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Heterogeneous Age-Friendly Environments among Age-Cohort Groups

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Abstract: This study aimed to identify the underlying structures of age-friendly environmental characteristics and examine how they may vary across age-cohort groups based on life satisfaction. We used regionally representative data in South Korea. Exploratory and confirmatory factor analysis were conducted for age-friendly environmental indicators in three age-cohort groups. Regression models examined the association between the environmental factors and life satisfaction in the three age-cohort groups. Across all age groups, three factors converged: neighborhood problems, access to public services and programs, and community engagement. Regression analyses showed the three convergent environmental factors were all significantly associated with life satisfaction across all age-groups, but the association varies across the age-groups. The age-cohort based factor structures and differential patterns of association with well-being provide important background information on designing age-friendly communities.

Keywords: life course perspective; age-friendly environments; age-cohort groups; well-being

1. Introduction

1.1. Heterogeneous Age-Friendly Environments Among Age-Cohort Groups

As part of aging policies and programs, the concept of age-friendly environments has gained significant interest in recent years among policy makers and researchers in many countries. An age-friendly environment generally refers to a community in which older adults are valued, involved, and supported in both basic daily activities, such as driving and shopping, and through participating in a community that includes links to public and service organizations in the larger community [1,2]. Many international non-governmental organizations, such as the World Health Organization (WHO), as well as government entities and local communities have launched age-friendly initiatives to help older adults successfully age in place.

The present study aims to contribute to current knowledge of age-friendly environments in three respects. First, there is still relatively little empirical knowledge on how to accurately and appropriately assess the characteristics necessary for an age-friendly environment [3]. Chief among a number of barriers to conducting rigorous research on age-friendly communities is the absence of environmental measures from existing data sets. Most of the existing studies consist of descriptive examples of WHO initiatives to create age-friendly communities [4]. Developing reliable and parsimonious indicators of an age-friendly environment is an important step in designing and implementing policies and programs. In this study, using regionally representative data developed by the Seoul City government based on the WHO framework, we conduct factor analyses to identify the structure of age-friendly environments and examine to what extent these environments are associated with the well-being of older individuals.

Second, research on age-friendly environments could be enhanced by the use of a life-course perspective, which suggests that individual lives are shaped by the socio-historic environments in which individuals are embedded [5,6], reflecting the experiences of their birth cohort [7]. Numerous studies have investigated systemic differences among age-cohort groups in health and well-being, but little is known about possible variations in the meaning and importance of these characteristics among different age-cohorts. Improved knowledge of the factor structure of age-friendly environments and how it may vary across groups will provide important background information for providers to better design and implement services. In order to explore heterogeneous person-environment relations by age-cohort, we conduct factor analyses and regression analyses in three age-cohort groups (middle-aged, young-old, and old-old).

Third, the life-course perspective proposes that aging processes and experiences may be different by country, reflecting the historical and cultural imperatives of a particular society. As a concept, age-friendly environments may be universally beneficial, but specific aspects and effects may vary for different cultures and societies. Most existing research on age-friendly cities and communities has been conducted in Western developed nations [8]. A cross-national study on age-friendly environments and/or research in a non-western context would contribute to the literature. In this study, we examine the structures of age-friendly environments in an East Asian culture, South Korea.

1.2. Empirical Assessment of the Structure of Age-Friendly Environments

Age-friendly environment is a multi-dimensional concept. It includes the physical and social infrastructure that support daily activities through transportation, local amenities, safe and accessible housing, neighborhoods, and communities, access to social support, and opportunities to engage in meaningful activities [9,10]. There is, however, a lack of empirical studies that have examined to what extent the environmental features suggested in various frameworks apply to and affect the aging experiences of older adults in the real world.

In a comprehensive review of the existing literature, Dellamora et al. [11] found a paucity of published research on instruments for the large-scale assessment of the age-friendliness of an environment for older adults. As an initial attempt at empirically assessing the structure of age-friendly environments, Smith et al. [3] used the U.S. Environmental Protection Agency community framework as a guide to examine potential indicators of an age-friendly environment. An exploratory factor analysis (EFA) was done with data from a representative sample of older adults in Detroit, where most residents are African Americans with few socioeconomic resources. The authors found that age-friendly environmental characteristics were grouped into six factors: access to businesses and leisure activities, social interaction, access to health care, neighborhood problems, social support, and community engagement, suggesting that the concept can be empirically measured using many features of the physical and social environment previously identified as age-friendly.

Using these six environmental factors, Lehning and colleagues [12] studied the self-rated health of older adults as an indicator of well-being and found that environmental factors were significantly related to self-rated health above and beyond individual demographic and health characteristics. Specifically, access to health care, social support, and community engagement were associated with better self-rated health, while neighborhood problems were associated with poorer self-rated health. In another study, they examined to what extent environmental factors and the expectation to remain at home varied by income and found that age-friendly environmental factors had little impact on the expectation to remain in one's home, except for neighborhood and housing problems and less perceived safety. Considering the data came from Detroit, where most residents are African Americans with few socioeconomic resources, this finding may reflect a lack of choice for relocation due to limited financial resources.

