

Pedestrian Environment Evaluation for Health-friendly Apartment Complexes : Focused on Busan

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Abstract With a view to the residential environment plan to improve the quality of life and health status of dwellers, the purpose of this study is to explore the co-relation between pedestrian environment and health performance in apartment complexes and to analyze the residents' evaluations on pedestrian environment for 'pedestrians-friendly residential environment'. The method of this study was research review and questionnaire survey research. Questionnaire surveys were conducted with the housewives at the two subject apartments in Busan. Based on tools to assess pedestrian environment, this study analyzed correlation between health-related satisfaction with residential environment and satisfaction with pedestrian environment. Satisfactions with pedestrian environment showed a strongly positive (+) correlation with contentment with health-related residential environment. Second, this study analyzed residents' use, demands, and satisfaction for pedestrian environment. More active pedestrian environment are required (i.e. a trail or sports facilities) to create residential environment which could support the enhancement of physical health. To perform the mean comparative analysis and correlation analysis of the survey results, PASW 18.0 was used.

Keywords: *Pedestrian Environment, Pedestrians-friendly, Healthy Housing Environment*

1. INTRODUCTION

Improved living standards and enhanced quality of life enable people to increase their interests in health. Dwellers' demands for healthy residential environment have been also growing up continuously, and various solutions are being sought to enhance the satisfaction of residents.

In Korea, high and densely-populated apartment complexes account for 60 % of total housing types in urban areas (Statics Korea, 2010). Comprised with individual housing units and common spaces, apartments are, conceptually, a part of collective housing. In 1990s, various common spaces began to be provided in apartment complexes for comfortable and pleasant residential environment (Jung, 1997). Since then, in gear with the issues of 'well-being, sustainability, and health', facilities aimed to foster healthy residential environment have been expanded in apartment complexes: for example, parks, open green spaces, and pedestrian streets (Chiesura, 2004; Koohsari, Karakiewicz & Kaczynski, 2013).

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A pedestrian space is the place dedicated for pedestrians, which differs from the space to drive a vehicle. A sidewalk, a walkway, and a park area in apartment complexes are reckoned as a pedestrian space, which are used for multi-purposes such as the places for inhabitants to move, to take rests, to do light exercises, or to meet their neighbors. More pedestrian spaces can offer not only physical health to individuals and communities, but also a variety of social benefits (Koohsari, Karakiewicz & Kaczynski, 2013; An, Lee & Kim, 2013). At a city level, efforts started to be poured to facilitate pedestrian environment. Some streets are designated as 'a car-free street' or 'a bike road' and pedestrian ways-related environment is enhanced, with a view to upgrading it as a pleasant and comfortable space focusing on pedestrians (Kilicaslan, 2013).

In terms of residential complexes, it is needed to develop a pedestrian-friendly plan (Larco, Steiner & Stockard, 2012) so that plenty of dwellers can use the facilities in a safe and convenient way and have meetings spontaneously, and that spaces are systematically shared with neighboring facilities. However, the actual regulations related to pedestrian spaces are insufficient even though they are required within apartment complexes. Furthermore, safety of pedestrian spaces is not guaranteed in some outdated apartments.

Meanwhile, from an angle of Busan topography, apartments are developed adjacent to hill areas, which make issues of pedestrian spaces worse.

In this context, this study is designed to 1) explore the co-relation between pedestrian environment and health performance in apartment complexes, and 2) analyze the opinions of residents on pedestrian environment for the purpose of seeking solutions.

That's why this study is conducive to fostering 'pedestrians-friendly residential environment' where dwellers can enjoy healthy and pleasant lives.

2. METHODOLOGY

2.1 Evaluation Indicators of Healthy Housing Quality

To conceptualize 'health performance' of apartment houses, evaluation indicators were devised from the physical, mental, social and managerial perspectives, and accordingly sub-segments were established (Cho & Kang, 2011; Kang, Lee & Kim, 2013)(Table 1). Satisfactory level of respondents was explored, in this study, according to each category of evaluation indicators conceptualized by Kang et al. (2012).

