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Predictors of Quality of Life among Grandparents Raising Their Grandchildren: An Ecological Approach

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Purpose: The purpose of this study is to examine factors affecting quality of life among grandparents raising their grandchildren. **Methods:** This study carried out a secondary analysis of data from the 2014 Korean Longitudinal Study of Aging (KLoSA) and Statistics Korea. Data collected from 224 grandparents who reported raising their grandchildren were analyzed using descriptive statistics, independent t-test, ANOVA, pearson correlation coefficient, and multilevel regression analysis. **Results:** The mean score of the participants' quality of life was 62.63. Significant predictors of quality of life of the grandparents included subjective health status, last year's total house income, number of last year's travels, frequency of last year's movie seeing, and number of children's parks per 100,000 population. **Conclusion:** These results suggest that public health nurses in improving quality of life of grandparents focus on children's parks and formal social supports as community factors as well as regular exercise as an individual factor in order to be more effective.

Key Words: Grandparent, Quality of life, Multilevel analysis

INTRODUCTION

1. The Need for Research

In Korean society in the past, grandparents participated in the process of socialization of their grandchildren in the role of grandchildren's emotional stability, protection and discipline [1]. However, as the number of working women increases and women become more active in society, the role of caring for young children is expanding not only to the mother but also to the grandparents and the father. In particular, child care is often left to the child's grandmother or grandmother-in-law rather than to the child care facilities or others because of the problems of economic burden and trust in caregivers [2]. It is reported that grandmother is providing quality service at a much lower cost than any proxy service, and plays an important role in women's employment [3]. According to the 2014 survey of Korean older persons, 21.8% of elderly people aged 65 and over living together with their married children said that the reason of living together with their married children is to provide their children with housekeeping/grandchild raising help, and there were some differences by regions (8.7~49.0%) [4]. The elderly people aged 65 and over who have been directly brought up their grandchildren under 10 years old for the past year were 6.4%, which is significantly higher than 5.3% in 2008 [5].

As the function of socialization in the home weakens, grandparents have played important roles as tutor for the discipline of grandchildren, emotional supporter supporting the emotional security of grandchildren, family integrator maintaining and connecting the intergenerational relationship, and a guardian of their grandchildren [6]. Thus, improving the quality of life (QoL) of grandparents is a very important task not only for personal reasons but it affects the QoL of the family members that the grandparents belong to, the economic activity of the country, and the fertility rate as well.

In the meantime, the elderly are undergoing changes such as weakening of strength, loss of function, and occur-

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rence of chronic diseases in physical changes [7], while grandchildren's care work for grandparents in their old ages is further deteriorating their physical health, and can cause negative consequences such as stress, depression, and physical burden [8]. On the other hand, there are some reports that raising grandchildren is an experience that gives fun and pleasure to the plain life of old age, and experiences that make them feel important in the family and society [9]. In this way, grandparents' care should be grasped and approached in a multifaceted way because it can have a positive and negative impact on the QoL of grandparents. Regarding the QoL in old age, physical activity positively affects the QoL regardless of age, activity level, and health [10]. In addition, parks are associated with increasing physical activity by providing a safe environment for elderly people who like to walk a short distance and allowing them to spend more time in the park [11], and parks are a crucial condition for the interpersonal leisure satisfaction of elderly people and improving their QoL [12]. To improve the QoL for the elderly, it is necessary to consider the environment that increases physical activity and leisure activities, and in particular, in case of grandparents caring for grandchildren, the community environment related to caring should also be considered. Furthermore, it has been reported that formal social support, such as services provided by institutions and local communities as community characteristics, can reduce depression in grandparents [13]. In Korea, some local governments have supported grandparents who raise their grandchildren by providing policy grants since 2011 [14].