Based on the World Health Organization's (WHO) framework for Age Friendly Cities (ACF), Park and Lee [13] examined life satisfaction among South Korean older adults, exploring the extent to which multi-dimensional environmental characteristics are associated with low socioeconomic status

(SES). The findings showed that physical (i.e., housing, transportation, and neighborhood), social environment (social participation and social inclusion), and health and social service environment all contributed to older adults' life satisfaction after adjusting for the effects of SES disadvantage and demographic characteristics. Importantly, members of the most vulnerable subgroup in the Korean context—poor older adults living alone—are more likely to have higher life satisfaction when they have higher levels of support in physical and social environments. As the first studies to examine the features of an age-friendly environment, these findings together suggest that more research is needed to examine replicability and applicability of the concept across diverse contexts and populations [12].

1.3. Heterogeneity of an Age-Friendly Environment Across Age-Cohorts

Aging may differ significantly across age groups. Each age cohort group's life transitions and trajectories are shaped by such factors as educational resources, demographic and socio-economic changes (e.g., family, work, savings), historic contingencies (e.g., war), and institutional changes (e.g., pension and health care systems) [14]. Extensive research has examined age-cohort differences in relation to various outcomes in old age, including disablement [15,16], depression [17,18], and social support and networks [19,20].

The environmental gerontological perspective suggests that different age cohorts have different developmental tasks. For older people who are still working, their housing environment might not be the most imminent concern, while for those who are retired, neighborhood conditions such as access to the city and public transportation might be important. For the very old, many with increasing functional limitations, their home's basic conditions and supportive features may become much more important [21,22]. Despite the well-established evidence regarding the importance of environment for later-year health and well-being, few environmental studies have examined variations in the aging experience across different age cohorts. Oswald et al. [23] examined the relationship between physical and social aspects of the housing environment and outdoor place attachment in different urban districts. They found that basic physical housing aspects were most important among the oldest old (71–80 years) and least important among the youngest (51–60 years). In terms of social needs, age was not an important factor, instead, living in a pleasant area was. The findings illuminated that there are different patterns of what is needed from the living environment depending on age group. In another study, Oswald and colleagues [24] examined the relationship between the social and physical aspects of home and neighborhood and life satisfaction, finding that apartment size was positively related to life satisfaction in the young-old but negatively related for the old-old, while perceived neighborhood quality was more important to the old-old than the young-old.

These existing studies indicate that home and neighborhood environment are differentially associated with later-year adaptation among different age-cohort groups, but there is little known about the factors involved. An important initial step is to empirically verify how age-friendly environmental indicators vary across age groups.

1.4. South Korean Context

South Korea (hereafter Korea) provides a unique context for examining possible age-cohort differences in characteristics of an age-friendly environment. Korea is home to the world's fastest-aging population: By 2018, 14% of the population will be aged 65 and older; by 2050, it will be 38.2% [25]. In this study, we used three age-cohort groups: middle-age, young-old, and old-old. Individuals in the middle-aged group, as in many other countries, comprise the "sandwich generation", juggling multiple life tasks including working and family caregiving for their children and aging parents [26,27]. What is unique about this group in Korea is that they experienced two major Asian financial crises in the late 1990s that resulted in massive job loss and the related break up of families. As a result, they have been found to suffer from rapid declines in physical and mental health [28].

Older adults in Korea have become the most disadvantaged in the society. They have lived through years of extreme historic transitions and turbulences such as the Japanese occupation during World War

II, the Korean War, military dictatorships that failed to institute long-term financial security systems, and major Asian financial crises. Many lost educational opportunities and have experienced economic deprivation that has led to not having the savings necessary to sustain financial independence [29]. The oldest-old subgroup is by far the most vulnerable, as they are less educated, tend to be poorer, and have a high rate of cognitive impairment and physical limitations. They are also more likely to experience (or already have experienced) stressful life events such as the death of a spouse [30].

In Korea, research and policy interest in age-friendly environments is at an early developmental stage. Many existing social-relational studies demonstrate that a supportive social environment (many friends, contact with relatives) is associated with better health outcomes [31–33]. Only a few studies examine such physical aspects of environment as housing and neighborhood, and those that do focus on the relationship between housing characteristics and housing satisfaction among older adults. Kang and Jeoung [34], for example, examine how social and physical environmental characteristics are associated with housing satisfaction, finding that access to neighborhood amenities, facilities, and transportation is related to higher levels of housing satisfaction. To our best knowledge, no study has yet empirically examined age-friendly environmental factors and how they may vary by age group.

1.5. The Present Study

This study has two main research aims. First, we conducted two-step factor analyses across the three age-cohorts. An Exploratory Factor Analysis (EFA) was used to explore the empirical structure of age-friendly environmental characteristics. We then cross validated the emerged factor structure using Confirmatory Factor Analysis (CFA). Second, we examined to what extent age-friendly environmental factors are associated with life satisfaction for each age-cohort group. Since this is the first study to empirically look into the possible variation of age-friendly environmental structure characteristics across age-cohort groups, we did not have a specific hypothesis. However, based on the existing theoretical and empirical research related to the differential aging processes of historic and age cohorts, we expected to find variations by age group.