2.2 Evaluation factors of pedestrian environment

Based on previous studies dealing with 'Walking' and 'Pedestrian Environment'(Kwon & Ha, 2009; Kim & Kim, 2011; Moon & Lee, 2011; Wallmann, Bucksch & Frobeose, 2011; Ministry of Health & Welfare, 2011; Partnership for a Walkable America), factors were drawn up to assess the pedestrian environment of apartment houses. In addition to physical factors (such as Safety, Comfort, Accessibility), 'Placeness' related to the consciousness of dwellers was added to finalize evaluation factors (4 in total) and to conclude sub-factors (safety 8, comfort 6, accessibility 9, placeness 3) of assessment.

Table 1. Indicators to Evaluate Health Performance of Apartment Houses

Physical Indicator	<ul style="list-style-type: none"> - Residential performance related to dwellers' physical sanitation and pleasantness. - Disaster prevention and barrier-free facilities for safety of dwellers. - Layout and space configuration under the consideration of dwellers' convenience and comfort. - Environmentally-friendly facilities and design.
Psychological Indicator	<ul style="list-style-type: none"> - Residential performance related to mental and psychological wellbeing of residents. - Residential performance related to emotional stability and vitality. - Expression and maintenance of the sense of self-respect. - Guarantee of privacy and coordination for privacy. - Residential performance related to the sense of safety.
Social Indicator	<ul style="list-style-type: none"> - Local community which supports dwelling. - Residential performance related to dwellers' settlement consciousness. - Realization and maintenance of community spirit. - Residential performance related to healthy social lives.
Managerial Indicator	<ul style="list-style-type: none"> - Performance of activities to operate buildings and facilities. - Performance of activities to repair, maintain, and replace buildings and facilities. - Performance of activities to manage dwelling-supportive information. - Performance of activities to manage organizations for supporting and systemizing community lives.

Based on tools to assess pedestrian environment, apartment houses in Busan city were selected to make a field inspection, a survey on residents, and interviews with them. Structured questionnaires were used by surveyors, and satisfactory level and opinions of dwellers were examined through 5-point Likert scales (1= 'strongly disagree', 2= 'disagree', 3= 'neutral', 4= 'agree', 5= 'strongly agree'). Questionnaire surveys were conducted with the housewives at the subject apartments, from September 27, to October 7, 2013. In the final analysis, 393

questionnaires were used. To perform the mean comparative analysis and correlation analysis of the survey results, PASW 18.0 was used.

3. OVERVIEW AND CHARACTERISTICS OF SUBJECT APARTMENT COMPLEXES AND RESPONDENTS

3.1 Characteristics of subject apartment complexes

The apartment complexes with over 15 floors and 1000 households were chosen as subject complexes. To compare the satisfactory level and demands of pedestrians in accordance with physical environment, an old apartment complex and a new apartment complex were selected. The former was built over 20 years ago, so reconstruction is required to resolve physical aging while the latter was recently built, so pedestrian environment was relatively well-structured.

Settled in Buk-gu, Busan city, the apartment complex A was built in 1991 with 1468 households while the apartment complex B with 1306 families (based in Geumjeong-gu, Busan city) was constructed in 2010 (Table 3).



Table 2. Current state of subject complexes

State	A apartment	B apartment
Pathways width		
Obstacles on the pathways		
Resting facilities (including bench)		
Segregation of Pedestrian and Vehicle		

3.2 Characteristics of respondents

Apartment Complex A: The demographic characteristics of survey respondents showed the average age of husbands was 51.7 (people in 50s had the lion's share: 31.8%) while wives' average age was 49.9 (like husbands, wives in 50s had the highest portion: 32.9%). Majority of husbands and wives were university graduates and higher (husbands: 75.0% and wives: 60.8%). In terms of husbands, white-collar workers ranked first (33.1%) followed by self-employees (32.5%) while housewives took the largest bracket (58.6%).

Table 3. Overview of subject complexes

Item	A apartment	B apartment
Location	Busan, Buk-gu	Busan, Geumjeong-gu
Occupation	Jan. 1991	Aug. 2010
Number of Households	16 Buildings 14-15 Stories 1468 Households	15 Buildings 18-26 Stories 1306 Households
Heating Method	Individual Heating	Individual Heating
Size of Unit	91 m ² , 101 m ² , 124 m ² , 135 m ² , 139 m ² , 156 m ² , 170 m ²	88 m ² , 113 m ² , 129 m ² , 160 m ² , 183 m ² , 200 m ²
Parking	1 per household	1 per household
Layout Plan		

A family includes 3.4 members (SD=1.1) on the average. As to a house size, units from '105m²-119m²' ranked first (44.5%), followed by units within the range of '79m²-95m²' (28.3%), and units bigger than 135m² (27.2%).