An ecological model is an approach in which human behavior related to health is influenced by the environment and focuses on the interaction of its influences [15]. McLeroy and colleagues presented factors affecting human behaviors as five multi-layered levels including intrapersonal factors, interpersonal factors, organizational factors, community factors, and public policy factors [15]. Previous studies based on ecological models have applied ecological models to health promotion behaviors and leisure activities of elderly people using elderly general welfare centers or elderly people living in free elderly facilities [12,16], but studies on the QoL of grandparents who raise their grandchildren based on ecological models are scarce. Thus, based on an ecological model, this study attempts to identify the specific predictors of the QoL of grandparents who raise their grandchildren by examining intrapersonal, interpersonal, and community factors.

2. Purpose of Research

This study attempts to investigate the factors affecting the QoL of grandparents caring for their grandchildren based on an ecological model, and following are the specific objectives.

First, this study aims to explore grandparents' intrapersonal factors (demographic characteristics, health related characteristics), interpersonal factors (family characteristics, social support system), community factors and QoL. Second, this study aims to investigate the difference of grandparents' QoL according to intrapersonal, interpersonal, and community factors and their relevance. Third, this study aims to identify intrapersonal, interpersonal, and community factors affecting the QoL of grandparents.

METHODS

1. Research Design

This study is a descriptive correlation study using the raw data of the Korean Longitudinal Study of Aging (KLoSA) and secondary data from the National Statistical Office to investigate the factors affecting the QoL of grandparents caring for their grandchildren.

2. Research Participants and Data Collection Methods

The Korean Longitudinal Study of Aging (KLoSA), which was used in this study, was the data collected for the elderly people aged 45 years and over nationally excluding Jeju Island, for the purpose of investigating the actual conditions and behavior patterns of elderly people [17]. The contents of the survey were about the population, family, health status, employment, income and consumption, assets, subjective expectation and QoL, and when the panel subject died, the other family members were surveyed.

KLoSA's survey method was the Computer Aided Personal Interview (CAPI), interviewers with the notebooks visited the sample households and conducted computer interviews. The sampling frame is the enumeration districts of the Population and Housing Census in 2005, and 261,237 general area and apartment enumeration districts excluding the island area and the facility unit enumeration districts are determined as the sampling unit enumeration districts. Before sampling the enumeration district, the whole areas were stratified by 15 metropolitan cities, and then stratified by local government administrative dis-

tricts called "Dong", "Eup", or "myeon", and finally stratified into the general house and the apartment enumeration districts within each administrative district. After that, the systematic sampling method was applied to extract the number of assigned samples. When the sampling area changes as the panel survey continued, the preliminary sample enumeration districts were utilized to keep 1000 sample enumeration districts. The 5th KLoSA sample in 2014 was 9,431 people, and 7,467 people were surveyed (response rate, 79.2%), including 438 deaths and 7,029 survivors. Among 7,029 living participants, 262 participants were answered "Yes" to the question "Have you helped raise your grandchildren under the age of 10?", and 38 people were excluded because of suspected dementia, the final number of participants included in this study was 224. As results of Mini-Mental State Examination (MMSE) consisted 19 items, if the cognitive function score is 24 points or more, it can be regarded as normal; the score of 18 points or more and 23 or less indicates a decrease in cognitive function; if the score belows 17 points, it can be suspected as dementia [18].

In addition, this study used local newspapers in the area and the National Statistical Office (NSO) data where the participants reside, which have the potential to affect the QoL of grandparents. The data on the grandchild caretaker support project was provided by the Gwangju Daily Newspaper [14], and the nursery supply rate by region was provided by the research report of the Korea Institute of Child Care and Education [19], and the number of libraries, the number of children's parks, the number of public sports facilities, the number of public heath institutions, and the number of the elderly leisure welfare facilities were provided by the data of the NSO [20-24].

The KLoSA data are the data downloadable from the employment survey site with personal information deleted, and the data of the NSO are publicly available. Therefore, this study was conducted after the approval of the study ethics committee (IRB No. 2016-0026), ensuring anonymity and confidentiality without harm to the participants.