2. Methods

2.1. Design and Sample

This study is a secondary data analysis of the Seoul City-wide Needs Assessment of Middle- and Old-aged Adults [35]. Seoul is one of 250 cities that have joined the WHO Global Network of Age-Friendly Cities and Communities. The Seoul Welfare Foundation (SWF) developed indicators of an age-friendly environment using WHO Global Age-Friendly Cities Guidelines [36], a checklist for cities to assess their progress toward age friendliness. Data was collected via face-to-face interviews during November and December 2012 from a representative sample of 4000 non-institutionalized individuals aged 50 and older. The protocols for data collection were reviewed and approved by the internal review board of the Seoul Welfare Foundation. Proportional stratified random sampling was employed. We divided the sample into three age-cohort groups: middle-aged (range 50 to 64 years; 59%; $n = 2343$), young-old (range 65 to 74 years; 23%; $n = 936$), the old-old (older than 75 years of age; 18%; $n = 721$).

2.1.1. Measures

Age-friendly Environment Characteristics. The data contain 48 environmental indicators in 9 domains based on the WHO framework including housing, transportation, neighborhood environment, outdoor spaces and buildings, social participation, respect and social inclusion, working environment, communication and information, community and health services. All questions were measured on a 5-point scale ranging from 1 (not at all) to 5 (very much).

The assessment of outdoor spaces and buildings contains seven questions. For example, participants were asked to what extent green spaces and outdoor seating are sufficient in number

and well-maintained, whether pedestrian crossings are sufficient in number and safe for people with different levels and types of physical ability and whether public toilets are clean, well-maintained, and accessible.

Housing environment was measured with three questions, including “To what extent is your housing equipped with the physical features of housing such as water, heating, and others?”, and “To what extent do you want to modify your house to prevent accidents and alleviate physical inconvenience (i.e., grab bar, anti-slippery device, barrier free device, etc.)?”.

Transportation environment was measured with seven items. For example, participants were asked to what extent public transportation in Seoul is reliable and frequent, whether vehicles are accessible, not overcrowded, and offer priority seating for the elderly and whether voluntary transport service is available where public transportation is limited.

Neighborhood environment was measured with six items. For example, a question asks, “To what extent, in your neighborhood, are many parts of sidewalks, walls, and public facilities ridden with unsightly scribbles?”, and, “To what extent does vandalism occur frequently in my neighborhood?”.

Outdoor space and building was measured with seven items, including “To what extent are walking trails and parks easy to access from my home”, and “To what extent do the sidewalks in my area have smooth surface and are they free of obstructions and safe for me to walk on?”.

Social participation was measured by six items including, “There any many opportunities to participate in various social activities (religious, cultural gatherings, leisure activities, hobbies, etc.)”, and “There are many opportunities to join volunteer services”.

Respect and Social inclusion was examined with six questions such as “Are older people regularly consulted by public, voluntary and commercial services on how to serve them better?”, and “Are service staff courteous and helpful?”.

Working environment was examined with four items, including “To what extent are career training programs for reemployment available before and after retirement?”, and “It is easy to obtain information about getting a job or starting a business?”.

Communication and information was examined with four questions, including “Do activities and events attract all generations by accommodating age-specific needs and preferences?” and “The information about the community events (e.g., how to participate, how to use facilities, transport routes) is easy to obtain.”.

Community and health services environment was measured with five items, including “To what extent are health and social services conveniently located and accessible by all means of transport?” and, “Is there wide public access to computers and the Internet, at no or minimal charge, in public places as government offices, community centers and libraries?”.

Life Satisfaction. Life satisfaction was measured using eight items that explored multi-dimensional aspects of older-adult life experiences, including satisfaction with health condition, relationships with family and friends, and social and cultural activities and participation. As an example, one question asked participants the extent to which they were satisfied with relationships with their family members. All questions were measured on a 5-point scale ranging from 1 (not at all) to 5 (very much). Responses to the eight variables were averaged to create a life-satisfaction indicator ($\alpha = 0.78$).

Covariates. Gender was coded 0 (men) and 1 (women). Education was measured as categorical variables from 0 (no education), 1 (middle-school graduate or 9 years), 2 (high-school graduate or 12 years) and 3 (some college and higher). Home ownership was coded as 0 (renter) and 1 (home owner). A binary indicator for disability status (0/1) was used. For disability, respondents were asked if they had been diagnosed with any of following health conditions: developmental disorder, brain disorder, visual impairment, hearing impairment, speech impairment, intellectual disorder, autism, psychiatric disorder, a heart disease, a respiratory disease, liver disease, facial disorder, urinary disorder, epileptic disorder, and others.

2.1.2. Analysis

We conducted two-step factor analysis, starting with EFA. Of the two approaches for EFA, principal component analysis (PCA) and common factor model, we chose the latter with a principle axis factor since the unique variance of each measurement variable is not in the ignorable range [37]. SMC (squared multiple correlation) was used to estimate common variance, and oblimin rotation was chosen for factor rotation. To determine factor numbers, factor models were identified with large Eigen value differences and cumulative proportion of variance reaching about 75–85% total variance [38,39].

