

Original Research Paper

Statistical Evaluation on Neighborhood Facilities in Relation with Residential Satisfaction and Preference

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Abstract: This paper presents a study on the method of evaluating the residential environment in terms of neighborhood facilities and urban planning. Subjective evaluations through questionnaire survey were performed in order to grasp the resident's behaviors and preferences. In 2013, questionnaires were distributed to more than 3,000 households of younger families located in Kitakyushu City, Northern Kyushu Island, Japan. In this study, we analyzed the result of questionnaires with the statistical method and performed some discussions. As results, several findings could be described as follow: (1) Almost of the respondent were still unsatisfied about the safety, even the safety level score has increased during 10 years; (2) more than 60% of households realized their comprehensive wish on living condition, which means the target of residential environment plan and design are nearly achieved; (3) the study on the model fitness shows that the evaluation system developed in this study captured most attributes that underlie residential environment and can offer a promising and valuable theoretical framework for the evaluation of residential environmental quality. Further, this paper also contributes some strategies on efficient planning and development of the residential environment.

Keywords: Residential Environment, Neighborhood Facilities Satisfaction, Questionnaire, Environment Evaluation

Introduction

Urbanization and the aging population have become increasingly important issues of urban planning in developed countries (DESA, 2005). Migrants moved to the bigger cities tend to be young therefore the population aging will be more severe in rural and local cities than in big cities. Over the years, the urbanized environment of big cities has become the main subject of urban planners, policy makers and many researchers have devoted to evaluating residential environment satisfaction as an indicator of citizen's quality of life. Therefore, it is necessary to clarify the present residential environment situation especially in terms of the neighborhood facilities. Considering the deep relationship between people's behavior and physical components characteristic, we tried to conduct the comprehensive analysis by using statistical data and geographical tools.

People's behaviors are complicated with numerous influencing factors such as of social, economic,

psychological and natural conditions. Since the 1930s, researchers from various disciplines have conducted studies on measuring the lifestyles and the quality of life, not only that, the international organization such as UN, UNDP, UNESCO and WHO have established various measurement method (Morita *et al.*, 1985). In this study, we adopted the WHO's four concepts (Ge and Hokao, 2004) of the residential environment to evaluate the satisfaction of the basic living requirement of human beings. The four concepts are the satisfaction of Safety, satisfaction of Health, satisfaction of Amenity and satisfaction of Convenience.

By targeting the younger age (20 to 40 years old of householders) of multi-person household type (with children) instead of one-person household type or elderly couples we can get more sensitive response to the urban characteristics such as safety and urban form. This paper hopes to meet the following objectives: (1) To investigate the actual situation from the viewpoint of family whether they are satisfied or unsatisfied in

some component of residential environment; (2) to develop the method to understand the diversification of residential behaviors by making clear the residential emphasis influencing factors in local city; (3) to compare and monitor the development of the living environment quality during 10 years (based on data of 2003 and 2013 in same areas).

A review of the literature indicated that the concept of measuring residential satisfaction has been used in numbers of disciplines such as economics, social, physiological and engineering. Residential satisfaction and its correlation with neighborhood conditions are one of the most studied topics in the field of residential environment. Smith *et al.* (1997) found some physical elements that contribute to the quality of the community and establish a framework for understanding the relationship between quality of the urban environment and its physical form or design. Moore (1997) has proposed four-level of theoretical construction in organizing and integrating studies of the residential environment, which are conceptual orientations, frameworks, models and theories. Turkoglu (1997) measured the perceived quality of residential environments in Istanbul which facing with housing shortages issue. Bonaito and Bones (2002) identified clusters of residents who use the city in different ways and who differ in their perceptions and evaluations of neighborhood attributes. Lee (2008) conducted a field survey of 331 Taipei residents to survey subjective resident assessments of Quality of Life and found the causal relationships among the QOL variables. Lovejoy *et al.* (2010) examined characteristics associated with higher levels of neighborhood satisfaction among residents of traditional versus suburban neighborhoods, using an ordered logic model in eight California neighborhoods, found that neighborhood satisfaction is higher among the traditional neighborhood residents.

In Japanese society, there are also various researchers in the field of environment satisfaction based on questionnaire surveys. Morita *et al.* (1985) developed environmental index according to the urban resident's evaluation through qualitative questionnaire and quantitative data of different aspects of the environment in some cities of Japan. Savasdisara (1988) conducted a study to identify the physical and socio-environmental components of a neighborhood that affect resident's satisfaction to more than 329 randomly selected occupants in Tokyo in 1986. Ge and Hokao (2004) used questionnaire survey of two Japanese cities to evaluate the satisfaction and classified various pattern of residential preferences. Despite an increasing number of studies and many researchers have been performed to evaluate residential environment and some

evaluation models and index systems have been presented for the evaluation of residential areas, only a few have paid attention to the identification of the components that influence the degree of residential satisfaction and the literature on residential lifestyles is not rich, especially in Asian societies.

Methodology

Investigation Method

The questionnaire survey was carried out at the beginning of 2013 among 3,450 households targeted the families and selected in the high density of local residential areas. In order to obtain representative samples, the sampling method was designed to three levels. In the first level, the areas were decided then we classified each based on the geographical characteristics. In the second level, we selected the most populous residential area of each district to get a high number of respondents. In the third level, by using Geographical Information System (GIS) we selected the nearest elementary school in each selected residential area. Through the elementary school, the questionnaires were distributed randomly from first-grade to sixth-grade students and to let the parents or householders fill in the answers. Figure 1 shows the location of distributed questionnaires in Kitakyushu City. Later, the name of the district will be used to represent the data results of each area. The basic information of districts and feedback numbers are shown in Table 1. On the other hand, Table 2 shows the main contents of the questionnaire survey, divided into four categories includes the questions concerning the family characteristics, housing characteristics, four concepts of satisfaction evaluation and residential preferences. The householders were asked to evaluate their present residential situation with respect to residential satisfaction on multi-attributes.

