluded that it brought residents the formation of personalized space, the improvement of QoL(quality of life), ADL(activities of daily living), the social participation and abundant interpersonal relationship[2].
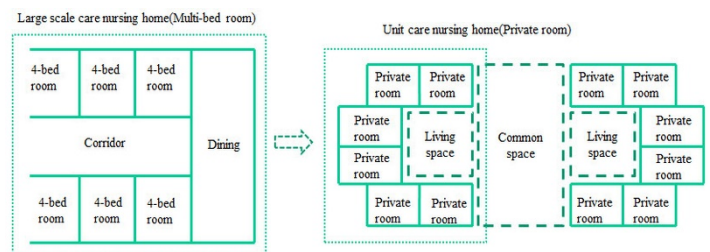

Fig. 1. Large scale care and unit care Japanese nursing home

On the other hand, what does this transition imply to changes in community facility, an important common facility for residents and local people to gather together? And, how to quantitatively evaluate common space spatial structure changes in nursing home? Figuring out this change particular-

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ly in terms of spatial characteristics would be helpful in future nursing home community facility design.

In this paper, 62 nursing homes which were built in the year from 1978 to 2014 are selected from Japanese architecture publications, with which the community facility spatial characteristics is analyzed to develop an understanding of how it has been changed, and what is the inherent spatial structure quantitative difference between classical large scale care and modern unit care nursing homes, so as to provide a reference for future community facility design in Japan and other countries.

2 METHODOLOGY

Hillier's space syntax theory and methodology is applied in this study[3].The theory has been getting extensive use since it was introduced and has been generally accepted as a means in spatial characteristics comparative study from the point of view of space accessibility[4,5].

The space syntax metrics of connectivity, depth, and integration are calculated to depict changes in community facility spatial characteristics.

The connectivity measures the number of immediate neighbours that are directly connected to community facility. The depth itself is defined as change steps from a space to others, and the step between immediate neighbours is one, so the bigger the depth of a space is, the difficult to access this space. The integration describes the average depth of a space to all others, this metric is also regarded as the index of accessibility. The higher the integration of community facility is, the better it is spatially integrated in nursing home, and the easier to access and easier for people to gathering together there.

Further, to conduct spatial comparison of community facility to nursing home itself, the functional integration ratio, FIR, which is the ratio of integration of community facility to nursing home all space average as in eq. 1 is calculated as well.

$$FIR = \frac{Integration\ of\ community\ facility}{Integration\ of\ nursing\ home\ all\ spaces\ average} \quad (1)$$

UCL DepthMap tool provides different approaches to devise and analyse spatial characteristics[6]. The convex map approach utilizes vertical boundaries to convert 3-D space to a number of "fattest" or largest 2-D convex polygons[7], and establishes connection for each polygon based on the availability of direct access[8]. Due to this "fat" nature of the convex shape, it is said that this approach is best suited for defining spaces such as building interiors, and this approach is applied in this article for community facility spatial characteristics evaluation[9].

Floor plan of each selected nursing home is scanned and converted to AutoCAD file, which is then imported to DepthMap tool to create convex map. Based on space functionality, each space unit is presented by using one or multiple convex maps but to have least possible number of convex maps to cover all the spaces[10]. The wall, any kind of partition which separates spaces is taken as boundary while doors and openings are considered as connection points. For multistory buildings, elevators and staircases are regarded as connection points.

The selection of nursing homes is evaluated in two groups based on the scale of nursing care performed, large scale care group and unit care group. The former is classic nursing home where 2~10 residents share living room while the latter is modern type where nursing care is conducted in small group unit.

3 FINDING AND DISCUSSION

3.1 Large Scale Care Nursing Home

Usually large scale nursing home was designed to have a long corridor, along which housing and service facilities were built. In some cases, it was also designed into different functional areas connected by connection corridors. A typical floor plan, convex map and spatial integration result is shown in Fig. 2. Here, the integration is coloured according to its value, high value of well integrated location to poor is presented from red, to yellow, green, and dark blue(Fig.2).

This example is a nursing home for 80 residents built in 1996. The living rooms were mainly located in 2 living areas with a long corridor connected. The community facility, physical training room, dining room etc. common facilities were situated in the area slightly away from living area while service station was closely based to living area. The DepthMap calculation presents it is the long corridor which owns the highest spatial integration as red colour shown(Fig.2).

Fig. 2. Typical large scale care nursing home floor plan(left) and integration result(right)

Because care service is carried out for large group by limited staffs, the care service station normally was allocated very close or in centre area for the convenience to reduce moving distance in providing care service(SS in Fig. 2). On the other hand, it reminds the community facility was not getting enough attention in this kind of nursing homes. One factor is that there were only 17 nursing homes in the total of 40 investigated where community facility was implemented, and in most of the deployed nursing homes, community facility was situated in a place away from living or central area, as shown in this example(CS in Fig. 2). This basically causes lower spatial integration in community facility, and high in service station in large scale care nursing homes.

3.2 Unit Care Nursing Home

Normally unit care nursing home is constituted by multiple care units, each offers accommodation for about ten residents

where nursing care is performed by exclusive staffs in accordance with resident individuality and the rhythm of life. By this concept, a common living space is designed in each unit where the light meal, nursing care and mutual activities are conducted. Besides, dedicated dining room, physical training room, and community facility may also be furnitured(Fig. 3).

The example is a nursing home built in 2005 in Okinawa for 112 residents, a two-story building with 5~6 care units in each floor. The care units were situated in 3 areas with each contains 1~2 units. In addition, a physical training room, a dedicated dining room were located in another area, and a community facility with audio and visual techniques equipped hall was built in adjacent. The different functional areas were linked by connection corridors, and links between care units was done via open space(hall, lobby etc.) or short corridors(Fig. 3).

