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Difference in the Suicide Rates of Upper & Lower Floors of High-Rise Apartment Residents

Pathological Phenomenon & Spatial Structure of High-Rise Apartments

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ABSTRACT

Cities facing rapid growth often respond to housing shortage by providing large-scale, high-rise apartment complexes. However, several studies report negative effects of high-rise apartment environment on people's spatial behaviour. For example, Kim & Kim (2016) analysed low-income residential areas in Seoul and found that high-rise apartment complexes have higher suicide rates than detached single-family houses, and that spatial configuration of apartment complexes has decreased social interactions among residents. Gifford (2007) reviewed relevant studies and argued that people living on higher floors were less satisfied with their homes and their mental health was negatively affected. Gifford further suggested that these negative effects might lead to social problems such as suicide and crime, which in turn have negative effects on society. However, no study to date examined a possible connection between spatial configuration of floors and suicide rates in high-rise apartment complexes.

This study attempted to analyse the effects of floors (height) on suicide rates by modelling spatial configuration. All apartment complexes in City "A" have been included in the statistical analysis. Research methods are as follows. First, a database including tenure type, area, address, and number of residents in all apartment complexes was created. Second, apartments were categorized into two income groups, and spatial configuration characteristics were analysed for lower and upper levels in both apartment categories. Third, differences in suicide rates were analysed for lower and upper levels in both apartment categories. Finally, the relationship between apartment levels with different spatial configuration characteristics and suicide rates was examined and interpreted.

This study identifies the relationship between spatial configuration and suicide rates by reporting high suicide rates of people living in high-rise apartment environment, particularly among low-income residents. It contributes to environment behaviour studies by revealing potential spatial pathologies that accompany living in high-rise apartments.

KEYWORDS

HIGH-RISE APARTMENT, SOCIAL HOUSING, SUICIDE RATE, SPACE SYNTAX, SPATIAL PATHOLOGY

1. INTRODUCTION

Since the 1960s, many studies have examined behavioural issues, weakening of social ties, and mental health issues found in high-rise living environment (Lester, 1994; Moore, 1976; Goodman, 1974). Gifford (2007) conducted a comprehensive literature review on previous studies on negative emotions, deterioration of health, and social pathology phenomenon suffered by the residents of high-rise buildings.

In Korea, where apartment units now account for more than half of all housing units, researchers have been studying high-rise living environment since the early 1990s. Many studies have raised concerns about the effects of living in such environment, including stress, anxiety, and other psychological disorders.

SHIN & KANG (1996) analysed the causes of stress present in high-rise living environment and determined the health effect of living environment on residents. Kang (2003) also studied degrees of anxiety, depression, and aggression found in residents of very tall residential buildings and argued that the people who lived in upper levels are relatively more susceptible to mental health issues.

However, there is no previous study on suicidal behaviour caused by high-rise living environment, which would be the most extreme psychological disorder. Also, most studies have analysed behaviours of residents in low-rise and high-rise residential buildings without examining the physical environment of each floor. Kim & Kim (2016) is the only study that compared and analysed low-income residential areas in Korea and concluded that high-rise apartment complexes have higher rates of suicides compared to single-family housing complexes, and that spatial configuration of apartment complexes lead to disconnect in communication among residents. But even this study neglects the patterns of suicide rates for different spatial configurations of floors in the high-rise apartment buildings.

Given the wide range of psychological disorders suffered by the residents of high-rise buildings, suicidal behaviour merits more attention. In addition, since many studies conclude that economic condition is one of the most important factors affecting a person's suicidal behaviour (Ham, 2013), it is important to control for income level of the residents. Also, it is necessary to interpret pathological phenomenon such as psychological sense of isolation found in high-rise living environment with a spatial configuration perspective.

In Korea, apartments are supplied as either private housing or social housing. Private housing is supplied mainly by the private sector, purchased and owned by the middle class with assets. On the other hand, supply of social housing is guided by the national government's housing policies. The primary goal of social housing is to provide housing stability for people who do not own homes, mostly low-income residents. Therefore, there is a significant difference in household income between the residents of private and social housing. [1]

Given these two types of apartment housing in Korea, this research will examine the difference in the suicide rates between lower and upper floors in both private housing and

[1] In the study site, permanent social housing comprises more than half of all social housing units. 83.7% of all households belong to the first and second income quintiles, and a significant number of residents are National Basic Livelihood Security beneficiaries.

social housing, whose residents live under very different socioeconomic conditions. Living environment that leads to pathological disorders will be analysed by studying the spatial configuration of high-rise apartment buildings.