Confirmatory Factor Analysis (CFA) was conducted to assess construct-related validity of the factor structure identified through the EFA [40]. To do so, we split the three age-cohort samples into two equal number groups through random sampling. For example, the middle-aged group ($n = 2343$) was divided into two groups and for one group we conducted EFA ($n = 1172$) and CFA for the other group ($n = 1171$). The same process was repeated for young-old group ($n = 936$) and old-old group ($n = 721$). This cross-validation process has been widely utilized as a way to examine fit between theoretically discussed factor structures and empirical data. Next, life satisfaction was regressed for environmental factors to examine their effects after the effects of covariates were controlled. In the first model, socio-demographic controls were entered. In the second, factor scores for environmental factors were added.

3. Results

Table 1 presents characteristics of the sample in this study. Within the sample, 22% completed high school (12 years) and 8% had a disability. The middle-aged group had higher levels of education (59% completed high school), a lower proportion of home ownership (76%), and a lower proportion of disability (3%). (A full description of original items is presented in Appendix A.)

Table 1. Descriptive characteristics of the study sample (Mean (SD), %).

	Entire	Middle-Aged Group (Range = 50–64, N = 2343)	The Young-Old Group (Range = 65–74, N = 936)	The Old-Old Group (Range = 75–, N = 721)
Life satisfaction(M)	3.2 (0.45)	3.3 (0.42)	3.2 (0.47)	3.1 (0.47)
Women (%)	51.7	51.0	51.3	54.4
Education (%)				
No education	6.0	0.6	8.1	21.4
Middle school	34.1	17.8	56.1	58.1
High school (12 years)	43.7	58.9	28.2	14.3
Some college or higher	16.3	22.7	7.6	6.2
Disability (%)	5.1	3.1	7.4	8.5
Home ownership (%)	71.9	75.6	68.3	64.4
Household Income (\$, yearly)	\$32,724 (\$20,481)	\$40,486 (\$19,927)	\$23,332 (\$15,541)	\$19,704 (\$15,625)

3.1. Exploratory Factor Analysis Across Age-Cohort Groups

In EFA analysis, the Eigen value and its differences, proportion, and cumulative proportion are used to determine the number of factors. For the middle aged and young-old groups, the findings suggested (results not shown) substantial differences in Eigen value in the four, six, and eight factor models, suggesting that a three to eight factor model was possible. For the Old-old, a three to ten factor model was suggested.

3.2. Confirmatory Factor Analysis

Table 2 shows the fit indices. In general, Root Mean Square Error of Approximation (RMSEA) values less than 0.08 are viewed as acceptable [41], while Comparative Fit Index (CFI) and Non-Normed Fit Index (NNFI) values greater than 0.90 have been used as representing an acceptable model fit [42,43]. All three fit indices indicate that the model fits the data very well. Based on the preliminary results and interpretability, we chose a four-factor model for the middle-age group: neighborhood problems, access to public services and programs, community engagement, and access to outdoor spaces and transportation; for the young-old group, a five-factor model was chosen adding transportation; for the old-old group, a six-factor model was chosen, adding housing.

Table 2. CFA Overall fit indices.

	Models	Chi-Square	df	<i>p</i>	TLI	CFI	RMSEA
middle-aged (N = 2343)	3 factor	12184.38	1085	0.000	0.845	0.859	0.066
	4 factor	6140.35	1083	0.000	0.895	0.909	0.045
	5 factor	7278.78	1080	0.000	0.833	0.844	0.060
	6 factor	8672.97	1071	0.000	0.798	0.809	0.065
	7 factor	10,060.05	1065	0.000	0.754	0.766	0.060
	8 factor	11,734.01	1054	0.000	0.712	0.724	0.072
young-old (N = 936)	3 factor	5954.44	1081	0.000	0.852	0.864	0.056
	4 factor	5267.42	1081	0.000	0.874	0.887	0.052
	5 factor	10,853.74	1077	0.000	0.921	0.933	0.050
	6 factor	8932.78	1072	0.000	0.886	0.898	0.062
	7 factor	7759.21	1064	0.000	0.882	0.894	0.064
	8 factor	7343.76	1057	0.000	0.854	0.867	0.069
old-old (N = 721)	3 factor	4896.16	1082	0.000	0.799	0.811	0.064
	4 factor	4617.19	1082	0.000	0.845	0.857	0.064
	5 factor	4282.93	1078	0.000	0.875	0.889	0.057
	6 factor	4187.57	1069	0.000	0.919	0.924	0.052
	7 factor	3574.32	1063	0.000	0.885	0.903	0.055
	8 factor	3114.2	1055	0.000	0.879	0.896	0.057
	9 factor	3345.55	1049	0.000	0.864	0.889	0.067
	10 factor	3512.5	1042	0.000	0.844	0.873	0.070

Table 3 summarizes the factor structure. Across all age groups, neighborhood problems, access to public services and programs, and community engagement were identified as important for an age-friendly environment. However, differential factors were also identified: In the middle-age group, outdoor spaces and transportation emerged as a single factor, while in the young-old group, these two items were extracted as separate; in the old-old group, housing was identified as an additional factor. (A full description of factor structure for each age-cohort is presented in Appendixs A–C.)