3. Selection and Definition of Research Variables

1) Satisfaction of life (Quality of Life, QoL)

In the KLoSA questionnaire, a single question "How satisfied are you with your overall QoL (happiness) when compared to others in your peer group?" was measured in a range of 0 to 100 points at intervals of 10 points, and the closer to 100 points the score is, the more satisfied the respondent is.

2) Intrapersonal factors

Intrapersonal factors are personal characteristics such as knowledge, attitude, behavior, self-concept, technology, and individual development process, etc.[10]. This study employed sociodemographic characteristics of grandparents (age, sex, and residence area), health behaviors (regular exercise) and health status (subjective health status, grip strength index, depression, and cognitive function score) as variables. The residential areas were classified into large cities, small and medium cities, and rural areas (eup and myeon areas), and the subjective health status was reclassified as good, normal, and bad, and regular exercise was considered as a dichotomous variable of yes or no.

The index of grip strength was measured on the average of the grip strength measured on the left and right hands by the researchers using a dynamometer. The unit was expressed in kg, and the range was 0 to 50, which were regarded as continuous variables. KLoSA used 10 items out of 20 items of the Center for Epidemiological Studies-Depression (CES-D), which consisted questions about feelings and behaviors for the past week, in order to measure depression degree. If there is a symptom of depression about 10 items, '1' is assigned, if not, '0' is given, and then all the scores are added to generate a variable. Therefore, the score range for depression symptoms in this study is 0~10, and the higher the score, the more depressed. The cognitive function score is summarized using the total score of 19 items of Mini-Mental State Examination (MMSE), and it is normal if the score is 24 or higher [18].

3) Interpersonal factors

Interpersonal factors mean the effects of formal and informal social relations and social support systems including family, colleague, and friend relations [10]. In this study, the characteristics of family (household gross income, living with children, child's job, total number of grandchildren raised by grandparents, period of caring grandchildren, care hours per week), social support system (the number of meetings with close friends, whether to have social gathering, leisure activities for the past year) were measured as variables. The number of meetings with close friends was reclassified frequently (more than twice a month) or rarely (less than once a month), social gathering included religious meetings and acquaintance meetings, and the yearly leisure activities included trips, sightseeing, excursions, movies, performances, concerts, exhibitions, and sports events.

4) Community factors

Community factors refer to the effect of community or-

ganizations, institutions, and informal relationships [10]. In this study, the characteristics of the community where the grandparents reside were identified. In terms of community characteristics related with caring, this study investigated the presence of grandchild caretaker support project and nursery supply rate by region, the number of public libraries, and the number of children's parks per 100,000 population were included, and in terms of community variables related with grandparents, the number of sports facilities per one million population, the number of health care institutions (public health centers, public health sub-centers, primary health care posts) per 100,000 population, and the number of elderly welfare facilities (elderly welfare centers, senior citizens centers, elderly classrooms) per 100,000 elderly population were surveyed. The grandchild caretaker support project provides financial grants to grandparents who care for grandchildren, and in this study, whether to have the grandchild caretaker support project was included as a community variable [17]. The nursery supply rate by region was calculated by using the ratio of the number of nurseries to the number of registered residents in 0~6 years of age in 2014[19], and the data provided by the NSO were used for the number of public libraries and community variables related with grandparents [20-24].

4. Data Analysis Methods

In this study, the relationship between the QoL of grandparents and the ecological factors was analyzed using the PASW SPSS/WIN 23.0 program, and multilevel analysis was performed using STATA 13.1.

First, grandparents' QoL and intrapersonal factors (sociodemographic characteristics, health related characteristics), interpersonal factors (family characteristics, social support system), and community factors were analyzed using descriptive statistics such as percentages and averages.

Second, the difference and relationship among grandparents' intrapersonal factors, interpersonal factors, and community factors and QoL were analyzed using independent t-test, ANOVA, Pearson's correlation coefficient, and posttest of ANOVA was conducted using Scheffé method.