House ownership rate was high at 88.9%, and average residence period was 9.3 years (SD=6.9) and residents living in the apartments for more than 10 years amounted to 42.1%, demonstrating that there were plenty of long-time dwellers.

In terms of monthly income, bracket less than 3 million won was the highest (33.9%) while the bracket more than 5 million won was the lowest (19.9%), proving that they were generally placed in low-income bracket compared to average monthly income of Busan city (4,076,229 won, as of 2/4 Q in 2013, the Statistics Korea).

Apartment Complex B: Average age of husbands was 50.1 (people in 60s were the most: 33.5%) while the average of wives was 48.8 (people in 30s took the biggest percentage: 29.1%) When it comes to academic background, 87.4% of husbands and 76.4% of wives graduated from universities, more than majority. As for jobs of husbands, white-collar workers (33.7%) and professionals (25.7%) had large portions while housewives had lion's share (55.4%). Average of family-members was at 3.4 people. Concerning a house size, units from '105m²-119m²' ranked first (49.0%), followed by units within the range of '79 m²-95m²' (25.8%), and units bigger than 135m² (25.3%). House ownership rate was high at 85.0%. As it was built in 2010, 100% of dwellers resided in this apartment house for less than 5 years.

In terms of monthly income, bracket more than 5 million won was the highest (49.0%) while the bracket less than 3 million won was the lowest (15.7%), proving that they enjoyed relatively higher income than those inhabiting in the apartment complex A.

Table 4. The Characteristics of Respondents

Item	Details	M(SD)	
		A Apartment	B Apartment
Age of husbands	30s or under	39(22.9)	39(20.1)
	40s	30(17.6)	52(26.8)
	50s	54(31.8)	38(19.6)
	60s or over	47(27.6)	65(33.5)
	Total	170(100.0)	194(100.0)
Education level of husbands	High-school graduate	43(25.0)	22(12.6)
	Over college	129(75.0)	152(87.4)
	Total	172(100.0)	174(100.0)
Occupation of husbands	Office worker	54(33.1)	59(33.7)
	Self-employed	53(32.5)	36(20.6)
	Production worker	8(4.9)	7(4.0)
	Professional	28(17.2)	45(25.7)
	Etc.	20(12.3)	28(16.0)
	Total	163(100.0)	175(100.0)
Age of housewives	30s or under	41(23.7)	57(29.1)
	40s	39(22.5)	40(20.4)
	50s	57(32.9)	49(25.0)
	60s or over	36(20.8)	50(25.5)
	Total	173(100.0)	196(100.0)

Education level of housewives	High-school graduate	67(39.2)	41(23.6)
	Over college	104(60.8)	133(76.4)
	Total	171(100.0)	174(100.0)
Occupation of housewives	Office worker	17(10.5)	30(18.1)
	Self-employed	16(9.9)	8(4.8)
	Production worker	5(3.1)	2(1.2)
	Professional	18(11.1)	24(14.5)
	Full-time housewife	95(58.6)	92(55.4)
	Etc.	11(6.8)	10(6.0)
	Total	162(100.0)	166(100.0)
Number of family	2 person or under	41(21.5)	49(24.7)
	3 person	53(27.7)	60(30.3)
	4 person	74(38.7)	72(36.4)
	5 person or over	23(12.0)	17(8.6)
	Total	191(100.0)	198(100.0)
House ownership	Own	169(88.9)	164(85.0)
	Rent	21(11.1)	29(15.0)
	Total	190(100.0)	193(100.0)
Housing size	79 m ² -95m ²	54(28.3)	51(25.8)
	105 m ² -119m ²	85(44.5)	97(49.0)
	135 m ² and over	52(27.2)	50(25.3)
	Total	191(100.0)	198(100.0)
Residence period in their apartments	Less than 5 years	67(35.3)	198(100.0)
	5-10 years	43(22.6)	0(0.0)
	10-20 years	50(26.3)	0(0.0)
	More than 20 years	30(15.8)	0(0.0)
	Total	190(100.0)	198(100.0)
Driving	Yes	103(53.9)	140(73.7)
	No	88(46.1)	50(26.3)
	Total	191(100.0)	190(100.0)
Average monthly income (ten thousand won)	Under 300	63(33.9)	31(15.7)
	300-400	48(25.8)	33(16.7)
	400-500	38(20.4)	37(18.7)
	500 and over	37(19.9)	97(49.0)
	Total	186(100.0)	198(100.0)