2. LITERATURE REVIEW

2.1 Research on Pathological Phenomenon Found in High-Rise Buildings

High-rise apartment buildings became the dominant form of housing in Korea in the 1980s, and today account for more than 60% of all housing. Internationally, many researchers have studied pathological disorders caused by living in high-rise environment. Gifford conducted a review of previous literature on both positive and negative effects of high-rise living environment (Table 1). This study posited that high-rise living environment not only causes psychological issues, but also residents' dissatisfaction with their homes, mental issues, children's behavioural issues, crimes, and other social problems.

Many studies have pointed out that physical living environment affects the people who are users of that space. In particular, the impact on low-income and other people who have no control over their environment (children and the elderly) are known to be even higher (SEO ET AL., 2004; KANG & SHIM, 2000). Therefore, it is necessary to analyse social disorders while paying attention to high-rise living environment of social housing where low-income people are concentrated.

Category	Researcher(s)	Result(s)
Home Satisfaction	Gittus, E(1976)	Residents with children report low home satisfaction
	Moore, N.C(1975)	More complaints about sense of isolation, loneliness, and noise compared to single-family housing residents
	Saegert, S(1979)	High level of dissatisfaction from sense of isolation
Mental Health	Moore, N. C(1976)	Residents in high-rise buildings show more neurotic symptoms compared to single-family housing residents
	Goodman , M(1974)	Ratio of residents with mental pathological symptoms higher in upper floors
	Hannay, D.R(1979); Littlewood, J & Tinker, A(1981)	Residents in upper floors show negative psychological symptoms more often The symptoms decrease after moving out of upper floors
	Husaini, B.A., Moore, S.T & Castor, R.S(1991)	Depression, schizophrenia, and panic disorder occurs more often among residents of upper floors (lower/upper floors comparison)
	Edwards, J.N., Booth, A.,& Edwards, P.K(1982)	More family trouble with spouse and children
Children's Behavioural Issues	Ineichen, B. & Hooper, D.(1974) ; Taylor, Kuo & Sullivan(2002)	Children living in high-rise apartment buildings have more than double the number of behavioral issues, including bed-wetting and anger attacks

	Gifford, R & Lacombe, C(2006)	Significant impact on behavioral issues experienced by children living in upper floors of high-rise buildings
	Crawford & Virgin.(1971); Gittus, E(1976)	Lower athletic abilities of children who live in upper floors of high-rise buildings since they mostly play alone in confined space
Crime	Slum surgery in St. Louis(1951)	Insufficient semi-private buffer space invite crimes
	Yancey, W(1972); Newman(1975)	Higher floors have more crimes and negativity in the community
Social Ties	Nadler, A., Bar-Tal, D & Drukman, O(1982)	Students in lower floors tend to help others more
	Bickman, L(1973); Wilcox, B.L & Holahan, C.J(1976)	Social support and participation, frequency of helping others decrease in higher floors
	Korte, C & Huismans, S(1983)	Residents of higher floors have lower level of positive social relationships
	Ginsberg, Y & Churchman, A(1985)	97% of residents on the eighth floor know their neighbors on the same floor; only 36% know their neighbors on the twentieth floor
	Sinnett, E.R, Sachson, A.D & Eddy, G(1972); Michelson(1977)	Residents in the lower floors have more social relationships Residents in the upper floors have social relationships mostly outside of the residential complex where they live

* GIFFORD (2007), NEGATIVE ASPECTS SUMMARIZED BY THE AUTHORS

Table 1 : Studies on Negative Effects of High-Rise Living Environment

2.2 Research on Accessibility to Floors in a High-Rise Apartment Building

It is reported that living in higher floors lead to stronger sense of psychological isolation (MOORE, 1975; SAEGERT, 1979). In particular, children and the elderly - who do not enjoy full range of freedom in their physical activities – participate in even fewer outside activities when they live in higher floors (CRAWFORD & VIRGIN, 1971; KANG & SHIM, 2000). Elevators, which serve as the primary means of vertical movement in high-rise apartments, often cause stress from fear of accidents, waiting, and threat of crimes. (SHIM & KANG, 1996; LOH & KIM, 2008). The results of these studies indicate that the residents living in higher floors have less psychological stability and suffer from many stress factors as they travel from the ground to upper floors. In other words, the psychological accessibility is low for the residents.

