STUDY THE FACTORS OF SAFETY CARE SYSTEM FOR SENIOR HOUSING

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Abstract - Based on the progressing of population aging together with the changes in social patters, there might exist an ideal way to support the elderly who still have abilities to deal with their requirements of daily life. The interior facilities, equipment and design within these spaces will coordinated with the physical and mental conditions of the elderly and the planning and design of various services required. The safety care system will become the most important topic in the field of architecture and interior design, simultaneity. This literature studies a large elder residential house through questionnaire survey and data analysis at the Guishan, Taoyuan. The “Life Protection System” and “Identity System” two factors are obtained among thirteen questions of “Safety Care System” after factor analysis. The results show “Life Protection System” gain higher average score about 4.149 and the average of the factor “Identity System” is relatedly lower as 3.777. It presents the residents pay more attention to “Life Protection System” of “Safety Care System” than other factors.

Keyword - Senior House, Safety care system, Elderly

I. FOREWORD

Following with the aging of the population and the change of social pattern, the living pattern of the elderly will move towards various type nursing care. The " United Nations Principles for Older People " notes that the elderly should be able to live in a safe and suitable environment. According to the survey Taiwan's Ministry of the Interior at 2021, the elderly think that living at home is the most ideal way to provide for the senior living. However, in recent years, due to social changes, the willingness of children to live together, the low birth rate, the increase of professional women and the rise in housing prices, etc., it will be more difficult to actualize multi-generations in the same house in the city area. Will the elderly be able to enjoy their old life at home in the future? If the elderly cannot live with their children and must face physical and mental progressive decline. Is there exist any alternative for them?

The research survey mentioned above also shows that if there is a suitable welfare organization for the elderly. There are about 60% of the elderly are willing to live there (Li Niande, 1999). According to American scholar Wilmoth's research in 1998, he pointed out that the elderly who live alone in the United States have a higher death rate when they live in institutions after the age of 70, especially almost all of them live in institutions after the age of 80. According to the statistical data of the Ministry of the Interior, at the end of June 2018, there were 527,380 houses for elderly live alone. It’s accounted for 7.5% of the total number of houses in Taiwan, an increase of 57.3% compared with the end of 2009, especially at New Taipei City, Taipei City and Kaohsiung City. The housing status of the elderly live alone increased from 335,360 housing at the end of 2009 to 527,380 housing at the end of June, 2018. It is increase about 192,020 housing (+57.26%) in the past 10 years, it means the percentage of these elderly residential house is increase from 5.37% to 7.52% within decade 2009 to 2018. (+2.15 percentage points).

Recent years, due to the economic and financial situation of the elderly increase independently with higher economic income. It means they have the ability to choose their own ideal way of living style, and are not necessary to rely on their children for support. Obviously, the higher the education level of the elderly, the lower the rate of living with their children. Perhaps because they have their own house, savings, and pension make them have the ability to live separately from their children and choose their favorite retirement lifestyle.

Home should be a place where we rest our body, mind and spirit every day. It should meet basic requirements personally such as safety, comfort, warmth and happiness. However, the elderly housing in Taiwan seldom can meet these basic requests completely. Therefore, the ideal elderly house must be designed in accordance with the physical and mental conditions of them together with the consideration for the mobility degradation, which is different from the general common housing design (裴晉國, 2002)。Thus, it is an important topic for the government, investors, architectural or interior design workers to plan and design to create a “home” as a living environment with its independent and respect to the elderly life. Consequentially, this study plan to find out the factors

and the degree of importance that the elderly in Taiwan on the "SCS - Safety Care System" in the home space.

According to the research goals mentioned above, this study only focuses on residents of a health-care village residential community in Linkou District, New Taipei City, Taiwan (Abbr. "Health-Care Village"). Due to the limited area, the inference of the results in this study is limited. This manuscript focuses on exploring the importance of occupants to the factors of the indoor safety care system. Other types of elderly living styles, as well as related aspects of architecture, ergonomics, firefighting, medical services and management will not be discussed with this study.