Third, multi-level regression analysis was conducted to identify intrapersonal factors, interpersonal factors, and community factors that affect the QoL of grandparents. This study conducted a two-level regression analysis. First, a null model, which includes only constants without independent variables, was established, and then the individual level model, which includes individual level predictor variables including intrapersonal and interpersonal factors (Model 1), and individual-community level model, which includes predictive variables at the individual level and the community level (Model 2), were established to analyze the fitness of the models and the fixed and random effects at the individual and community level.

RESULTS

1. Characteristics of the Participants

The participants of this study were 224 grandparents who had taken care of their grandchildren. The average age was 67.86±7.06, and 86 participants (38.4%) were below 64 years old and 138 participants (61.6%) were over 65 years old. There were more women than men (84.4%), 53.6 % resided in metropolitan cities and 46.4% residing in small and medium cities and rural areas.

In the health characteristics, 51 participants (22.8%) were satisfied with the subjective health status, while 111 participants (49.6%) perceived to be normal 62 participants (27.7 %) perceived to be worse, and 107 participants (47.8%) had regular exercise. Also, the grip strength index was 21.74± 6.34kg and the depression score was 3.08±2.64 points. The cognitive function score was 25.27±3.33, which was normal, but 70 participants (31.3%) of the participants had cognitive function score of 23 or less, demonstrating the cognitive function was decreased (Table 1).

2. Characteristics of Interpersonal Variables

In terms of the characteristics related to the family, the gross income of households was 2,750.12±2,251.08 (10,000 won) last year, and it was confirmed that the income gap per household was large, and 99 participants (44.2%) were living with their children. 98.2% of the children had occupations, and the number of children in care was 1.74±0.99. The mean duration of care for grandchildren was 3.41± 4.25 years, with an average time of 59.39±59.13 hours per week.

In relation to the social support system, 141 participants (62.9%) frequently met close friends, but 83 participants (37.1%) rarely met close friends. It was confirmed that 47 participants (21%) had a religious meeting, 129 participants (57.6%) had a social gathering, and 13 participants (5.8%) had a cultural center or sports meeting that they could spend leisure time together. In the last year, 107 participants (47.8%) had travel, tourism, and outing experience, and 21 participants (9.4%) had participated in movies, performances and concerts (Table 2).

Table 1. Characteristics of Intrapersonal Factors and Quality of Life according to Intrapersonal Factors (*N*=224)

Variables	Characteristics	Categories	n (%) or M±SD	Median	Range	Quality of life			
						M±SD	t or F	r	*p*
Quality of life			62.63±15.53	70	20~90	62.63±15.53			
General characteristics	Age (year)		67.86±7.06	67	56~87			-.10	.144
	Gender	Male[a]	35 (15.6)			68.00±15.68	2.25		.026
		Female[b]	189 (84.4)			61.64±15.33			(a>b)
	Residence area	Big city	120 (53.6)			62.00±17.47	0.22		.804
		Small city	82 (36.6)			63.29±12.48			
		Municipal district	22 (9.8)			63.64±14.96			
Health related characteristics	Subjective health status	Good[a]	51 (22.8)			70.98±12.04	29.81		<.001
		Middle[b]	111 (49.6)			64.86±13.27			(a>b>c)
		Bad[c]	62 (27.7)			51.77±16.05			
	Regular exercise	Yes[a]	107 (47.8)			66.54±13.04	3.75		<.001
		No[b]	117 (52.2)			59.06±16.76			(a>b)
	Grip strength index (kg)		21.74±6.34	20.66	8.2~43.1			.30	<.001
	Depression score		3.08±2.64	2	0~8			-.39	<.001
	Cognitive function score		25.27±3.33	26	18~29			.31	<.001

3. Characteristics of Community Variables

Among the characteristics of the 15 cities and provinces, there was one place (6.7%) in which there was a grandchild caretaker support project, and the average childcare center supply rate by region was 55.13±5.29%. The number of public libraries and small libraries compared to the population was 100.95±77.36, and the average number of children's parks per 100,000 population was 21.43±6.21. In addition, the number of public sports facilities per one million population was 364.97±168.18, and the number of public health centers, substation health centers, and health clinics combined per 100,000 population was 5.60±8.74. It was confirmed that the number of elderly welfare centers, senior citizens centers and silver colleges for the leisure of elderly people are 843.15±554.61 per 100,000 elderly people (Table 3).