Table 3. Age-friendly environment factors and Life Satisfaction across age-cohort groups.

Age-Cohort	Baby Boomer (N = 2343)				The Young-Old (N = 936)				The Old-Old (N = 721)			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE
Covariate												
Women	0.01		0.00		0.03		0.02		0.02		0.09	
Education	0.02 **		0.02 **		0.05 **		0.03 **		0.02		0.02	
Married	0.00		0.027		0.05		0.05 *		0.00		0.02	
Disability	−0.04		−0.07		−0.11 *		−0.174 **		−0.10		−0.12 *	
Home ownership	0.13 **		0.10 **		0.19 **		0.13 **		0.15 **		0.15 **	
Household income(yearly)	0.22 **		0.17 **		0.15 **		0.14 **		0.17 **		0.17 **	
Age-friendly factors												
Neighborhood problems			−0.04 **				−0.06 *				−0.02	
Access to services & programs			0.30 **				0.45 **				0.23 **	
Community engagement			0.34 **				0.30 **				0.16 **	
Outdoor spaces & transportation			0.062 *									
Outdoor spaces							0.08 *				−0.00	
Transportation							−0.00				0.05	
Housing											0.00	
Constant	1.23 **		1.71 **		1.65 **		1.52 **		1.65 **		1.66 **	
Model R ²			0.42				0.53				0.28	
Model F-value			174.35 **				91.96 **				22.97 **	
Model R ² Δ			0.29 **				0.32 **				0.12 **	

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

3.3. Age-Friendly Environment Factors and Life Satisfaction

Table 4 presents the results of the regression analyses. In the middle-aged group, all four environmental factors were significantly associated with life satisfaction. After controlling for socio-demographic variables in model 2, life satisfaction was negatively associated with neighborhood problems and positively associated with access to social services and programs, community engagement, and outdoor spaces and transportation. In the young-old group, all factors except transportation were significant, with life satisfaction negatively related to neighborhood problems and positively with access to social services and programs, community engagement, and outdoor spaces. In the old-old group, only two environmental factors were significantly related to life satisfaction in a positive direction: community engagement and access to social services and programs.

Table 4. Factor Structure across age-cohorts.

	Baby Boomer Group	Young-Old Group	Old-Old Group
Neighborhood problems	○	○	○
Access to services and programs	○	○	○
Community engagement	○	○	○
Outdoor spaces and transportation	○		
Outdoor spaces		○	○
Transportation		○	○
Housing			○

4. Discussion

A community can either support or inhibit the aging in place of older adults. To date, limited empirical research has assessed the age-friendly environmental concept, making it difficult to know if the concept is generalizable and applicable across all older adults and different societies. To the best of our knowledge, our study is the first to examine the empirical structure of the concept and how it may vary across age-cohort groups as related to their well-being. Our findings demonstrated that the age-friendly environment concept can be empirically measured with a parsimonious set of items and suggest that age-friendly environmental factors may vary by age.

We found both convergent and divergent factor structures across all age-cohorts. The convergent factor structure consisted of neighborhood, community engagement, and access to public services and programs. Interestingly, these empirical three factors identified in all age-groups correspond to the theoretical constructs of the environment [8,44]: physical, social, and service. Many existing studies have shown the importance of distinctive aspects of the environment. For example, lack of neighborhood safety is known to be associated with an increased risk of morbidity and disability among elders [45], less social support [46,47], and depressive symptoms [48], and the importance of social participation and involvement for successful aging is strongly established. Our study provides initial evidence that the conceptual cores of environment can be empirically measured and suggests that support in the three domains of environment is important for all elders.

We also, however, found diverging patterns of factor structure. Among the middle-aged group, outdoor spaces and transportation emerged as a single, combined factor. For this age cohort in Korea, there is intense work stress and also long hours (average of 2163/year), the second highest among Organization for Economic Cooperation and Development (OECD) member countries [49]. This age cohort also represents Korea's sandwich generation, who are saddled with the twin obligations of caring for their children and their aging parents. It seems plausible that for this group, the value of a safe and pleasant outdoor environment is not necessarily a primary concern, rather, the environment may be perceived as a physical space for using the transportation services that they need in order to do their everyday business.

In contrast, for the two older age groups, outdoor spaces and transportation were independent factors. In Korea, a relatively high proportion of older individuals work past retirement age (65 years of age) compared to other countries. The effective retirement age is reported to be 71.2 for men and 67.9 for women [50]. As those in the young-old group transition toward retirement, they may become more interested in how clean and well maintained their immediate environment is. Another interesting finding concerns the old-old group: Housing was identified as a separate factor only for this group, perhaps reflecting the fact this age-cohort increasingly spends more time at home [51].