II. LITERATURE REVIEW

1). Elderly House

According to the Taiwan Ministry of the Interior's "Promoting Private Participation in the Elderly Housing Construction Promotion Program", the definitions and applicable principles of elderly house would be:

(1) The term "elderly housing" in this program refers to buildings for residential use in accordance with Article 15.1.2 and 15.1.3 or built in accordance with other relevant laws and regulations, and its facilities and equipment comply with the provisions of Chapter 16 of the Building Design and Construction, the Building Technical Regulations.
(2) With reference to Article 5 of the Implementing Rules of the Welfare Law for the Elderly and Article 1 of the Interim Regulations on the Welfare and Living Allowance for the Elderly, the elderly living in a residence must be at least 60 years old, and the aborigines shall be at least 55 years old, and can live for self-care, the age of the spouse living together shall not be less than 50 years old.
The biggest difference between senior housing and ordinary common housing is that the internal equipment and housing design need to be in line with the physical and mental conditions of the elderly, as well as the planning and design of various services required. The type of service depends on the type of housing for the elderly.

2). Interior live space of Elderly House

The spatial type of "elderly house" is based on the Chapter 16 Elderly Residence Article 295 of architectural design and construction rules, the Building Technical Regulations. The service space of the elderly residence must include at least:

A. Residential units: the spaces of bedrooms, bathrooms, toilets, and kitchen.
B. Shared service area: the space of halls, corridors, stairwells, elevator rooms, stair halls, shared bathrooms, toilets and kitchens in buildings.
C. Public service space: space for public dining room, public kitchen, social hall, and service management room.

There should have four basic characteristics for the living environment of elderly (Lin yuzi, 1997):
A. Safety: To prevent accidents, it should be a "barrier-free" environment design, and emphasize that barrier-free design needs to have (a). Variability; (b). Diversity; (c). Commonality; (d). Continuity; (e). Safety; (f). Comfort and (g). Aesthetics to meet the needs of modern users;
B. Complementary: It can help the elderly maintain independence in daily life.
C. Rehabilitation: In the functional design, it is necessary to consider reducing the burden on the caregivers;
D. Variability: A variable space should be reserved in the space planning to cope with the gradual degradation of the body and the need to change the space or install auxiliary devices.

Lin yuzi (1997) indicate that the daily accidents of the elderly in their homes surveyed at Japan. The result shown the proportion of accidents among the elderly over 65 years old is quite high. As higher as about 90% elder will have accidents such as falls. There are about 30% of cases of being bedridden due to injuries such as fractures. In the meantime, about 87.5% are caused by falls due to height differences or obstacles on the same level floor, and even lead to death. The third is the bathroom drowning, the fourth is the house fire and the fifth is falling from the stairs. Therefore, it is very important to build a safe and accident-free residential environment for the elderly for they can live within a healthy and happy life.

Zeng siyu (2002) research show that in 1979, Sweden's Spri developed a design guidelines for local nursing homes centered for the elderly. It is stipulated that the wards are all composed of individual with attached bathrooms. In addition to beds, bedside tables and internal ramps for wheelchair users, the furniture, wall decorations, plants, etc. that are used by individuals can also be brought in, the minimum area of each room will be 16 square meter which bathroom do not included. It also indicates that the formation of the minimum living unit would including following space which are kitchen, dining room, work space, bathroom for disable, medical care, corner of nursing, staff office, etc.

In 1983, guidelines for the transformation of chronic hospitals for the elderly into local long-term care facilities were announced to improve the livability of wards, such as adding locks to doors, nameplates on door panels, and mailboxes (Zeng siyu, 2002). Therefore, the interior living space design of "elderly house" should pay attention to the autonomy and

privacy of the occupants, and be oriented toward individualization, so as to create a good interior residential quality.

The physiological degenerated phenomenon of the elderly is most serious in terms of vision, speed and memory. The following characteristics should be considered within interior design (NICHIJU - Nippon Housing Equipment Co., Ltd., 1998):

A. Legibility: the fonts of signs, information bulletin, etc. should not be too small.
B. Accessibility: It can smoothly reach the level (handrails are installed in the aisle) or move vertically (elevator), and the riser and tread of stair.
C. Convenience of Facilities: Add handrails to bathtubs and toilets, sit toilets, and horizontal handle faucets.
D. Safety: There is no height difference on the floor, avoid using too hard floor materials, non-slip floor materials, and install night lights on the corridor between the room and the toilet.
E. Comfort: color matching, lighting and lighting.
F. Safe Facilities: emergency call equipment, firefighting equipment, etc....