Within space syntax methodology, there is almost no research on vertical links in high-rise apartment buildings. In general, the concept of j-graph (HILLIER, 1999) is applied for analysis of multiple floors. Spatial configuration model is designed such that depth of 1 is given for connection between floors, so that the accessibility decreases by one. Another option is to adopt connecting method used in BRÖSAMLE ET AL. (2007) for multi-levels. This approach assumes a room for stairs between floors, and this stair space connects to multiple floors. Higher floors have lower accessibility in this model, in which floors are connected vertically. But it is more appropriate where floors are connected by stairs. But when we examine residents' movement patterns in high-rise apartments, most people use

elevators rather than stairs. Hence, modelling vertical connections between floors in high-rise apartment is not fully compatible with modelling lower buildings in which floors are connected by stairs.

2.3 Definition of Lower and Upper Floors

There is no agreed upon definition for lower and upper floors. It is useful to examine definitions in previous studies on social pathological phenomenon and high-rise living environment (Table 2). In general, previous studies defined 1st to 5th floors as the lower floors, to which the residents can "walk up the stairs." Upper floors are defined as 6th floor and above. This research follows this convention and defined "lower floors" as 5th and lower floors, while "upper floors" is defined as 6th floor and above.

Researcher(s)	Study Area	Definition of Upper Floors
Wilcox&Holahan(1976)	Comparison of 1st-5th Floors and 7th-10th Floors in a Dormitory	7th Floor and Above
McCarthy&Saegert(1979)	Comparison of Three-Story and Fourteen-Story Buildings	4th Floor and Above
Hanny(1981)	Comparison of a Single-Family House, 1st-4th floors & 5th Floors and Above in a High-Rise Building	5th Floor and Above
Bynum&Purri(1984)	Comparison of 3rd-4th Floors and 6th-10th Floors in a Dormitory	6th Floor and Above
Saegert(1982)	Comparison of Three-Story and Fourteen-Story Buildings	4th Floor and Above

Table 2 : Examples of Studies on Social Pathological Phenomenon and High-Rise Living Environment

3. METHODS

This study utilizes records from the database of suicides for five years, between 2007 and 2011. The spatial extent of the study includes all apartment complexes in city "A" in Korea. The research first categorizes apartments into private and social housing, based on socioeconomic characteristics, then examines the differences in suicidal rates in lower and upper floors for apartments in both categories. Also, by conducting a spatial configuration analysis of the apartment complexes, the study explores how the degree of spatial integration leads to an increase in social pathological disorders.

To this end, first the numbers of residents in each floor of all apartment buildings within city "A" are calculated. The numbers of households in each floor are determined from official household address records. The population is then estimated from average household size in the 2010 Population Census.

Second, to control for income level - one of the dominant factors influencing suicidal behavior – the apartments in the study area are categorized into private and social housing apartments. This controls for income level of the residents and helps to clearly determine the effect of floor on suicidal behavior. This is followed by an analysis of the suicide rates

distribution for all apartments – both private and social. The distribution of floor level is extracted from the database with addresses where suicides took place. Suicide rates are calculated following the international convention, as the number of suicides per 100,000 persons.

Third, the suicide rates for lower and upper floors are analyzed for each apartment category, and the differences are tested for statistical significance using Chi-square test.

Fourth, the vertical corridor of a prototypical apartment building in the study area is modeled, represented with a diagram for a full analysis of the spatial configuration of the residential environment. Using space syntax methodology, the spatial configurations of all the floors from the ground to the top are analyzed. Given that the connectivity of vertical corridor from the ground level to each floor is the key factor rather than visibility within a single floor, an appropriate axial map analysis is conducted.

Finally, the psychological disorders and suicidal behaviors caused by living in upper floors in high-rise buildings (as argued in previous studies) are interpreted and discussed from a social, spatial configuration perspective based on the results of this study.

4. RESULTS

4.1 Analysis of the Suicide Rates

4.1.1 Categorization of Apartments by Income Level

Multiple studies on suicide have concluded that income level is a major factor leading to suicide. Therefore, it is important to control for income level, specifically by categorizing apartments according to the income levels of their residents. Hence, the difference between private and social housing apartments can serve as an important standard when examining the effect of floor on suicide rate. In this context, all apartments in city "A" are analyzed first, followed by an analysis of suicide rates conducted separately for private and social housing units.