In data processing, the households are taken as the respondents and all the questions are taken as variables. In the process of data filtering, we deleted the feedback with no answers for the most questions. As a result, the final valid feedback percentages are shown.

Hierarchical Evaluation Method

The hierarchical evaluation method was firstly introduced by Ge and Hokao (2004) established in four levels considering the residential concepts present by the *WHO*, as described in Fig. 2. Safety (security), Health, Convenience and Amenity (comfort) are the four concepts of the residential environment to satisfy the basic living requirements of human beings. According to this method, "comprehensive satisfaction of residential environment" in Stage 1 depends on "comprehensive

satisfaction of Amenity, Safety, Health and Convenience” in Stage 2. Attributes of Stage 2 are assumed to depend on satisfaction with items in Stage 3. For example, “comprehensive satisfaction of Amenity”

(Stage 2) is assumed to depend on A1 (Amenity with natural environment), A2 (Amenity of park and green space) and A3 (Amenity of town beauty) which is the items in Stage 3.

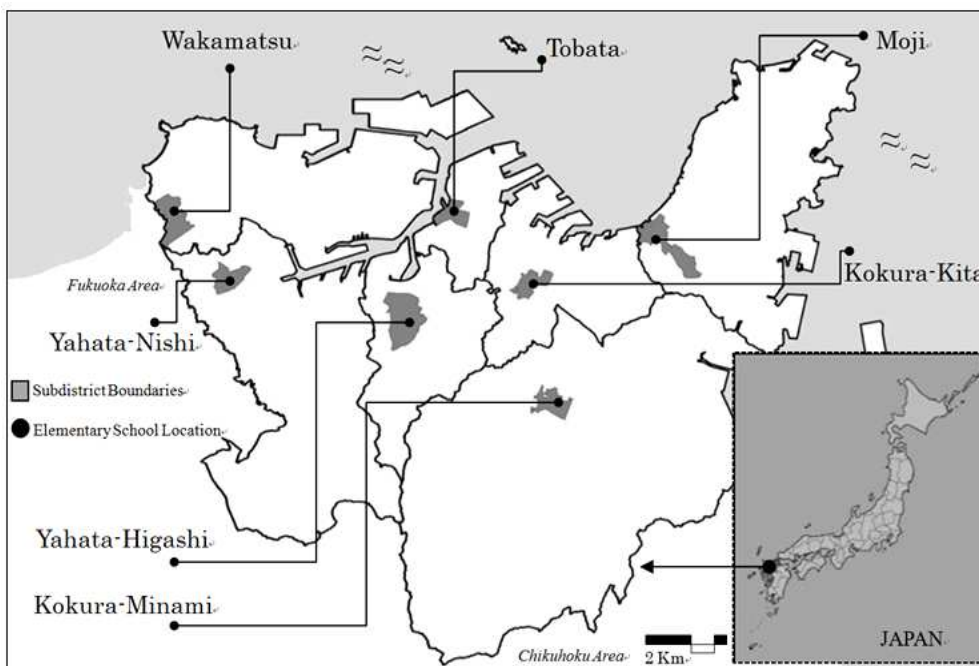


Fig. 1. Location of investigated area in Kitakyushu

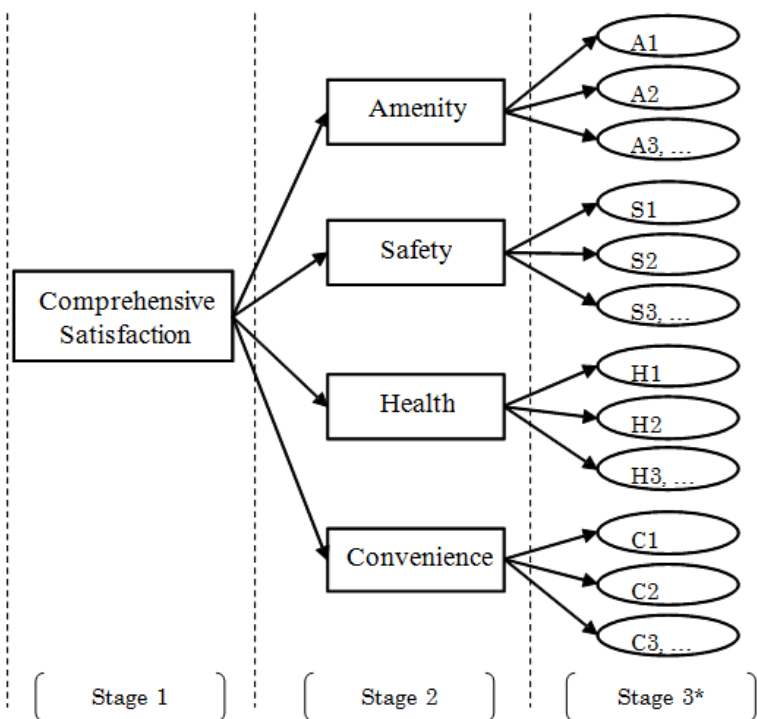


Fig. 2. Hierarchical evaluation method on residential environment; *A1, A2, A3, etc. are referring to Table 2