III. METHODOLOGY

This research is mainly to discuss the degree of attention paid to the indoor safety care system factors by the elderly living in a health care village in Linkou, New Taipei City. The quantitative "Correlation Approaches Method" is employed to understand the built environment of the health care village through questionnaires and interviews in order to understand what constitutes of a safe care system and its effects of living behavior.

The measurement tools based on relevant literature discussing and analyzing, the main focus is the components of the indoor safety care system together with the content of the ambience and design factors mentioned by Backer (1987) as the basic structure, then supplemented by the qualitative interviews and senior interior designer and practitioners revised it after discussion to construct the "Indoor Safety Care System Scale". The scale mainly consists of 13 items including barrier-free environment design, firefighting facilities, safety monitoring system and recognition system in the health village. The answering method adopts the Likert five-point scale method, and the subjects are asked to rate "very important", "important", "no opinion", "not important" and "very unimportant" according to their subjective views on the content of each question and rank from 5 point to 1 point. The higher the average score, means the higher the emphasis on the safe care system. Individual attributes include 5 variables: "Gender", "Age", "Education level", "Occupation", "Marital status" and a total of 6 questions.

This study takes the residents living in the health care Village as the research object. After the questionnaire test, the questionnaires are sorted out, and the invalid questionnaires are eliminated. Then, the coding work is carried out, simultaneously. The statistical software named as SPSS for Windows 26.0 is used as the analysis tool. The data statistical analysis methods including 1). Reliability analysis; 2). Times distribution; 3). Descriptive statistics; 4). Factor analysis and 5). Variance test.

IV. DATA ANALYSIS

In order to improve the recovery rate of the questionnaires, the distribution of the questionnaires is entrusted to the management and service center of the "Health Care Village" and gifts were given to those who answered the questionnaire to increase the return rate at same time. The completion of the questionnaire and the return of the questionnaire was completed within one month. The total number of questionnaires are 250, excluding 33 households who could not answer (households who went abroad or non-residents). Thus, total of 217 questionnaires were sent out, and 143 valid questionnaires were returned, with a return rate of 65.89%.

1). Descriptive Statistics

There were 60 male subjects, accounting for 42% of the total sample size, and 83 female test subjects, accounting for 58% of the total sample size among the 143 questionnaires investigated. The age distribution was 5 people under 64 years old (3.5% of the total sample number); 21 people aged 65-74 years old (14.7%); 117 people over 75 years old (81.8%). It shows that most of the subjects are over 75 years old (late stage of elderly). The distribution of education level is as follows: 83 public employees (58% of the total sample number); 3 doctors and nurses (2.1%); 14 industrial and commercial personnel (9.8%); 29 householder (20.3%) and the other 7 people (9.8%). The marital status is 72 people who are married and living with their spouse (50.3% of the total sample number); 13 people who are married but not living with their spouse (9.1%); 58 people who are single (40.6%). It shows that the current marital status of the subjects is mostly married and living with their spouses, followed by singles.

2). Factor Analysis

The "Safety Care System Scale" in this study has a total of 13 items. First, the KMO and Bartlett test were performed to test its applicability, and it was found that its KMO=.934, and the approximate chi-square distribution of the Bartlett spherical test result was 1541.112 (df= 77), p= .000, which has reached a significant level. It means that there are common

factors in the correlation matrix of the parent group, and factor analysis can be carried out. Using the principal component analysis (PCA) method, the common variable components of the thirteen items were extracted, and the Orthogonal rotation method was used to seek the maximum possibility of factor separation. Total of 2 factors with eigenvalues greater than 1 were obtained. The overall internal consistency of the scale is Cronbach's α= .947, which can explain 70.54% of the variance. This study named these two factors according to the individual connotations; the names, contents and reliability of these two factors are:

(1) "Life Preservation System": Barrier-free environment design, firefighting facilities, safety monitoring system and other facilities in the health care village. Cronbach's α= .939 for this factor.
(2) "Identification System": Colors and numbers are used in the health care village to strengthen the identification ability of the elderly who living in the village. Cronbach's α= .874 for this factor.
The results of this factor analysis are shown in Table 1 below:

Factor	Content of Item	Extracted factors and their loadings	
		1	2
Life Preservation System	Set up room emergency call bell	.870	
	Room living care sensor	.855	
	Set up emergency call indicators at the door	.838	
	Emergency call bell in bathroom	.816	
	No height difference (threshold) design on the ground	.722	
	Safety handrails design	.685	
	Installation of fire detectors	.682	
	Set up health management center	.621	
	Bathroom safety grab bars	.614	
Identification System	Different colors of odd and even number floor carpets		.847
	Separate letterboxes by color		.778
	Connected emergency escape balcony design		.775
	The elevator entrance marks the number of the floor		.745
Initial eigenvalue		8.061	1.108
Average*		4.149	3.777
Standard Deviation		.521	.616
Explainable variance (%)		62.011	62.011
Cumulative explained variance (%)		8.524	70.535

Table 1 Factor Analysis of the Safe Care System Scale
*mean range 1 to 5

3).Descriptive Statistics
The importance of each factor in the "Safe Care System Scale" is as follows in order of their averages (Table 2):

1)."Life Preservation System": average 4.149; 2) "Identification System": average 3.777:

Factor	Min	Max	Average *	Standard Deviation
Life Preservation System	2.111	5	4.149	.52
Identification System	2.500	5	3.777	.61

Table 2 The average of the importance of each factor in "Safe Care System Scale"
* mean range 1 to 5

The results of the analysis show that the average number of "Life Preservation System" is 4.149, and the average number of "identification system" is relatively low (3.777). It shown the residents paid attention to the importance of Life Preservation System is higher than Identification System and it will be about 78% compare with 69%. The discusses about the importance of each factor in the safe care system as below:

(1) "Life Preservation System"
This factor includes barrier-free environment design, firefighting facilities, safety monitoring system and other facilities in the health care village. Through Table 3, we can understand the importance of individual items. There are the top three important terms are: 1). "Setting up a health management center": the average importance level is 4.25; 2). "Emergency call bells installed in resident's rooms": the average importance level is 4.21; 30. "Emergency call bell in the bathroom": the average importance level is 4.21. Obviously, the least important one is: "safety handrail in the bathroom": the average importance level is 4.04.

Items	Min	Max	Ave. *	S.D.
Set up room emergency call bell	1	5	4.25	.69
Room living care sensor	1	5	4.21	.65
Set up emergency call indicators at the door	2	5	4.21	.59
Emergency call bell in bathroom	3	5	4.20	.57
No height difference (threshold) design on the ground	3	5	4.15	.56
Safety handrails design	2	5	4.14	.63
Installation of fire detectors	1	5	4.09	.69
Set up health management center	3	5	4.06	.59
Bathroom safety grab bars	1	5	4.04	.72
Overall	2.1	5	4.1499	.5210

Table 3 Statistical of Average Satisfaction of Each Item for "Life Preservation System"

Ave.=Average, S.D. = Standard Deviation,
* mean range 1 to 5

(2)" Identification System "
This factor is to use colors and numbers in the interior of the health care village to enhance the identification ability of the elderly who living in the village. It shown the degree of satisfaction of individual items through Table 4. Among the items, the ranking of importance is: 1). "The elevator entrance marks the number of the floor" (3.94, the average number of importance); 2). "Separate mailboxes by color " (3.77); 3). " Different colors of odd and even number floor carpets"(3.74). The one with the lowest importance level is “Connected emergency escape balcony design ", the average importance level is 3.66.

Items	Min	Max	Ave. *	S.D.
Different colors of odd and even number floor carpets	2	5	3.94	.69
Separate mailboxes by color	2	5	3.77	.76
Connected emergency escape balcony design	3	5	3.74	.66
The elevator entrance marks the number of the floor	1	5	3.66	.78
Overall	2.5	5	3.777	.6160

Table 4 Statistical of Average Satisfaction of Each Item for " Identification System "

Ave.=Average, S.D. = Standard Deviation,
* mean range 1 to 5

4). Variance test
In order to understand the differences in the impact of individual attribute variables on the "safety care system", the t-test for difference testing and Analysis of Variance (ANOVA) for single-factor analysis were employed with this study.