4. Relationship between Major Variables and QoL

The score of average QoL of grandparents was 62.63±15.53 points (Table 1), and according to the residence area of the grandparents, the score was 62.00±17.47 points in large cities, 63.29±12.47 points in medium-sized and small-sized cities, and 63.64±14.98 points in eupmyeon districts. The relationship between individual characteristics, community characteristics, and QoL is shown in Tables 1, 2, and 3. Age was not statistically significant, and the QoL of men was higher than that of women (t=2.25, p=.026). With regard to the health related characteristics, the higher the perceived health status, the higher the QoL (F=29.81, p<.001), and the QoL was high when exercising regularly (t=3.75, p<.001). In addition, the grip strength index (r=.30, p<.001), the depression score (r=-.39, p<.001), and the cognitive function (r=.306, p=.001) were shown to be statistically significant. In terms of family-related characteristics, the higher the total gross income of households, the higher the QoL (r=.16, p=.020), whether to live with the children, whether or not for the child to have a job, and the number of grandchildren they cared for, caring period and weekly caring time did not show statistically significant difference. In addition, the more frequently they met close friends (t=2.87, p=.005) and the higher they participated in religious meetings (t=3.06, p=.003), their QoL was found to be high, and when they went on a trip or an outing last year (t=4.91, p<.001) and when watching movies and performances (t=2.46, p=.015), their QoL was found to be significantly high.

In terms of community characteristics, the QoL was significantly high when there was a grandchild caretaker support project (t=5.63, p<.001), and the supply rate of childcare centers was higher (r=.24, p<.001), the QoL was significantly high (r=.24, p<.001). In addition, the QoL was high when there were a large number of children's parks

Table 2. Characteristics of Interpersonal Factors and Quality of Life according to Interpersonal Factors (*N*=224)

Variables	Characteristics	n (%) or M±SD	Median	Range	Quality of Life			
					M±SD	t or F	r	*p*
Family related characteristics	Household gross income last year (10,000 won)	2,750.12±2,251.08	2,450	60~12,000			.16	.020
	Living with children							
	Yes	99 (44.2)			61.92±14.26	-0.61		.541
	No	125 (55.8)			63.20±16.49			
	Child's job							
	Yes	220 (98.2)			62.86±15.49	1.65		.101
	No	4 (1.8)			50.00±14.14			
	Total number of grandchildren	1.74±0.99	2	1~8			.06	.399
	Period of caring grandchildren (year)	3.41±4.25	2	0~9			.06	.391
	Care hours (hr/w)	59.39±59.13	42	3~168			.06	.400
Social network related characteristics	Number of meetings with close friends							
	Frequently	141 (62.9)			64.75±15.19	-2.70		.008
	Rarely	83 (37.1)			59.04±15.51			
	Religious meeting							
	Yes[a]	47 (21.0)			68.09±13.13	3.06		.003
	No[b]	177 (79.0)			61.19±15.82			(a > b)
	Social gathering							
	Yes	129 (57.6)			63.64±14.89	1.14		.258
	No	98 (42.4)			61.26±16.32			
	Leisure activities for the past year							
	Yes	13 (5.8)			67.69±10.13	1.78		.094
	No	211 (94.2)			62.32±15.76			
	Number of traveling in the last year							
	Yes[a]	107 (47.8)			67.66±13.15	4.91		< .001
	No[b]	117 (52.2)			58.03±16.15			(a > b)
	Number of seeing a movies in the last year							
	Yes[a]	21 (9.4)			70.48±12.03	2.46		.015
	No[b]	203 (90.6)			61.82±15.64			(a > b)

which children can use with their grandparents (r=.21, p=.001), and the more elderly welfare facilities available to the elderly over 65 years, the QoL was significantly high (r=.13, p=.047).