The apartment complexes in the study area include buildings with different number of floors and forms, ranging from five to 28 floors. Of 241 apartment complexes, 115 complexes contain only 15-floor apartments, in which 69.7% of all households live. The number of households and suicides in each apartment category are as follows (Table 3).

A total of 158,916 households live in 1,505 buildings in 241 apartment complexes in city "A." Overall, 85.2 people per year commit suicide. In private housing apartments, there are 137,109 households living in 1,389 buildings in 221 apartment complexes, where 64.2 people per year committed suicide. In social housing apartments, there are 21,807 households living in 116 buildings in 20 apartment complexes, where 21 people per year committed suicide. While total resident population in private housing is six times larger, the number of people who committed suicide is 64.2, only about three times larger. It implies that the suicide rate of social housing residents is higher than that of private housing residents.

Category	All Apartments			Private Housing Units			Social Housing Units		
Floor Category	Lower Floors	Upper Floors	Sub-total	Lower Floors	Upper Floors	Sub-total	Lower Floors	Upper Floors	Sub-total

Number of Households	57,196	101,720	158,916	49,443	87,666	137,109	7,753	14,054	21,807
Population (Persons)	162,437	288,885	451,322	140,418	248,971	389,390	22,019	39,913	61,932
Number of Suicides (Persons/Year)	28.4	56.8	85.2	23.0	41.2	64.2	5.4	15.6	21.0

Table 3 : Apartment Population and the Number of Suicides

4.1.2 Analysis of Suicide Rates in Lower & Upper Floors by Apartment Category

Table 4 presents the results of the overall suicide rates comparison between the lower and upper floors in apartments in city "A." In total, the average suicide rate of all apartment residents is 18.88 per 100,000 persons. The suicide rate of lower floors residents is 17.48 per 100,000 persons, while upper floors residents is 19.34 per 100,000 persons – approximately 10% higher. However, Chi-square test to examine the relationship between floor and suicide rate yields $X^2 = 0.111$ and p-value of 0.739, indicating that the difference is not statistically significant at $p<0.05$ level. In other words, without controlling for income level, there is no significant difference in suicide rates between lower and upper floors for all apartments in the study area. Separately, the suicide rate of private housing residents is 16.49 per 100,000 persons. The suicide rate in upper floors is only 1.04% higher, and the p-value of 0.864 show that there is no statistically significant difference. On the other hand, the suicide rate of social housing residents is 33.91 per 100,000 persons, more than 2.06 times the rate of private housing residents. Within social housing, the suicide rate of the upper floor residents is 59.38%, much higher than the suicide rate of the lower floor residents. Chi-square test shows that $X^2 = 3.063$ and the p-value is 0.08 – statistically significant difference at $p<0.1$ level.

Category		All Apartments (Private & Social Housing Units)	
		Private	Social
Overall Average Suicide Rate	18.88	16.49	33.91
Suicide Rate, Lower Floors	17.48	16.38	24.52
Suicide Rate, Upper Floors	19.34	16.55	39.08
Increase (%)	10.64	1.04	59.38

* Unit: Persons/100,000 Persons

Table 4 : Suicide Rates in Lower & Upper Floors of Private & Social Housing Units

An analysis of the difference in suicide rates for apartment categories with different socioeconomic levels show that suicide rate difference is statistically significant between lower and upper floor resident groups in social housing apartments. It shows that the suicide rate increases in higher floors for low-income residents. The average suicide rate was higher in social housing apartments (33.91 per 100,000 persons) compared to the rate in private housing apartments (16.49 per 100,000 persons). The suicide rate in social housing apartments was more than two times the rate of private housing apartments, and the difference between the lower and upper floors was 59%. In private housing apartments, there

was no significant difference in suicide rates between the lower and upper floors. Hence, it can be interpreted that for all social housing residents, floor category and suicide are dependent variables, while for low-income residents, whether they live in the lower or upper floor can influence their suicidal behaviors.

4.2 Analysis of Spatial Configuration

High-rise apartments in this research have the same floor plan for all floors in each building, and the building's core (stairs and elevator) serve as the vertical corridor within an apartment building. Therefore, it is important to analyze the difference in the degree of integration between floors, starting from the ground floor. In other words, for conducting spatial configuration analysis, spatial configuration characteristics within a single floor are less important than the connectivity between the apartment complex outside the building to each floor in the building. Hence, an axial map analysis is more suitable for this study than a VGA analysis.