The calculation demonstrates the connection corridor is the space with highest spatial integration(right side in Fig. 3, number is the order from high integration to low).
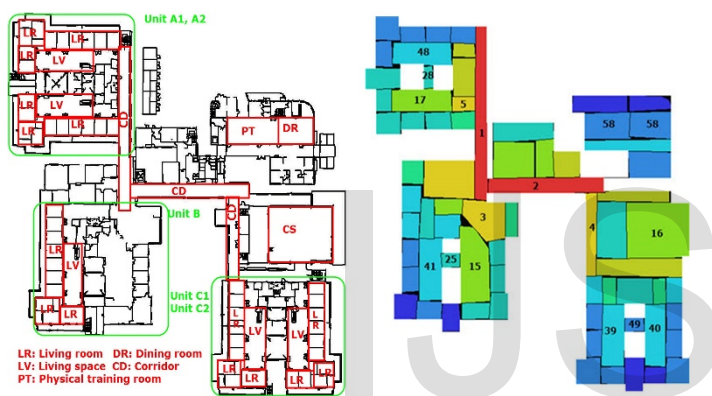

Fig. 3. Typical unit care nursing home floor plan(left) and integration(right)

Investigation also tells the community facility was implemented in 17 of the 22 investigated unit care nursing homes, and, it also found that in most cases it was located in middle or between different functional areas, which resulted its higher spatial integration as our example(#16 in Fig. 3).

3.3 Comparison Between Large Scale and Unit Scale Nursing Home

The average integration, connectivity, mean depth, and FIR for community facility in large scale care and unit care nursing home is presented in Fig. 4.

Compared with large scale care nursing homes, the integration is increased by about 13% from 0.9723 to 1.1023, connectivity increased about 11% from 3.1176 to 3.4706, FIR is increased by about 13%, and, the mean depth is decreased from 4.34 to 4.18 in unit care nursing homes(Fig. 4).

This result reveals that community facility has spatially
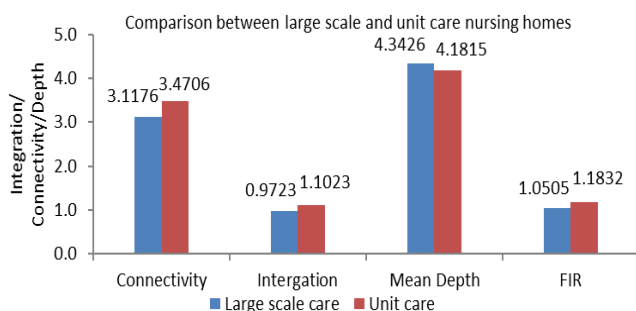
been taken as an important common facility in unit care nursing home with more direct connections, less steps to access and higher spatial integration. And, the increased FIR also confirms that spatial integration of community facility is about 18% higher than nursing home all space average in unit care nursing homes.

Fig. 4. Unit care nursing home with connection corridor as most integrated

3.4 Overall Changes of Community facility in the Past 35 Years

The overall changes of community facility in past 35 years is presented in Fig. 5, again, the integration, connectivity, and FIR was in uptrend(Fig. 5).

The FIR was changed from less than 1.0 in most nursing homes built before 1995 to more than 1.0 in that after 1995(Fig. 5). This tells generally the community facility has been positioned to place with higher spatial integration in most of nursing homes built after 1995. This result also reflects the change in consideration from accommodating more elderly with higher priority in early Japanese nursing homes to allocate community facility to higher spatial integration place with higher priority in modern Japanese nursing homes.
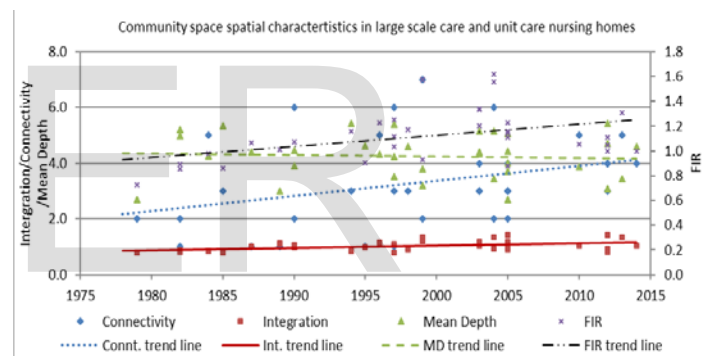

Fig. 5. Community facility spatial characteristics overall changes in past 35 years

The slightly decreased mean depth indicates the steps to access community facility were decreasing, which also confirms that community facility was getting to be situated to space with better access. Combined all changes in spatial characteristics above, it can be concluded that community facility in modern Japanese nursing home generally has been getting spatially sited to a place with easier access and easier for people to gather together.

4 CONCLUSION

The analysis of spatial characteristics and community facility in particular for Japanese nursing homes discloses that in classical large scale care nursing homes, the corridors along which living rooms and service facilities are distributed is the highest spatial integration place, and in modern unit care nursing homes, the route space links different functional areas basically is the highest spatial integration place.

The comparison between large scale care and unit care nursing homes confirms that the spatial integration, connectiv-

ity of community facility is increased by about 13%, and the mean depth to access community facility is decreased. This reveals the changes has happened in allocating community facility to higher spatial integration place in modern Japanese unit care nursing homes.

The overall transition of community facility in Japanese nursing home in the past 35 years also confirms its uptrend in both spatial integration and connectivity. This transition reflects a culture of connect to great community in modern Japanese nursing home design, that is, to make community facility easily accessed and gathered by nursing home residents and local people.

ACKNOWLEDGMENT

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