Table 1. Basic information of Kitakyushu City and feedback number

District	Characteristic	Area (km ²)	Households number**	Distributed	Valid feedback*
1 Moji (MJ)	Port and tourist area(slope)	73.3	50,825	550	150
2 Kokura-Kita (KK)	Commercial and business (plain)	39.2	98,044	450	48
3 Kokura-Minami (KM)	Nature and commuter (slope)	170.2	99,321	650	227
4 Wakamatsu (WM)	Nature and residential (slope)	67.8	39,699	450	179
5 Yahata-Higashi (YH)	Leisure and tourist (slope)	36.3	35,711	600	37
6 Yahata-Nishi (YN)	Residential (plain)	83.0	121,656	237	
7 Tobata (TB)	Industrial (plain)	16.6	29,885	600	150
Total		486.4	475,141	4,450	1,028

*valid feedback for conducting statistical analyses

**2012 Data, City of Kitakyushu, (<http://www.city.kitakyushu.lg.jp/>)

Table 2. Questionnaire structure and contents

Categories	Questionnaire Contents
Basic information	1) District name
Housing characteristic	2) Address
	3) household characteristics
Satisfaction of neighborhood	1) House type
	2) House size
Residential Preferences	1) Amenity (A)
	Comprehensive satisfaction of amenity
	2) Safety (S)
	Comprehensive satisfaction of safety
	3) Health (H)
	Comprehensive satisfaction of safety
	4) Convenience (C)
	Comprehensive satisfaction of convenience
	1) Convenience of shopping
	2) Security from crimes
3) Convenience of commuting	
4) Safety of walking, bicycle and car	
5) Nearby the workplace	
6) Medical and welfare services are easy	
7) Convenience of children going to school	
8) Cleanliness is high	
9) Access to neighbor city is good	
10) Social connection is good	
11) Beauty of nature	
12) Education for children	
13) Beauty of city	
14) Economic reason	
15) Noise and air quality of outdoor	
16) House design	
17) Sunshine and ventilation are good	
18) Good for leisure	
19) Safety from disaster	
20) There is inner (special) attachment	
21) Nearby the parent's house (independent)	

Evaluation of Neighborhood Satisfaction

Questionnaire Results on Residential Living Environment

Table 3 shows the household characteristics and residential conditions of the seven districts respectively. The family member of the survey subject is mostly four persons per house and the age ranges are mainly from

the 30 to 40 s. House types are dominated by multiple apartment overalls but in some district detached house number is higher. Other residential conditions such as floor space and years of residence were also shown. The mean scores and standard deviations of attributes of Stage 1 and 2 are presented in Table 4, which indicate the degree of satisfaction with various residential attributes. It can be seen that, the overall evaluation of residential environmental quality in terms of

“Satisfaction of residential environment” revealed that residents were fairly satisfied with the quality of residential environment, with the average score (standard deviation) of 0.66(0.99), which is close to the midpoint of the point scale (0.00). The scores of amenity, safety, health and convenience are 0.94(1.02), -0.03(1.11), 0.86(1.00) and 1.03(0.94) respectively. Further, Table 5 shows the satisfaction scores of each contributed factors of residential satisfaction. There are a high average of scores in Amenity and Health, but in terms of Safety and Convenience, negative scores were

founded. Especially for Safety of Blind Spot, Bicycle Path and Security from Crime, average satisfaction scores are very low in all investigated districts. It may be because most of the respondents are parents of elementary school children who have high attention on the safety of their children from home to school. Blind spot (unidentified space) and low-security monitoring could lead any criminal activities which are very unpredictable. The Safety of Bicycle Path is also being a concern of the householders since their children may use the bicycle for commuting.

Table 3. Basic characteristic of households

Item	Categories	Percentage	Sample
House type	Detached	38.2	1196
	Multiple	61.3	
Floor area (m ²)	<50	20.3	1433
	50~100	40.5	
	100~150	28.4	
	150~200	6.8	
	>200	4.1	
Residence period (years)	0~5	38.7	1745
	6~10	29.5	
	11~15	20.2	
	16~20	6.9	
	>20	4.6	
Family size (person)	≤3	21.5	1774
	4	53.1	
	5	19.2	
	≥6	6.2	

Table 4. Comprehensive evaluation results on residential environment

	Area		Stage 1	Stage 2			
			Comprehensive satisfaction of living environment	Comprehensive satisfaction of amenity	Comprehensive satisfaction of safety	Comprehensive satisfaction of health	Comprehensive satisfaction of convenience
1	MJ	Mean	0.69	1.08	-0.11	1.05	1.14
		(StD)	1.02	1.00	1.14	0.85	0.85
2	KK	Mean	0.98	1.04	0.02	0.96	1.26
		(StD)	0.80	0.92	1.11	1.01	0.85
3	KM	Mean	0.71	1.09	-0.12	0.91	1.11
		(StD)	0.97	0.85	1.11	0.96	0.79
4	WM	Mean	0.91	1.20	0.18	0.97	0.65
		(StD)	0.78	0.83	1.04	0.93	1.06
5	YH	Mean	0.67	1.06	-0.12	0.97	1.45
		(StD)	0.92	1.00	1.14	0.95	0.79
6	YN	Mean	0.52	0.82	-0.02	0.69	0.91
		(StD)	1.09	1.07	1.13	1.13	0.99
7	TB	Mean	0.32	0.35	-0.08	0.66	1.23
		(StD)	1.04	1.19	1.11	1.04	0.90
	Total	Mean	0.66	0.94	-0.03	0.86	1.03
		(StD)	0.99	1.02	1.11	1.00	0.94