5. Effects of Individual and Community Factors on the QoL of Grandparents Caring for Grandchildren

The null model, the individual level model (Model 1), and the individual-community level model (Model 2) were sequentially tested to confirm the factors affecting the QoL of grandparents caring for their grandchildren. In the univariate analysis using significance level .05, variables showing significant differences in grandparents' QoL were included as the independent variables to be included in the multi-level analysis. Age was not significant in univariate analysis but was included in the final model as demographic characteristics. The Variance Inflation Factor (VIF) value for the correlation between independent variables before the multilevel analysis was 1.10~6.64, which was less than 10, confirming that there was no problem in multi-collinearity.

The null model is a model without explanatory variables and verifies whether there is regional difference in the QoL of grandparents. To examine the random effects of the null model, the two-level variance (τ=12.34) indicating the difference in QoL between regions was statistically significant (x^2=3.92, p=.024). Intra-class Correlation Coefficient (ICC) was 0.051 {12.34/227.72+12.34}, and 5.1% of the total variance was caused by regional differences. In other words,

Table 3. Characteristics of Community Factors and Quality of Life according to Community Factors (A=15, *N*=224)

Characteristics	n (%) or M±SD	Median	Range	Quality of life			
				M±SD	t or F	r	*p*
Grandchild caretaker support project							
Yes[a]	1 (6.7)			75.38±7.76	-5.63		< .001
No[b]	14 (93.3)			61.85±15.55			(a > b)
Nurseries regional supply rate (%)	55.13±5.29	55.3	48~68			.24	< .001
Number of public libraries per population	100.95±77.36	63	17~217			.22	.070
Number of children's parks per 100,000 population	21.43±6.21	22.38	12~40			.21	.001
Number of public sports facillities per 1,000,000 population	364.97±168.18	287.80	224~1147			.13	.061
Number of healthcare institutions per 100,000 population	5.60±8.74	2.34	0~32			.10	.122
Number of elderly welfare facillities per 100,000 elderly population	843.15±554.61	763.59	329.3~2,314.5			.13	.047

the QoL of grandparents caring for grandchildren can be influenced not only by individual factors but also by regional differences.

Model 1 is a model in which only independent variables at the individual level are input. We identified a regression model with explanatory variables such as age, gender, subjective health status, presence of regular exercise, grip strength index, depression score, cognitive function score, household gross income of last year, meeting with friendly people, religious meetings, last year's travel or sightseeing, experience of outing, participation in movies, performances, and concerts. As a result of analyzing the fixed effect on the QoL in model 1, the QoL was lower as the subjective health condition was worse (β=-9.82, p < .001), and the QoL was higher as household income increased (β=0.01, p < .001), there was a religious meeting (β =4.47, p = .043), and they went on a trip or outing last year (β=4.07, p = .035). Other variables including age, gender, regular exercise status, grip strength index, depression and cognitive function scores, the number of times they meet close friends, and participation in movies and performances last year were not found to be statistically significant.

In the random effect of Model 1, the p-value was .055 as a result of the likelihood ratio test of comparing between the model with random effect and the model without random effect, and there was no statistically significant difference at the significance level of .05. However, the ICC was still 6.34% even with individual level variables, it indicated the need for Model 2 to account for differences between regions. Therefore, the results of model 2 are obtained by additionally inputting the regional level variable as an independent variable. In the random effects of Model 2, the variance of the region was reduced to nearly zero, and the value of reduced variance was not statistically significant (p > .999). In other words, it can be said that the input of the community variables explained the difference between the regions well.

As for the fixed effects of Model 2, cases such as the subjective health status, last year's household gross income, religious gatherings, and travel or outings last year that had shown statistical significance when individual level variables were applied, were still statistically significant. At the community level, the higher the number of children's parks per 100,000 population (β=0.47, p = .035), the higher the QoL, but the grandchild caretaker support project, the nursery supply rate by region and the number of elderly leisure welfare facilities were not statistically significant (Table 4).