The findings from regression analyses add further empirical evidence that environmental contexts on well-being in old age differ by age-cohort. The three convergent environmental factors were all significantly associated with life satisfaction across all groups. In addition, although neighborhood problems were not significantly related in the old-old group, the direction of association was consistent with the other two age groups. The lack of significance might be due to low power because of the much smaller sample for this oldest group.

It is interesting that the overall pattern of the environment well-being association varies across the age-groups. Our analytical approach does not allow for direct comparison across these groups. The absence of a significant role for housing environment on life satisfaction was unexpected, especially given that environmental gerontological researchers have examined many aspects of the physical environment. We speculate several factors may have contributed to this. First, our housing indicator was fairly limited compared to those used in other research. For example, other researchers have examined objective and subjective indicators of housing quality [23], basic versus higher-order housing needs [52], and used multi-dimensional indicators such as adequacy, quality, and use of housing [53]. Future research efforts should use a more refined set of indicators when examining the physical environment. The lack of significance for transportation on life satisfaction may be because transportation services are highly available and satisfactory. In Korean, public transportation is free for all individuals aged 65 and older, and this policy is highly popular and much used [54,55].

5. Limitations and Conclusions

Certain limitations of this study should be acknowledged. First, a longitudinal investigation would enhance key aspects of the research on age-friendly environments. Generalizations across age-cohort groups would be stronger had we examined if environmental characteristics change over time. Second, prior research has illuminated the importance of both subjective and objective dimensions of environment as related to the health and well-being of older adults [23,53]. In this study, all the age-friendly environmental measures were self-reported, so there is a possible risk of measurement errors.

Despite these limitations, this study provides important background information on planning and designing age-friendly communities that reflect the differential needs of older adults. In Seoul City and other mega cities in Korea, major social and economic policies and program development have been designed and implemented by the local government. In such city environments, the local governments can utilize the well-developed public infrastructures for public services in creating age-friendly environments. From the designing to implementation process, the government can reflect the heterogeneous importance and needs identified by different age-cohort groups in this study. Importantly, the components of age-friendly cities and community in an urban environment do not necessarily apply in rural areas [56]. In fact, little attention has been paid to rural areas. This is not surprising since the initial impetus for age-friendly environments lay in the concomitant phenomena of the rapid growth of the older population and urbanization, and the well-known tendency to stay put in familiar homes regardless or despite of declining functioning and health. In a number of developed countries, the population is aging faster in rural areas. The problem is that socio-economically depressed rural areas in which the majority of residents are lower-income older adults are limited in their ability to develop and implement sustainable age-friendly communities. In sum, results from the EFA and any future analyses on the relationship between these factors and elder outcomes

should be replicated in other city environments. For creating an age-friendly environment in the rural area, however, it is an important future research inquiry to examine if and to what extent the same methodology and checklist of the WHO age-friendly initiative may be applicable to rural areas and develop rural area-specific age-friendly environment that reflects a close/narrow physical and social environment in rural areas.

Author Contributions: S.P. and S.L. conceived and designed the study; S.L. conducted the analysis; S.P. wrote the paper.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. The Middle-Aged Group Factor Structure

Table A1. The middle-aged group factor structure.

Factor	No	Items	Factor Loading
1. Neighborhood environment	15	In my neighborhood, many parts of sidewalks, walls, and public facilities are ridden with unsightly scribbles.	0.5409
	16	Vandalism occurs frequently in my neighborhood.	0.6912
	17	Noise level is high in my neighborhood.	0.7086
	18	Petty crimes occur frequently in my area.	0.7420
	19	There are a lot of loitering people in my neighborhood.	0.8451
	20	Drunken people are frequently seen in my neighborhood.	0.8431
2. Access to services and programs	22	My current home is well equipped with everyday necessities such as running water, a bathroom, heating system, and others.	0.3108
	31	The staff at Seoul Metropolitan City, the district office, the community center, and the public health service are kind and helpful.	0.5130
	41	The staff at public facilities such as the hospital and the welfare agency are helpful and responsive when I make inquiries.	0.5017
	42	The size of the letters in brochures, newsletters and captions on TV programs are large enough for me to read.	0.4002
	43	At public facilities (Seoul Metropolitan City, the district office, the community center, etc.) and the welfare center, I can use computers and the Internet for free or at a low fee.	0.3846
	44	In my area, I have easy access to programs and information on health education, nutrition class, physical therapy, etc.	0.4743
	45	The health center and the welfare center are built in ways that make it easy and safe for me to use.	0.6437
	46	Seoul Metropolitan City, the district office, the community center, the welfare center provides sufficient information on welfare service.	0.5180
3. Community engagement	24	The venues for most of events and activities that I can participate are easy to reach.	0.3970
	25	Entertainment, leisure and sports activities take place at times convenient to me.	0.4596
	26	The information about the community events (e.g., how to participate, how to use facilities, transport routes) are easy to obtain.	0.4481
	27	There are many opportunities to participate in various social activities (religious, cultural gatherings, leisure activities, hobbies, etc.).	0.5198
	28	There are many opportunities to join volunteer services.	0.5379
	29	The Seoul Metropolitan Government and my community provide sustained assistance and support to those in need.	0.4756

Table A1. Cont.