Table 5. Evaluation results of each residential satisfaction factors

Categories (Stage 3)		YN	YH	KK	KM	TB	MJ	WM
Amenity	Nature	0.80	0.83	0.79	1.11	-0.04	1.20	1.37
	Park and Green space	0.54	0.29	1.08	1.01	0.04	0.99	1.01
	Town beauty	0.54	0.63	0.90	0.76	0.35	0.70	1.22
Safety	Street light	0.03	0.34	0.04	0.08	-0.04	-0.24	0.15
	Blind spot	-0.31	-0.20	-0.31	-0.31	-0.45	-0.41	-0.42
	Road maintenance	0.20	0.20	0.50	0.00	0.14	0.02	0.68
	Pedestrian	0.19	0.31	0.50	0.03	0.29	0.08	0.61
	Bicycle path	-0.41	-0.89	-0.17	-0.69	-0.55	-0.76	-0.38
	Road traffic	-0.19	0.00	-0.19	-0.09	-0.13	0.01	0.69
	Shelter	0.35	-0.03	0.52	0.24	0.28	0.46	0.61
	Security/monitoring	-0.17	-0.43	-0.13	-0.26	-0.11	-0.09	-0.06
	Natural disaster	-0.06	-0.26	0.02	-0.07	-0.14	-0.09	0.16
Health	Sewage	0.97	1.17	1.27	1.14	1.09	1.25	1.31
	Noise	0.02	0.57	0.63	0.54	0.10	0.66	0.29
	Vibration	0.77	0.83	1.00	0.92	0.73	1.03	0.93
Convenience	Garbage	0.77	0.94	1.00	0.94	0.81	1.01	1.18
	Sp.market	1.28	1.34	1.38	1.44	1.31	1.83	1.18
	Post office	0.68	0.94	0.98	0.63	1.52	0.91	1.21
	Bank	0.76	0.89	0.81	0.73	1.22	0.04	1.06
	Library	0.38	1.06	0.79	0.61	1.13	0.39	0.10
	Medic. Fac	1.08	1.60	1.25	1.14	1.10	1.19	-0.99
	Element.Sch	0.90	1.11	1.42	1.28	1.13	1.39	1.50
	Mid.Sch	0.65	0.77	1.38	0.96	0.30	0.11	0.71
	Train St.	0.39	0.94	0.92	1.18	1.45	0.77	-0.55
	Bus stop	0.84	1.43	1.54	-0.58	1.58	1.50	1.20
	Open space	0.97	0.91	1.21	0.97	-0.74	1.17	0.98
Comprehensive evaluation	0.46	0.59	0.74	0.53	0.53	0.58	0.67	

Table 6. Multiple regression analysis results

Factor (label)	Regression equation	R square
Amenity (A)	$y = 0.439(A3) + 0.224(A1) + 0.235(A2) + 0.410$	0.700
Safety (S)	$y = 0.451(S3) + 0.383(S2) + 0.204(S1) - 0.108$	0.694
Health (H)	$y = 0.482(H2) + 0.317(H3) + 0.177(H1) + 0.085$	0.755
Convenience (C)	$y = 0.420(C2) + 0.262(C3) + 0.337(C1) - 0.025$	0.615
Comprehensive	$y = 0.229(A) + 0.209(S) + 0.190(H) + 0.139(C) + 0.667$	0.807

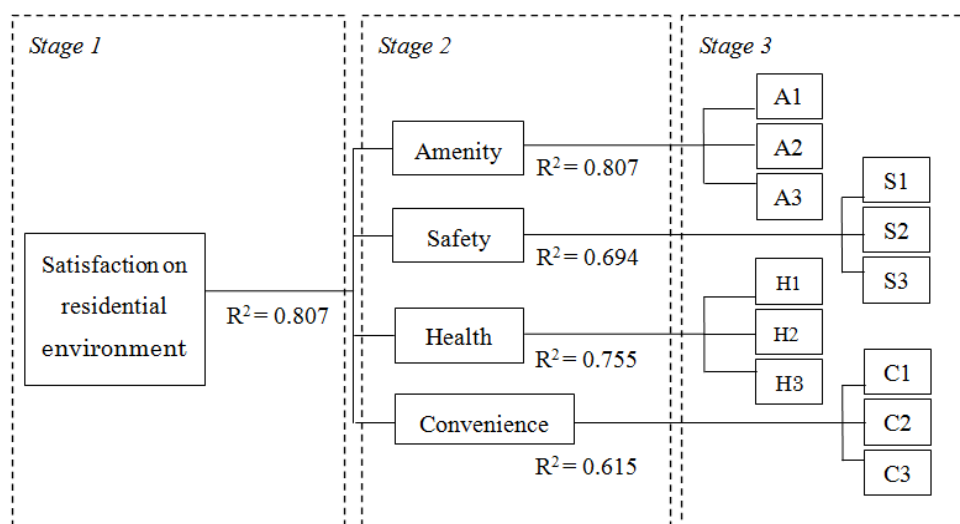


Fig. 3. Hierarchical evaluation method

Based on the hierarchical scheme in Fig. 3, Table 6 summarized the results of regression analysis. It shows that 80.7% of the variance in the assessment of “Residential Satisfaction” (Stage 1) can be explained by the four Stage 2 attributes. Satisfaction with “Amenity” appeared to be the most important attribute ($R^2 = 0.807$), then come the attributes of satisfaction with Health, Safety and Convenience ($R^2 = 0.755$, $R^2 = 0.694$, $R^2 = 0.615$). Three attributes A1, A2 and A3 (Stage 3) can explain 70% of the variance in satisfaction with amenity. The amenity of neighborhood/town beauty appears more important than the amenity of the natural environment and open space. The three of Stage 3 attributes H1, H2 and H3 appears to explain 75.5% of the variance in satisfaction with Health (Stage 2), in which Health from noise seems to be much more important than air and water. As to the satisfaction with safety (Stage 2), the three attributes S1, S2 and S3 (Stage 3) can explain about 69.4% of the variance, in which Safety of disaster seems more important than Safety in mobility and crime.