DISCUSSION

This study aimed to identify the factors affecting the QoL of grandparents caring for grandchildren under an ecological approach, and this study applied the multilevel analysis method by reflecting the characteristics of data with a hierarchical structure of intrapersonal, interpersonal, and community factors. Throughout this study, the individual level factors of the intrapersonal and interpersonal factors affecting the QoL of grandparents caring

Table 4. Factors related to the Quality of Life among Grandparents Caring for Grandchildren Using Multilevel Analysis (*N*=224)

Parameter	Categories	Model 0 Null model β	Model 0 Null model *p*	Model 1 Individual level β	Model 1 Individual level *p*	Model 2 Individual-community level β	Model 2 Individual-community level *p*
Fixed effect	Intercept	63.26	< .001	34.53	.039	11.70	.664
Individual level	Age			0.15	.306	0.15	.298
	Female (ref: Male)			-1.99	.515	-1.90	.530
	Middle subjective health status (ref: Good)			-2.48	.256	-3.11	.144
	Bad subjective health status (ref: Good)			-9.82	< .001	-10.50	< .001
	Regular exercise (ref: No)			3.40	.058	2.94	.097
	Grip strength index			0.19	.301	0.19	.309
	Depression score			-0.76	.055	-0.67	.085
	Cognitive function score			0.58	.066	0.54	.084
	household gross income last year (10,000 won)			0.01	< .001	0.01	< .001
	Rarely meet close friends (ref: Frequently)			-1.55	.428	-2.17	.261
	Having religious meeting (ref: No)			4.47	.043	4.32	.044
	Number of traveling in the last year (ref: No)			4.07	.035	3.74	.048
	Number of seeing a movies in the last year (ref: No)			1.45	.650	2.67	.400
Community level	Grandchild caretaker support project (ref: No)					3.74	.444
	Nurseries regional supply rate (%)					0.28	.476
	Number of children's parks per 100,000 population					0.47	.035
	Number of elderly welfare facillities per 100,000 elderly population					-0.01	.383
Random effect	Level 1, δ^2	227.72		130.29		127.32	
	Level 2, μ_0 (τ)	12.34		8.82		< .01	
	x^2	3.92		2.54		< .01	
	p	.024		.055		> .999	
	ICC (%)	5.14		6.34		< .01	

τ=variance of μ_0; ICC=intra-class coefficient.

for their grandchildren were subjective health status, household gross income of last year, presence of religious meetings, and going on a trip or an outing last year, and the community level factor was the number of children's parks per 100,000 population. As in the ecological model, which is the theoretical framework of this study, the results of this study confirm that both individual factors and community factors affect the QoL of grandparents who care for grandchildren.

The average QoL of the participants was 62.63 points, and according to the residing region there were 62.00 points in large cities, 63.29 points in small and midium-sized cities, and 63.64 points in rural areas. Compared to the previous studies that examined the QoL of the elderly using other tools, it is found that this is similar to the 63.7/100 points (6.37/10 points) of the previous study that investigated the QoL of the elderly in Korean society [25], and that this is higher than 52.2/100 points (20.88/40 points), which is the result of the previous study of the QoL of rural elderly people [26]. This study is conducted for grandparents in regions except for Jeju Island, so it is difficult to compare the QoL directly with the studies that have been conducted in only one region, but the results of this study are similar to those of the previous studies on the average when considering urban and rural areas.

In this study, subjective health status and grip strength index were used for the item to evaluate the physical function of grandparents. In general, ADL (Activities of Daily Living) and IADL (Instrumental Activity of Daily Living) measures were used to measure physical function in the elderly. However, as the participants of this study were those elderly grandparents who resided in the region and cared for their grandchildren, and 38.4%(86 participants) of them were under 64 years of age, so ADL and IADL measures were considered inappropriate. The results of this study are similar to those of a previous study [7] which reported that the QoL was high when subjective health status was good, which had a significant effect on health-related QoL through subjective health status. On the other hand, the grip strength as a variable measuring the basic