(1) T test
Taking "gender" among the individual attribute variables as the independent variable and "safety care system" as the dependent variable, the t-test was executed to conduct a variance test. The result show that "gender" had no significant difference in the influence of the dependent variable (Table 5).

Factors	T value	Significance
life support system	.940	.534
Identification system	.775	.881

Table 5 Analysis of the "gender" difference for "safe care system"

(2) ANOVA
Taking "Age", "Education level", "Pre-retirement occupation" and "Marital status" among the personal attribute variables as independent variables, and two factors of "safety care system" as dependent variables, an independent sample single-factor variation was carried out for analysis. For those with significant differences, the post hoc test (Scheffe method) is used to test whether there are differences between different items. The results of analysis shown none of them reached significant difference.
The results of variance analysis on "individual attribute variables" show that "Age", "Education level", "Pre-retirement occupation" and "Marital status" in the individual attribute variables are independent variables, while two factors of "safe care system" were dependent variables, and the t-test and independent sample single-factor analysis of variance showed that all of them were not significant difference.

V. CONCLUSION

Based on the goals and questions, this study initially constructed the items of "Safety Care System for the Elderly Residence" based on the analysis and compilation of relevant literature, and revised it after qualitative interviews and discussions with senior interior designer to construct the "Safety Care System Scale". The scale mainly consists of 13 items including barrier-free environment design, firefighting facilities, safety monitoring system and identification system…etc. in the health care village. After factor analysis and factor naming, the "safety care system" is divided into two factors, namely: "life support system" and "identification system", and the analysis is based on these factors.

Based on the proposed issues of the research assumption, the research findings and conclusions of this study are described as follows:

Two factors of "safety care system":

1). Factor of "life support system" with the importance level is about 78% including barrier-free environment design, firefighting facilities, life safety care system and other facilities in the health care village. It is the most importance among all factors in this study. Other related studies have also indicated that the primary reason for the elderly to consider living in a health care institution is whether the institution meets a safe and barrier-free environment. This result shows that the well-planned safe environment in the institution meets the living environment needs of the elderly. Then, the elderly would give extremely high evaluations with further enhances the recognition of the residents after living experienced.

2). Factor of “Identification system" with the importance level is about 69%. Colors and numbers are used in the interior of the health care village to strengthen the identification ability of the elderly. Among them, the connected emergency escape balcony design is the least important item considered by the elderly although its important.

The results of this study show that the most important factor for design and planning the elderly housing is the "safety care system", which improves residents' sense of security in elderly housing. It should include barrier-free facilities, safety design, firefighting facilities, lighting and coloring together with central monitoring system:

1). Barrier-free environment planning: For example, there is no level difference in the floor of the whole space, safety handrails are installed in the aisles and bathrooms, the width of the aisles and doors in the whole indoor space is widen enough (to facilitate wheelchair access), handle-type faucets, horizontal handles are installed on the doors, toilets for disabled are provided on the public space.

2). Safety design: furniture without sharp corners and it must conform to the ergonomic size of the elderly, chairs must have armrests, and the floor should be made of non-slip materials (e.q. carpet, plastic floor tiles or anti-slip tiles) ...etc.

3). Firefighting facilities: smoke exhaust facilities, fire sensors and other firefighting facilities, connected fire escape balconies…etc.

4). Lighting and coloring: consider sufficient brightness without glare, choose bright together with soft color, and use different colors to distinguish floors or mailboxes for easy identification by the elderly.

5). Central monitoring system: room emergency call system, room infrared detection, power cut-off and anti-theft monitoring when going out of the room…etc.

When the elderly cannot live with their children and must face psychological changes and physical deterioration due to aging, studies have shown that a very high proportion of the elderly can accept suitable welfare institutions or housing for the elderly. However, how to provide a "housing for the elderly" and "community" like "home" requires a successful combination of many facets (management, medical services, architecture, interior and landscape design, air conditioning, firefighting…etc.). The ideal design of aging residential buildings on the site must be designed in accordance with the physical and mental status of the elderly, which is different from general common residential design. However, the future needs of residents are neglected by the most of domestic residential plan and designer. The results of this study are expected to provide related industries are used as a reference for planning the housing for elderly.

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