Factor	No	Items	Factor Loading
	30	The Seoul Metropolitan Government, the district office, the community center regularly seeks the opinions of the (elderly) residents to better identify their needs.	0.5033
	33	There are multi-generational events and activities.	0.5002
	34	The people in my neighborhood are courteous and respectful to senior citizens.	0.3087
	35	I feel respected in social interactions.	0.3137
	36	There are many job training opportunities for senior citizens.	0.5588
	38	It is easy to obtain information about getting a job or starting a business.	0.5973
	39	Career training programs for reemployment are available before and after retirement.	0.6486
4. Outdoor spaces and transportation	1	The public spaces (walking trails, parks, roads, sidewalks) in my neighborhood are clean and well-maintained.	0.5292
	2	Walking trails and parks are easy to access from my home.	0.4865
	3	The sidewalks in my area have smooth surface and are free of obstructions, making it safe for me to walk on.	0.4462
	4	The traffic signals allow enough time for me to cross the roads safely.	0.4733
	5	At crosswalks and narrow roads, drivers give way to pedestrians so that that the latter can safely cross the road.	0.5475
	6	Cyclists are considerate and give way to pedestrians.	0.4897
	8	It is easy for me to use buses or subways to get to where I want to go.	0.3577
	9	In the buses and subways there is enough seating area for the elderly and the infirm.	0.3908
	10	Bus drivers are careful and considerate when loading and unloading passengers to make sure safety.	0.4917
	11	Bus stops have shaded benches to provide comfort.	0.4977
	12	It is easy to obtain information on bus and subway routes.	0.4878
	13	Where it is hard to get an access to local buses or subways, there are free shuttle or community buses that I can use.	0.3950
	14	Traffic signage is large and easy for me to read.	0.4723

Appendix B. The Young-Old Group Factor Structure

Table A2. The young-old group factor structure.

Factor	No	Items	Factor Loading
1. Neighborhood environment	15	In my neighborhood, many parts of sidewalks, walls, and public facilities are ridden with unsightly scribbles.	0.5132
	16	Vandalism occurs frequently in my neighborhood.	0.6524
	17	Noise level is high in my neighborhood.	0.7054
	18	Petty crimes occur frequently in my area.	0.7660
	19	There are a lot of loitering people in my neighborhood.	0.8365
	20	Drunken people are frequently seen in my neighborhood.	0.8535
2. Access to services and programs	22	My current home is well equipped with everyday necessities such as running water, a bathroom, heating system, and others.	0.3658
	25	Entertainment, leisure and sports activities take place at times convenient to me.	0.3372
	31	The staff at Seoul Metropolitan City, the district office, the community center, and the public health service are kind and helpful.	0.4986
	41	The staff at public facilities such as the hospital and the welfare agency are helpful and responsive when I make inquiries.	0.5466

Table A2. Cont.

Factor	No	Items	Factor Loading
	43	At public facilities (Seoul Metropolitan City, the district office, the community center, etc.) and the welfare center, I can use computers and the Internet for free or at a low fee.	0.4530
	44	In my area, I have an easy access to programs and information on health education, nutrition class and physical therapy offered by the district office, the community center, the welfare center or the health center.	0.5632
	45	The health center and the welfare center are built in ways that make it easy and safe for me to use.	0.7033
	46	Seoul Metropolitan City, the district office, the community center, the welfare center provides sufficient information on welfare service.	0.6199
	47	The administrative processes at public offices and the public health center are simple and easy to follow.	0.6395
3. Community engagement	26	The information about the community events (e.g., how to participate, how to use facilities, transport routes) are easy to obtain.	0.3825
	27	There are many opportunities to participate in various social activities (religious, cultural gatherings, leisure activities, hobbies, etc.).	0.5070
	28	There are many opportunities to join volunteer services.	0.4652
	29	The Seoul Metropolitan Government and my community provide sustained assistance and support to those in need.	0.3635
	30	The Seoul Metropolitan Government, the district office, the community center regularly seeks the opinions of the (elderly) residents to better identify their needs.	0.3597
	32	The image of the elderly seen on mass media (e.g., TV, newspaper or radio) is positive.	0.3320
	33	There are multi-generational events and activities.	0.4700
	34	The people in my neighborhood are courteous and respectful to senior citizens.	0.3943
	35	I feel respected in social interactions.	0.4376
	36	There are many job training opportunities for senior citizens.	0.5812
	38	It is easy to obtain information about getting a job or starting a business.	0.6426
	39	Career training programs for reemployment are available before and after retirement.	0.6446
4. outdoor spaces	1	The public spaces (walking trails, parks, roads, sidewalks) in my neighborhood are clean and well-maintained.	0.6086
	2	Walking trails and parks are easy to access from my home.	0.5931
	3	The sidewalks in my area have smooth surface and are free of obstructions, making it safe for me to walk on.	0.5930
	4	The traffic signals allow enough time for me to cross the roads safely.	0.4692
	5	At crosswalks and narrow roads, drivers give way to pedestrians so that that the latter can safely cross the road.	0.6374
	6	At crosswalks and narrow roads, drivers give way to pedestrians so that that the latter can safely cross the road.	0.6469
	7	Public restrooms in a park are clean and convenient to use.	0.4358
5. transportation	8	It is easy for me to use buses or subways to get to where I want to go.	0.4477
	9	In the buses and subways there is enough seating area for the elderly and the infirm.	0.4236
	10	Bus drivers are careful and considerate when loading and unloading passengers to make sure safety.	0.4512
	11	Bus stops have shaded benches to provide comfort.	0.5081
	12	It is easy to obtain information on bus and subway routes.	0.5078
	13	Where it is hard to get an access to local buses or subways, there are free shuttle or community buses that I can use.	0.3150
	14	Traffic signage is large and easy for me to read.	0.3816