From the analysis, it may also be noted that the model fitness (R^2) is quite high, which is indicating that the hierarchical multi-attributes evaluation system established in this study can offer a promising and

valuable theoretical framework for modeling residential environment quality.

Satisfaction Changes during Ten Years

In 2003, the same questionnaire survey was performed in three residential areas in Kitakyushu City to a thousand households. The two urban residential areas were selected according to geographic location: Yahata-Higashi in east and Yahata-Nishi in the west. It was collected 800 valid feedbacks from the two same areas of total seven areas of a questionnaire survey in 2013. The data comparison between 2003 and 2013 might not represent the change of personal evaluation during 10 years due to the targets of families were may be different. But as the public environmental evaluation, by using the same approach of method and target areas, the residential satisfaction change during 10 years could be grasped and represent the areas development. Figure 4 shows the comparison of environment satisfaction between 2003 and 2013 among two districts. The minus axis values show the people’s non-satisfaction average values of total respondents. While Fig. 5 shows the land use maps of these two districts in the year of 2003 and 2013.

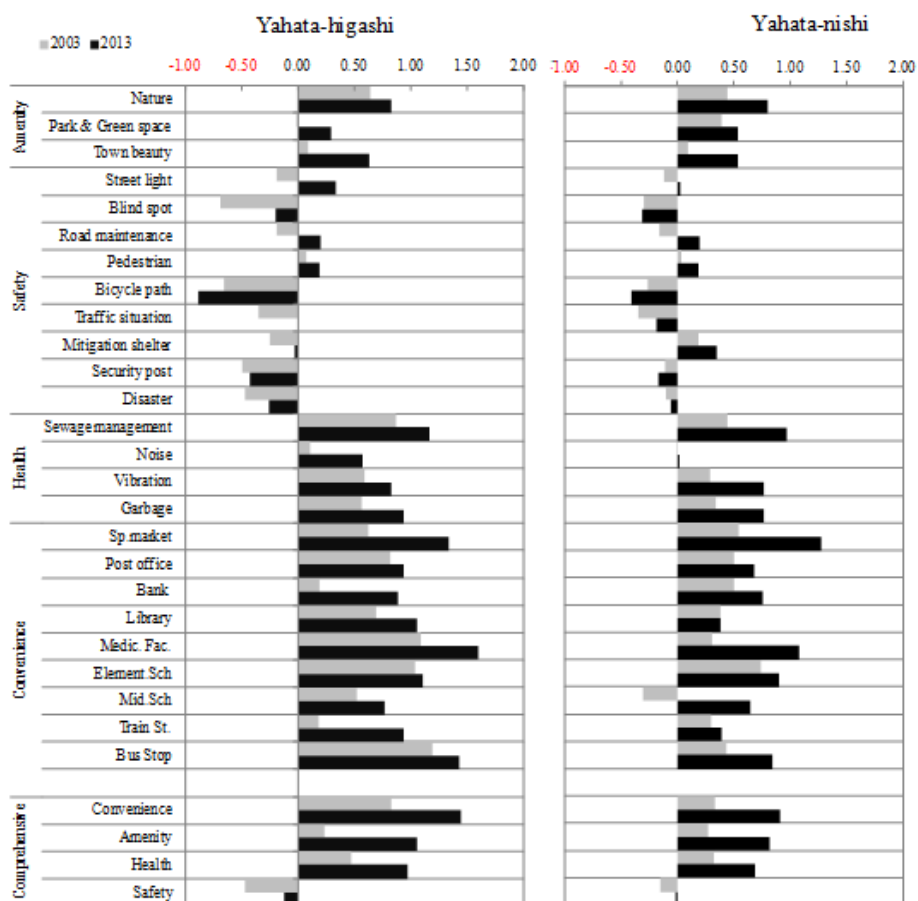


Fig. 4. Environment evaluation comparison between the year of 2003 and 2013

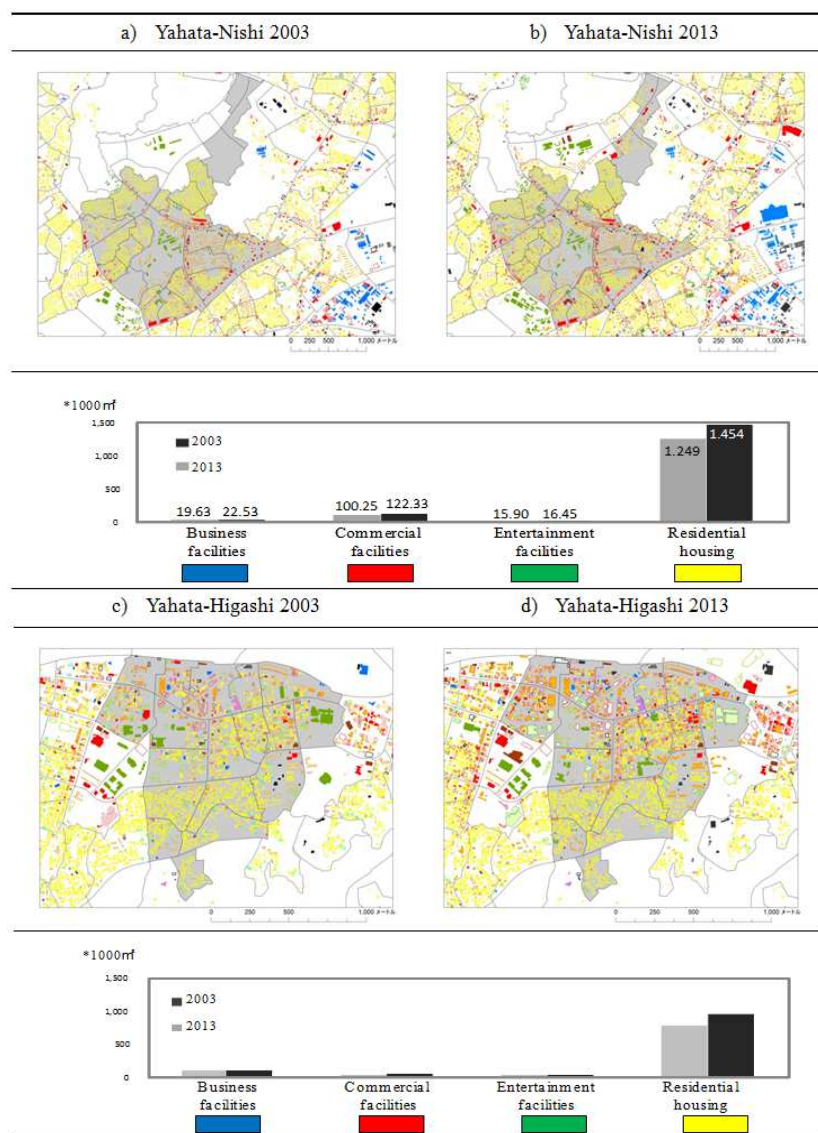


Fig. 5. Land use comparison between 2003 and 2013 data

From the results, most of the variables show the increase of satisfaction levels, in other words, during ten years the city facilities and environment qualities improved significantly. The increased number of residential housing also can be an indication that the quality of life in these areas also had increased. Although, further study are needed due to understanding what kind of household's type is increasing which very important to predict the future lifestyle's trend of the citizen.