For spatial configuration analysis of high-rise apartment building, a prototypical apartment building in the study area was modeled, represented with a diagram. Most of the buildings in the study area have a single core for vertical movements, and residents enter the house via a corridor. Therefore, the most common high-rise apartment type – a 15-floor apartment building with corridor access – was modeled for further analysis.

4.2.1 Method of Analysis for a Typical High-Rise Apartment Building

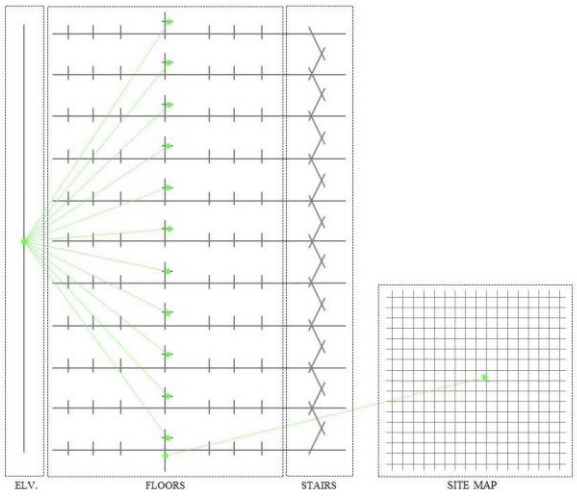

Figure 1 : Axial Map Modelling for a Typical High-Rise Apartment Building

Currently there is no widely recognized protocol to model vertical links for spatial configuration analysis in high-rise apartments. However, the primary means of vertical movements – the elevator – can be modelled by employing methodology used in BRÖSAMLE ET AL. (2007) which modelled stair connections in a low-rise building (Figure 1).

Via stairs, the corridor on one floor to the corridor on an adjacent floor is at depth 2. In this model, the elevator (which serves as the main corridor for vertical movements) occupies a separate space and is linked directly to all floors. Thus in reality, the residents on an elevator travel past the floors stacked on top of each other. But this modelling method eliminates the concept of distance between the ground and a floor in the building. In sum, every floor in the building, except for the ground floor (directly linked to outside) and the second floor (directly linked to the ground floor via stairs) all occupy the

same position in the model's hierarchy. (Figure 2) shows the results of the axial map analysis using this model.

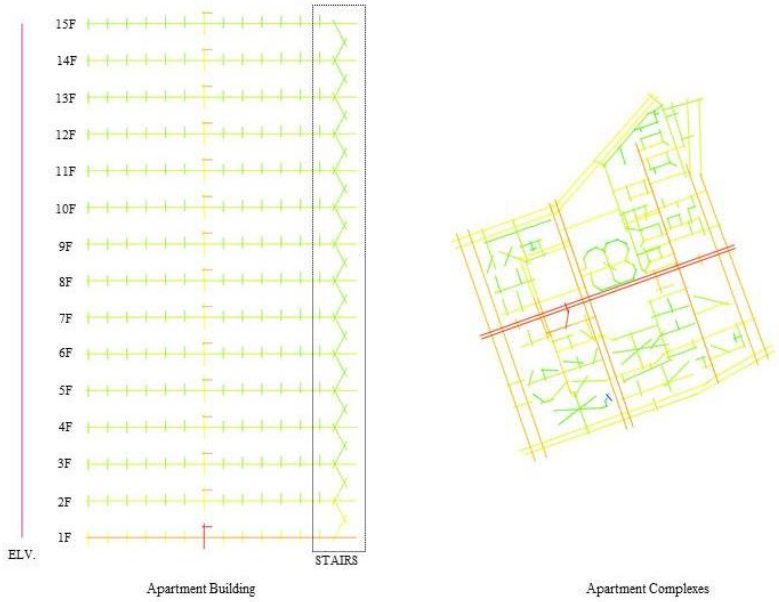

Figure 2 : Axial Map Analysis Result 1 – General Modelling Method

The integration value on the ground floor is the highest, since it is directly linked to the apartment complex. Next, except for the second floor directly linked to the ground floor via stairs and the third floor which is the next adjacent floor, the integration values for all floors from four to twelve are the same. Then the integration values begin to decrease from the thirteenth floor and is lowest on the fifteenth floor where there is no link to an upper floor via stairs. The integration values in the lower and upper floors are 0.98 and 0.94, respectively, not showing much difference. This result stems from the fact that the elevator (modelled separately, as seen in Figure 2) is directly linked to all floors. While the shortcoming of this modelling method is not apparent in low-rise buildings, the residents' actual use pattern and perception of space in high-rise buildings deviate significantly from this model. In other words, this modelling method is limited in its capability for use in spatial configuration analysis of high-rise living environment. For example, it cannot provide a modelling platform suitable for spatially interpreting research results such as how the children who live in higher floors spend less time playing outside (KANG & SHIN, 2000).