Appendix C. The Old-Old Group Factor Structure

Table A3. The old-old group factor structure.

Factor	No	Items	Factor Loading
1. Neighborhood environment	15	In my neighborhood, many parts of sidewalks, walls, and public facilities are ridden with unsightly scribbles.	0.5398
	16	Vandalism occurs frequently in my neighborhood.	0.6889
	17	Noise level is high in my neighborhood.	0.7128
	18	Petty crimes occur frequently in my area.	0.7638
	19	There are a lot of loitering people in my neighborhood.	0.8520
	20	Drunken people are frequently seen in my neighborhood.	0.8782
2. Access to social and health services and programs	30	The Seoul Metropolitan Government, the district office, the community center regularly seeks the opinions of the (elderly) residents to better identify their needs.	0.4224
	31	The staff at Seoul Metropolitan City, the district office, the community center, and the public health service are kind and helpful.	0.5928
	32	The image of the elderly seen on mass media (e.g., TV, newspaper or radio) is positive.	0.3425
	34	The people in my neighborhood are courteous and respectful to senior citizens.	0.3349
	41	The staff at public facilities such as the hospital and the welfare agency are helpful and responsive when I make inquiries.	0.4587
	42	The size of the letters in brochures, newsletters and captions on TV programs are large enough for me to read.	0.3597
	43	At public facilities (Seoul Metropolitan City, the district office, the community center, etc.) and the welfare center, I can use computers and the Internet for free or at a low fee.	0.4526
	44	In my area, I have an easy access to programs and information on health education, nutrition class and physical therapy offered by the district office, the community center, the welfare center or the health center.	0.6910
	45	The health center and the welfare center are built in ways that make it easy and safe for me to use.	0.7093
	46	Seoul Metropolitan City, the district office, the community center, the welfare center provides sufficient information on welfare service.	0.6189
3. Community engagement	24	The venues for most of events and activities that I can participate are easy to reach.	0.3443
	25	Entertainment, leisure and sports activities take place at times convenient to me.	0.3329
	26	The information about the community events (e.g., how to participate, how to use facilities, transport routes) are easy to obtain.	0.4352
	27	There are many opportunities to participate in various social activities (religious, cultural gatherings, leisure activities, hobbies, etc.).	0.5200
	28	There are many opportunities to join volunteer services.	0.5598
	29	The Seoul Metropolitan Government and my community provide sustained assistance and support to those in need.	0.4488
	33	There are multi-generational events and activities.	0.3636
	35	I feel respected in social interactions.	0.3110
	36	There are many job training opportunities for senior citizens.	0.6060
	38	It is easy to obtain information about getting a job or starting a business.	0.6371
	39	Career training programs for reemployment are available before and after retirement.	0.7001

Table A3. Cont.

Factor	No	Items	Factor Loading
4. outdoor space	1	The public spaces (walking trails, parks, roads, sidewalks) in my neighborhood are clean and well-maintained.	0.5904
	2	Walking trails and parks are easy to access from my home.	0.4522
	3	The sidewalks in my area have smooth surface and are free of obstructions, making it safe for me to walk on.	0.5460
	4	The traffic signals allow enough time for me to cross the roads safely.	0.5391
	5	At crosswalks and narrow roads, drivers give way to pedestrians so that that the latter can safely cross the road.	0.6474
	6	Cyclists are considerate and give way to pedestrians.	0.6165
	7	Public restrooms in a park are clean and convenient to use.	0.4951
5. transportation	8	It is easy for me to use buses or subways to get to where I want to go.	0.6052
	9	In the buses and subways there is enough seating area for the elderly and the infirm.	0.4730
	10	Bus drivers are careful and considerate when loading and unloading passengers to make sure safety.	0.5075
	11	Bus stops have shaded benches to provide comfort.	0.6027
	12	It is easy to obtain information on bus and subway routes.	0.6312
	13	Where it is hard to get an access to local buses or subways, there are free shuttle or community buses that I can use.	0.4196
	14	Traffic signage is large and easy for me to read.	0.5362
6. housing	21	Housing-related expense takes up a large share of my current living expenses.	0.3933
	23	I want to renovate my house to remove physical barriers and prevent accidents (e.g., installing safety railing and non-slip flooring in a bathroom, removing a door threshold or adjusting the height of the kitchen sink).	0.4184

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