Correlation between Neighborhood Satisfaction and Residential Preferences

Types of Residential Preferences

In order to identify the personal residential preference, there are twenty-one choices questioned to

the residents, including residential convenience factors (1)~(5), amenity and comfort factor (6)~(9), safety factor (10)~(15), community factor (16) and (17), economic factor (18) and other factor such as good design (19), good leisure (20) and special attachment (21).

Firstly, to focus on the residential environment itself, the principle component analysis was performed considering only residential environment factors. The analysis was performed by *SPSS ver. 19.0*, by extraction method of *Principle Component Analysis* and *Rotation of Varimax with Kaiser Normalization*. In Table 7, five principle components have been extracted: *1st = Amenity + Safety*; *2nd = Convenience related with children education and economy*; *3rd = Convenience of daily mobility*; *4th = Community and other*; *5th = Health*. According to

these results, the main preferences of selecting dwellings are in the order of *Amenity and Safety, Convenience, Safety, Health, Community and Economic*. The total variance shows that the above five principle components can explain the residential preference quite well, with the cumulative 56.1% and the first and second factors served as the 38.3%.

In order to analyze the personal preference residential type, the scatter plot of the distribution of component

value of the *1st* and *2nd* factors (which can explain about half contribution of the total factors) of each resident is plotted in Fig. 6, the X-axis is the *1st factor (amenity + safety)*; Y-axis is the *2nd factor (convenience)*. By thus, four groups pattern can be identified, which are Group I (amenity and safety type); Group II (convenience type); Group III (comprehensive type: Amenity + safety + convenience) and Group IV (others). Table 8 shows each group composition by personal preferences.