4.2.2 Spatial Configuration Analysis Incorporating Psychological Sense of Distance in High-Rise Apartment Buildings

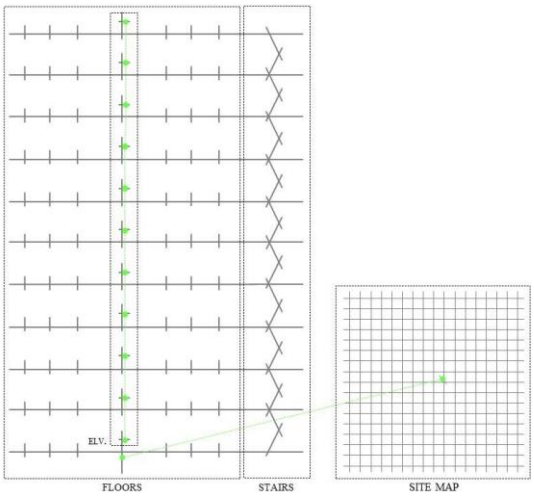

Figure 3 : Axial Map Modelling that Incorporates Psychological Sense of Distance in High-Rise Apartment Buildings

Almost all residents of a high-rise apartment building (except in the lowest floors accessible via stairs) use elevator. Compared to the residents of lower floors, the residents of upper floors spend more time in the elevator and experience far more time stopping at other floors as well. Also, a sense of isolation from the ground in the upper floors have a negative effect on residents' mental status (KIM & HA, 1996). In these ways, the residents of high-rise buildings experience spatial depth both physically and psychologically as they move vertically past the floors in elevators.

Hence, it is necessary to devise a model for spatial configuration analysis that incorporates both the residents' use patterns and their psychological status living in a high-rise apartment building, at a significant distance away from the ground level (Figure 3).

In the same manner as the existing model, the stairs connect one floor to the next, at depth 2. The elevator (the main corridor for vertical movements) is modeled to reflect use patterns of high-rise apartment residents. The elevator entrance in one floor is linked to the elevator entrances in the adjacent lower and upper floors. Therefore, when moving past multiple floors, depth increases in step with travel distance. This approach improves the existing elevator model, which did not reflect how residents use the elevator as well as other psychological factors. (Figure 4) show the spatial configuration analysis results of a high-rise apartment building using this modelling approach.

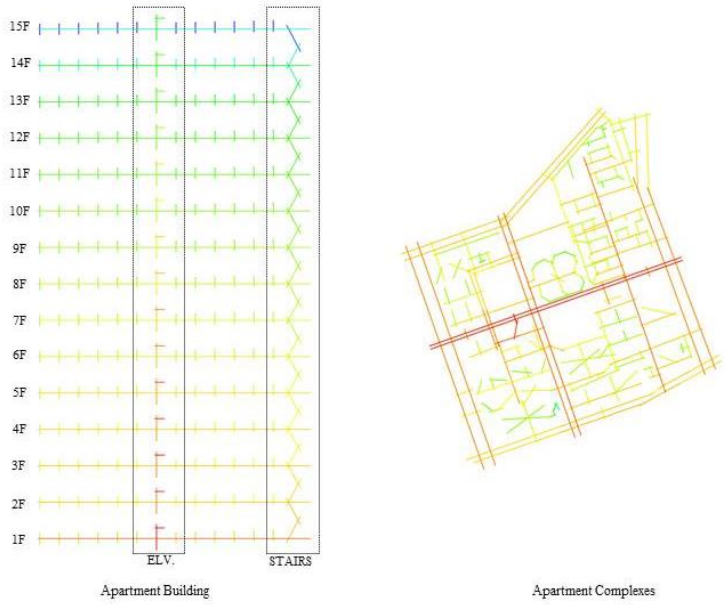

Figure 4 : Axial Map Analysis Result 2 – Modelling Method that Incorporates Psychological Sense of Distance