4. RESULTS

4.1 Correlation between Health-related Satisfaction with Residential Environment and Satisfaction with Pedestrian Environment

The investigation on how much inhabitants were contend with their residential and pedestrian environments (Table 5), concluding that dwellers in B were much higher satisfied with all questions than those in A. Particularly, in case of A, all questions were scored less than 3.0, unveiling that residents in A were dissatisfied. Especially, the satisfaction with pedestrian environment was the lowest at 2.6(SD=0.8).

Table 5. Health-related Satisfaction with Residential Environment and Satisfaction with Pedestrian Environment

	A apartment	B apartment	Total	t-value
Pedestrian Environment	2.6(0.8)	3.9(0.8)	3.3(0.6)	-15.5***
Physical Health	3.0(0.4)	3.7(0.5)	3.3(1.0)	-14.7***
Psychological Health	2.9(0.5)	3.8(0.5)	3.4(0.6)	-15.1***
Social Health	2.7(0.4)	3.7(0.5)	3.4(0.7)	-19.0***
Managerial Health	2.7(0.5)	3.5(0.6)	3.2(0.7)	-14.1***

*** p<.001

Satisfactions with pedestrian environment showed a strongly positive (+) correlation (more than 0.6 in every question) with contentment with health-related residential environment (Table 6), leading us to the interpretation that the co-relation between satisfaction with pedestrian environment and contentment with health-related residential environment was greatly high. Especially, contentment with pedestrian environment showed high co-relations with satisfactions with social health and physical health, implying that increased satisfactions with pedestrian environment can improve not only physical health of dwellers but also their satisfactions with healthy residential environment.

Table 6. Correlation between Health-related Satisfaction with Residential Environment and Satisfaction with Pedestrian Environment

	1	2	3	4	5
Pedestrian Environment	1				
Physical Health	.686***	1			
Psychological Health	.698***	.876***	1		
Social Health	.712***	.823***	.877***	1	
Managerial Health	.685***	.777***	.810***	.847***	1

*** p<.001

4.2 Dwellers' Purpose to Use Pedestrian Environment

Regarding this question, most respondents answered that they used pedestrian ways for basic purposes including commuting to school and job and for the taking a walk or an exercise in both apartment complexes.

Table 7. Residents' Purpose to Use Pedestrian Environment

Multiple Response: N(%)			
	A apartment	B apartment	Total
To meet neighbors	43(22.1)	37(18.8)	80
To use accommodations	105(53.8)	118(59.9)	223
To take a walk	126(64.6)	158(80.2)	284
To exercise	125(64.1)	107(54.3)	232
To rest	38(19.5)	65(33.0)	103
To pick up their kids	42(21.5)	50(25.4)	92
To watch over their kids	12(6.2)	13(6.6)	25
No use	15(7.7)	3(1.5)	18
Total	195	197	392

4.3 Residents' Evaluation of Pedestrian Environment

There were significant differences between two complexes. As for the overall satisfaction with the apartment environment, residents in Complex B gave higher scores on all aspects (i.e. safety, pleasure, accessibility and location) when compared to residents in Complex A (Table 8).

Complex A was measured to have high scores (4.2 (SD=0.9)) for questions [S5] 'Pathways are too steep' and [S6] 'Pathways are slippery when raining or snowing', while scoring low (2.0 (SD=1.0)) for questions [S7] 'CCTVs and streetlights are well established'.

Complex B was measured to have high scores (4.1 (SD=0.7)) for questions [A5] 'Public transit services are available within 10-minute walks' and [A6] 'Walking paths are located within 10-minute walks'; while scoring low (2.0 (SD=1.0)) for questions [S4] 'Many cars are parked on the pathways'.