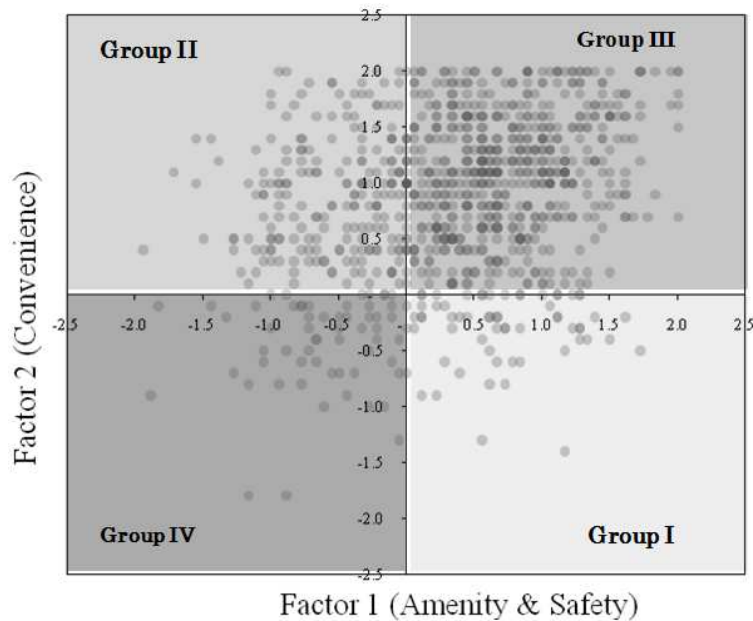


Fig. 6. Scatter plot of component values of 1st factor and 2nd factor

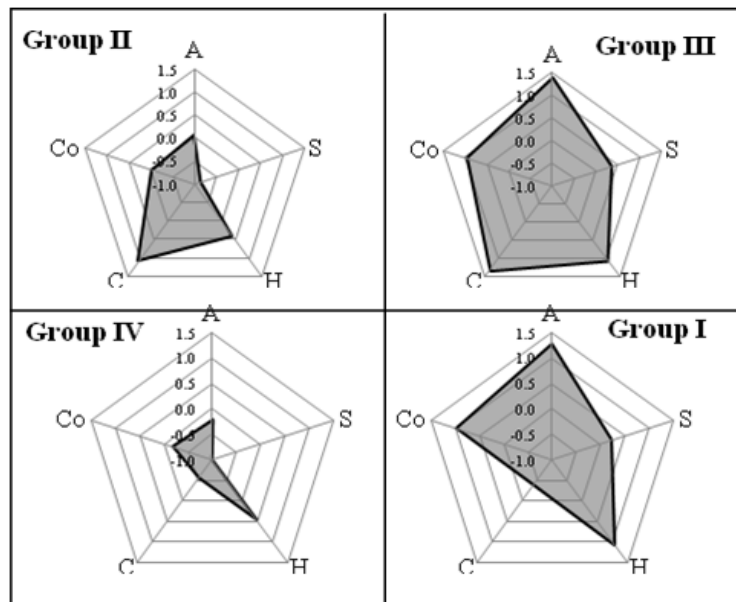


Fig. 7. Group characteristic upon satisfaction type

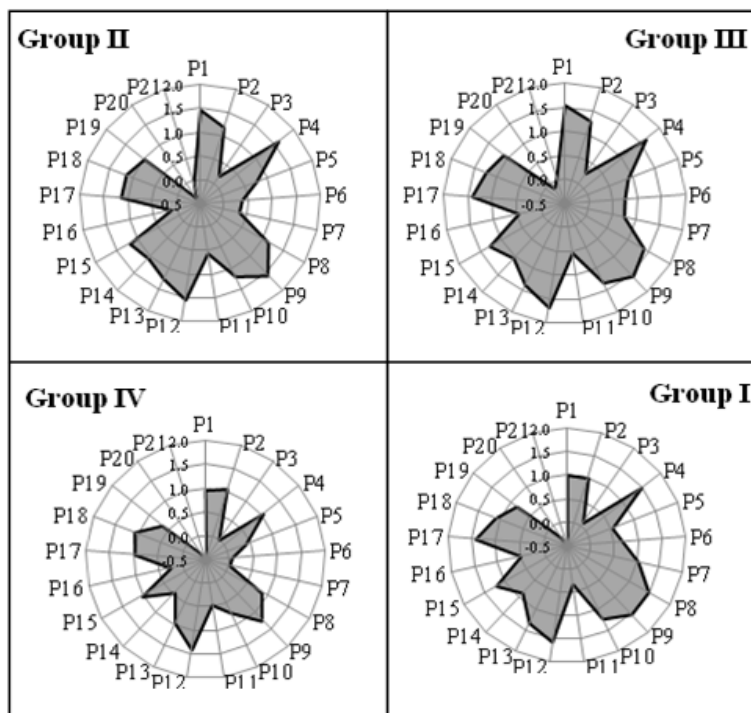


Fig. 8. Group characteristic upon preferences type

Table 7. Principal Component Analysis on residential preferences

Extraction method: Principal component analysis.
 Rotation method: Varimax with Kaiser Normalization.

Variance factor	Component				
	1	2	3	4	5
8. Noise and air quality of outdoor	0.740	0.181	0.046	-0.024	-0.100
12. Security of crimes is good	0.722	0.026	0.050	0.114	0.149
10. Safety from disaster is high	0.681	0.143	0.153	0.027	0.108
13. Safety of commuting is high	0.674	0.102	0.147	0.164	0.305
15. Cleanliness is high	0.636	0.294	0.019	0.178	0.126
9. Sunshine and ventilation are good	0.615	0.036	0.122	0.201	0.038
17. Education (for children) is good	0.548	0.220	0.028	0.138	-0.045
20. Good for leisure	0.062	0.685	0.184	0.330	0.181
7. Beauty of city/town	0.496	0.610	0.044	-0.163	-0.119
6. Beauty of nature	0.461	0.597	0.123	-0.211	-0.061
21. There is inner attachment	-0.002	0.591	0.155	0.113	0.492
16. Social connection is good	0.285	0.578	0.039	0.140	0.212
2. Convenience of commuting	0.071	0.039	0.820	0.120	-0.016
3. Nearby the workplace	-0.042	0.218	0.739	0.040	-0.106
1. Convenience of shopping	0.287	-0.059	0.567	0.016	0.318
19. House design is good	0.171	0.209	0.077	0.777	-0.066
18. Economical reason (rent/house price)	0.182	-0.022	0.100	0.726	0.086
11. Nearby the parent/relative house	0.103	0.161	-0.001	-0.029	0.800
Excluded Variables*					
*Variables with score of component lower than 0.5 are not included in result					
4. Convenience of children going to school	0.459	-0.018	0.415	0.011	0.092
5. Access to neighbor city is good	0.22	0.313	0.455	0.092	0.162
14. Medical and welfare services is easy	0.486	0.242	0.229	0.137	0.393

Table 8. Group composition by residential preference

Group label	Number of samples	Percentage (%)
I	61	6.55
II	226	24.27
III	582	62.51
IV	62	6.66
Total	931	100.00