The results indicate that the integration value is highest for the ground floor at 0.803, since it is directly linked to the axial map of surrounding apartment complex. The integration value decreases in upper floors and is lowest on the 15th floor (top floor) at 0.417. The overall integration values for the lower and upper floors are 0.72 and 0.55, respectively – the value for the upper floors is approximately 23.6% lower compared to the lower floors. It is expected that this difference will increase in even taller buildings. It shows that living in higher floors is related to lower psychological accessibility, being spaces with more depth. For spatial configuration analysis of high-rise living environment, particularly for low-income residents who are more heavily influenced by physical space, this model has better explanatory power compared to the existing model. In other words, in social housing apartments, higher floors have lower integration values due to psychological effects such as sense of isolation and distance from the ground. This can be interpreted as having impact on suicide rates which are higher in the upper floors.

5. CONCLUSIONS

This research examined the differences in the suicide rates between the lower and upper floors of both private and social housing apartments in city “A” in Korea and interpreted the results from a spatial configuration perspective. The results indicate that the suicide rates in the upper floors are higher in both apartment categories. However, the difference was not statistically significant in private housing apartments, while it was significant in social housing apartments. Also, a more suitable model for spatial configuration analysis of high-rise apartment buildings was applied, which confirmed lower integration values in higher floors. Based on these results, the relationship between living in higher floors and suicidal behaviours is as follows.

First, there needs to be a discussion on adopting better housing policies to improve housing environment of low-income residents, including addressing the issues arising from living in high-rise environment and constructing low-rise, high-density housing complexes. This research empirically demonstrated that the negative effects of high-rise living environment - argued in relevant literature - also manifest as suicidal behaviours. In addition, this effect is much stronger in social housing apartments with low-income residents. Given KIM & KIM (2017)'s conclusion that living environment can lead to suicidal behaviours, it can be stated that the low-income residents are more sensitive to living in high-rise environment. This calls for a need to revisit current housing policy of supplying high-rise apartment units as low-income housing. A further analysis of spatial issues arising from high-rise living environment of social housing apartments is needed, as well as discussion of means and incentives to induce lower income residents to live in lower floors.

Second, it seems that the residents who live in upper floors of private housing apartments overcome the negative effects of living in high-rise living environment. The results show that there is no statistically significant difference in the suicide rates between lower and upper floors of private housing apartments. It shows that the middle-class residents can be less sensitive to psychological disorders caused by high-rise environment. Perception of higher floors as luxury space probably contributes to setting higher prices for these units, and also a sense of pride on the part of the residents who live in the higher floors.

Third, spatial integration values decrease in upper floors of high-rise buildings, and it can be interpreted that this spatial configuration may affect residents' pathological disorders or even suicidal behaviours. KIM & KIM (2016) argued that for low-income residents, the suicide rate is higher in high-rise apartment complexes compared to single-family housing complexes. Previous studies have argued that the spatial structure of apartment complexes has negative impact on communication among residents compared to single-family housing. The difference in integration values for the lower and upper floors pointed out in this study support previous findings. In other words, the results of this study suggest the possibility of spatial configuration as a factor leading to higher suicide rate in the upper floors of high-rise apartment buildings compared to the lower floors.

This study is significant in that it statistically revealed for the first time that high-rise living environment is related to suicide. In addition, it employed a new modelling approach to analyse spatial configuration using behaviour patterns and psychology of the apartment residents, to better interpret pathological disorders in high-rise living environment. The results are anticipated to contribute to establishing better housing policies for low-income residents and help prepare guidelines for spatial planning and housing allocation.

This research examined the relationship between high-rise apartment environment and suicidal behaviour by analysing the distribution of floor levels (upper, lower) where suicides took place and conducting spatial configuration analysis for each floor. However, the results of this study are not completely robust due to limitation of data collection, as only bivariate analysis was conducted to evaluate the relationship between floor levels (upper, lower) and suicide rates. In the same context, the results do not identify a clear empirical relationship between suicide rates of different floor levels and the results of space syntax analysis.

Building on this study as a foundation, future research can employ multivariate analysis for better empirical testing and incorporate other data including gender, age, occupation,

housing price, income level, physical illness, and educational attainment as factors affecting suicide rates. Besides additional factors listed above, the results of spatial configuration analyses also need to be incorporated as a factor affecting suicide rates to examine the relationship between floor levels and suicide rates.

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