In terms of safety, residents living in Complex A reported feeling unsafe due in part to the steep slopes, poorly maintained pavements, insufficient CCTVs/streetlights, and inadequate safety measures (e.g. handrails and steps); whereas residents in Complex B reported feeling safe, despite being located on the slope, along with well-separated roads and pathways..

With regard to comfort, the pathways of Complex A were found to be too monotonous and poorly maintained, but have trees that are well-lined around the path and provide pleasant shade. Complex B has well-maintained accommodations and pavement, and thus scored high on the pleasure-related items.

As for accessibility, both complexes were located within 10-minute walks from public transit services and pathways.

However, Complex A is poorly connected to neighborhood amenities and found to be inconvenient without the use of vehicle. On the other hand, Complex B is well connected to neighborhood amenities and accessible by walking. In addition, its pathways have well-established signs for the convenience of residents.

In terms of placeness, Complex A was found to be more vibrant than Complex B. Complex A residents were more likely to have favorite pathways compared to their counterparts in Complex B.

Table 8. Residents' Evaluation of Pedestrian Environment

		M(SD)			
	Item	A apartment	B apartment	Total	t-value
Safety					
[S1]	Pathways are broken or interrupted.	3.4(0.8)	2.2(1.0)	2.8(0.9)	13.0***
[S2]	Pathways are narrow.	3.5(0.9)	2.2(0.9)	2.8 (1.1)	15.4***
[S3]	There are many obstacles (e.g. trees and poles) on the pathways.	3.4(1.0)	2.1(0.9)	2.7 (1.2)	13.7***
[S4]	Many cars are parked on the pathways.	3.4(1.2)	2.0(1.0)	2.7 (1.3)	12.7***
[S5]	Pathways are too steep.	4.2(0.9)	3.1(1.0)	3.6 (1.1)	12.3***
[S6]	Pathways are slippery when raining or snowing.	4.2(0.9)	2.7(1.0)	3.5 (1.2)	16.1***
[S7]	CCTVs and streetlights are well established.	2.0(1.0)	3.5(0.8)	2.8 (1.2)	-16.4***
[S8]	Safety measures (e.g. handrails and steps) are well established	2.7(0.8)	3.7(0.7)	3.2 (0.9)	-13.6***
Comfort					
[C1]	It is unpleasant to walk on the pathways due to dust and noise.	2.9(1.0)	2.2(0.9)	2.5 (1.0)	7.1***
[C2]	Trees (for shade) are well-lined along the pathways.	3.7(0.9)	3.3(0.9)	3.5 (0.9)	3.8***
[C3]	Landscape around the pathways is beautiful.	3.4(0.9)	3.7(0.8)	3.6 (0.9)	-3.4**
[C4]	There are resting facilities (including benches) around the pathways.	3.0(1.0)	3.8(0.9)	3.4 (1.0)	-7.9***
[C5]	Landscape around the pathways is boring.	3.3(0.8)	2.9(0.9)	3.1 (0.9)	4.3***
[C6]	Pathways are well-maintained.	2.9(0.8)	3.7(0.7)	3.3 (0.9)	-9.3***
Accessibility					
[A1]	I have to walk around the apartment wall/fences to get into the neighborhood.	3.0(1.1)	2.4(1.0)	2.7 (1.1)	5.5***
[A2]	Many pathways are hardly used in the apartment complex	2.8(0.9)	2.2(0.9)	2.5 (0.9)	6.3***
[A3]	Road signs and posts are well prepared in this apartment complex.	2.8(0.8)	3.3(0.9)	3.0 (0.9)	-6.4***
[A4]	Pathways are well connected to key facilities in the neighborhood.	2.7(0.9)	3.7(0.8)	3.2 (1.0)	-12.5***
[A5]	Public transit services are available within 10-minute walks.	3.7(0.9)	4.1(0.7)	3.9 (0.8)	-4.5***
[A6]	Walking paths are located within 10-minute walks	3.7(0.9)	4.1(0.7)	3.9 (0.8)	-4.4***
[A7]	I can walk to most of amenities in this neighborhood.	3.2(1.0)	3.9(0.8)	3.6 (1.0)	-8.4***
[A8]	I prefer walking to driving.	2.8(1.1)	2.4(1.1)	2.6 (1.1)	3.3**
[A9]	It is inconvenient to live in this apartment complex without driving.	3.7(1.0)	2.3(1.1)	3.0 (1.2)	12.4***
Placeness					
[P1]	I frequently run into neighbors on the pathways.	3.1(0.8)	3.4(0.8)	3.3 (0.8)	-4.4***
[P2]	Pathways in this apartment complex are always vibrant.	2.6(0.9)	3.6(0.9)	3.1 (1.0)	-11.1***
[P3]	There is a pathway that I particularly like in this apartment complex.	2.6(1.0)	3.7(0.9)	3.2 (1.1)	-11.0***