Table 9. Evaluation on residential preferences by group

Preferences type	Group of households			
	I	II	III	IV
P1) Convenience of shopping	1.02	1.46	1.56	0.97
P2) Convenience of commuting	1.02	1.17	1.30	1.06
P3) Nearby the workplace	0.10	0.19	0.26	0.02
P4) Convenience of children going to school	1.49	1.59	1.64	1.06
P5) Access to neighbor city is good	0.52	0.77	0.90	0.42
P6) Beauty of nature	0.67	0.38	0.74	0.06
P7) Beauty of city	1.03	0.34	0.76	0.03
P8) Noise and air quality of outdoor	1.48	1.14	1.39	0.87
P9) Sunshine and ventilation are good	1.5	1.57	1.57	1.24
P10) Safety from disaster	1.23	1.20	1.34	0.73
P11) Nearby the parent's house (independent)	0.33	0.56	0.55	0.45
P12) Security from crimes	1.57	1.54	1.70	1.40
P13) Safety of walking, bicycle and car	1.33	1.26	1.39	0.97
P14) Medical and welfare services are easy	0.87	1.08	1.06	0.44
P15) Cleanliness is high	1.21	1.19	1.29	1.03
P16) Social connection is good	0.49	0.12	0.48	0.24
P17) Education for children	1.43	1.15	1.43	0.98
P18) Economic reason	1.11	1.15	1.25	1.10
P19) House design	0.85	0.99	1.12	0.66
P20) Good for leisure	-0.28	-0.37	-0.12	-0.34
P21) There is inner (special) attachment	-0.51	-0.04	0.08	-0.56

Classification of Households by Residential Preferences

In order to understand the characteristics of each group, the satisfaction scores and importance (preference) scores from four types of the group are analyzed, shown in Table 9. Then each group characteristic will be presented base on these two judgments (satisfaction type and preference type). Figure 7 and 8 explained the group characteristics in terms of satisfaction type and preferences.

Group I: Amenity and Safety Type

The evaluation of satisfaction and importance of the amenity attribute are both quite high among all types, much higher than the comprehensive score of total samples. The same tendency can be noted in the case of the safety attribute, where importance evaluation is above the average and the satisfaction evaluation is the highest among the four types. On the other hand, the evaluation on convenience is the lowest among all types, which may illustrate the difficulty in pursuing the satisfaction with amenity, safety and convenience simultaneously. Families in group I regard amenity and safety as their first

preference and this seems to have been realized while the aspect of convenience is compromised.

Group II: Convenience Type

This type is focused on convenience and the evaluation on convenience importance is the highest. It is also shown that the satisfaction evaluation on convenience is quite high, much higher than the average. The importance evaluation on amenity and safety are the lowest and satisfaction with amenity and safety are also quite low among 4 types, much lower than the average. Similar to the group I, group II chooses the convenience as the most important factor on the dwellings and in consequence, their requirement on amenity and safety are given up to some extent.

Group III: Comprehensive Type

The importance evaluation on amenity, health and safety are highest among all types and the importance evaluation on convenience is also high. In addition, their satisfaction with convenience, amenity, health and safety rank the first among all types. It can be seen that their comprehensive wishes on living condition are realized to the largest extent, which is

also the target of residential environment plan and design. Also, the number of this group is as the highest as 582 residents, among all the residents, the percentage of this group is largest (62.51%).

Group IV: Other Types

The preference emphasized on other factors instead of amenity, safety and convenience. The evaluation of satisfaction and importance with four satisfaction factors are all very low while convenience is the worst and other three factors bear the worst. The comprehensive satisfaction on the residential environment is also the second lowest. The reason may be related to their unclearness of residential preference. The residential environment condition of this type is also worth being studied, in order to improve their residential environment, as well as their residential awareness.

Conclusion

The findings of this research showed that conveniences of the neighborhood facilities were found to be important in accounting for higher comprehensive satisfaction.

By comparing the results of 2003 and 2013, the increase of satisfaction levels of city facilities and environment qualities during ten years can be described. Especially in terms of convenience, amenity and health factors, it shows significant improvement. However, in case of safety, the satisfaction scores are still very low and it will become important issues for the future if the items related to safety such as bicycle path, blind spot and monitoring system are not rapidly improved. Satisfaction related to safety and security was found to be one of the most dominant predictors in explaining satisfaction with the general living conditions in Japanese urban communities.

Four groups of nuclear family's personal residential preference types in Kitakyushu City are identified and their influences on residential environment evaluation are also studied. It was found that more than half of total respondents comprehensive wish on living condition are realized to the largest extent, which mean the target of ideal residential environment plan and design nearly to achieve.

Further, deeper and wider research on residential behavior and its relationship with residential environment satisfaction in terms of commuting should be performed to develop and improve the city compactness. In the other hand, Japan is facing the aging populations which affected by many factors such as social and economical, therefore, research on different types of family groups are also needed to propose the sustainable city and community development in the futures.

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Author's Contributions

Didit Novianto: Proposed and designed the research plan, proposed and conducted the questionnaire survey (data collection) and conducted the data-analysis and fully contributed to the writing of the manuscript.

Weijun Gao: Contributed to the idea of the research flow and Contributed for many advices to improve the paper quality.

Soichiro Kuroki: Contributed to the assisting the main author to develop the idea in the manuscript and Contributed to the valuable advices to analyze and present the data.

Hidetoshi Fukahori: Contributed to geographical and governmental data collection and Contributed to the development of manuscript presentation.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

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