4.4 Inhabitants' Demands for Pedestrian Environment Improvement

At the dwellers' demands for pedestrian environment, you can see that the demands for crime-preventing facilities like CCTV were the highest in both apartment complexes. In apartment complex A, the demands were high for parking facilities such as a parking tower and a parking deck, which was presumably resulted from the fact that sidewalks and driveways were not separated so people parked their cars in walking ways, making people feel complaints. Likewise, this reason has led dwellers to high demands for installation of full-time pedestrian ways. In addition, the apartment A was built over 20 years ago, meaning the apartment went through physical aging. Therefore, inhabitants in A had higher demands for replacing floor materials of pedestrian ways than those in apartment B built 5 years ago.

Table 9. Residents' Demands for Pedestrian Environment Improvement

Multiple Response: N(%)			
	A apartment	B apartment	Total
Expansion of full-time pedestrian ways	66(33.8)	20(10.5)	86
Facilities for resting facilities in pedestrian ways (benches, pavilions, etc.)	52(26.7)	51(26.8)	103
Landscape facilities in pedestrian ways	29(14.9)	70(36.8)	99
Facilities for crime prevention in pedestrian ways (CCTV, etc.)	140(71.8)	111(58.4)	251
Maintenance and installation of street-lights	37(19.0)	47(24.7)	84
Construction of parking facilities (Parking tower, Parking deck, etc.)	120(61.5)	22(11.6)	142
Replacement of floor materials of pedestrian ways (Urethane, Elastic rubber chip)	67(34.4)	33(17.4)	100
Safety facilities in pedestrian ways (Handrails, Stairways, Landing facilities, Anti-slippery facilities)	26(13.3)	44(23.2)	70
Sun shade, Shade facilities	14(7.2)	45(23.7)	59
Installation and expansion of bike-ways	7(3.6)	39(20.5)	46
Reflective road signboards for night-walkers	22(11.3)	51(26.8)	73

5. CONCLUSION

With a view to the residential environment plan to improve the quality of life and health status of dwellers, this study was designed to explore the correlations between pedestrian environment and health performance and to analyze their opinions and demands for pedestrian environment so as to facilitate their satisfaction.

First, it's concluded that satisfactions with pedestrian environment had greatly high positive (+) correlations with contentment with health-related residential environment, confirming that if pedestrian environment was enhanced, dwellers' satisfaction with

healthy residential environment (physical, psychological, social, and managerial environment) could go up, not to speak of their contentment with pedestrian environment.

Second, both A and B showed high demands for crime-preventing facilities from the angle of pedestrian environment. In case of night walking, safety can increase and psychological fears of dwellers can decrease through installation of more street lights and anti-crime facilities like CCTV, etc., which is conducive to psychological health as well as physical health.

Third, the field inspection on both A and B apartment complex discovered that surrounding natural environment (such as air quality or landscape) was evaluated as good quality. Furthermore, residents replied, through interviews, that they were highly contending with natural environment and that most of them used pedestrian environment for taking a walk or an exercise. Therefore, more active pedestrian environment are required (i.e. a trail or sports facilities) to create residential environment which could support the enhancement of physical health. Besides, dwellers-participatory trial courses could be developed and community exercise programs could be introduced, enabling residents to invigorate their community, which is, in turn, conducive to the rise of social health of inhabitants.

Fourth, in case of apartment A which suffers from serious physical aging, dwellers made negative evaluations on maintenance and management of pedestrian environment. Broken or fragmented roads need repairing, and floor materials of outdated pedestrian ways shall be replaced. Such activities of continuous maintenance and management will improve managerial performance of apartments.

This study is based on apartment houses, representing Korean house type, so perception of 'pedestrian environment' can be different, depending on local and cultural characteristics.

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