physical strength of the body was measured as an average of 21.74±6.34 kg, and the average age of the participants in this study was about 67 years old. This is a result similar to that of the previous study in that it is reduced to 26.9 kg in the 50s, 23.9 kg in the 60s and 18.6kg in the 70s and 80s as the average grip strength of Korean women gradually decreased after their 20s [27]. The grip strength showed a significant difference in the QoL of grandparents in the univariate analysis but not significant in the multi-level analysis, that is, a multivariate analysis. These results suggest that considering various factors together, grandparents' QoL is affected by other variables other than the gripping strength. On the other hand, regular exercise, depressive symptom, and cognitive function, which were significant in univariate analysis, did not have a significant effect on the significance level of .05 in the multilevel analysis, but it is smaller than the significance level of .1, requiring further studies in future. As previous studies reported that depression has a direct effect on the subjective QoL of the elderly in the senior citizens center [26], and that the QoL increases as the elderly's cognitive function increases [28], it is necessary to continuously manage depression and cognitive function for the QoL of grandparents. In particular, based on the previous studies that grandmother's parenting stress increases depression, and the QoL decreases as grandmother's parenting stress increases [1,13], it is necessary to consider causes such as the parenting stress, which causes grandparents' depression rather than considering merely depression, The same causes should be considered together. Also, the results of this study that the higher the gross income of grandparents households, the higher the QoL are consistent with the results of previous studies [1,8] grandparents with financial difficulties may experience lower QoL, so the support of national level is required.

In this study, parenting characteristics, that is, the mean length of care or weekly care, did not affect the QoL of grandparents. This is consistent with previous research that grandchild care such as the number of caregiving grandchildren, years of care and time, and places of care, etc. have no significant effect on grandparents' life satisfaction and depression [29]. However, based on the result of previous research that conflicts with their child about caring rather than care itself affect grandparents' life satisfaction or depression [1,13], and continuous research including this should be conducted in future. In addition, in this study, the QoL was high when grandparents caring for their grandchildren had leisure activities such as religious gatherings, trips or outings, which supports the results of previous studies that the elderly's participation in leisure activities directly affected their life satisfaction and the more leisure activities the higher satisfaction they perceived [30]. This study also suggests that grandparents should be encouraged to have recreational activities that take into consideration the effects of trips or outings rather than watching movies, performances, concerts, exhibitions, sports events, etc.

According to the ecological model, in terms of community environment factors affecting the QoL of grandparents caring for their grandchildren, as the number of children's parks per 100,000 population increased, the QoL increased. As in the result of previous research that parks provide a safe environment for elderly people and is suitable for walking on short distances and increases physical activities [11], this study also found that as there are more children's parks in the community, because the grandparents are in a safer environment in which to walk, sit and spend time together with their grandchildren, physical activities can increase, which can improve the QoL of grandparents in the long run. The results of the present study suggest that high QoL is supported by performing leisure activities. As grandparents who care for their grandchildren often plan their daily work according to grandchildren's kindergarten or school schedule, having a children's park outside in a short distance can be very beneficial. Therefore, to improve the QoL of the elderly, there is a need for a multi-level integrated intervention program that simultaneously takes measures to increase individual activities and to build a community environment to enable physical activities.

Meanwhile, the grandchild caretaker support project has been implemented in one local government region nationwide since 2011[16], and in this study, the grandchild caretaker support project was significant in the univariate analysis, but in the final multilevel analysis, it did not affect the QoL of grandparents. This suggests that the data is inadequate because there is only one local government that currently supports it. However, the grandchild caretaker support project is an objective and official social support provided in the community, and can be very helpful for low-income families, and so the effect of grandchild caretaker support project upon grandparents' QoL needs to be evaluated. In addition, there was no statistically significant effect of supplying nurseries by region, and just as this is not the caring situation itself but the conflicts with care-related children and parenting stress that affected the QoL of grandparents, even if there is a difference in the supply rate of nurseries by region, it is regarded as the care situation itself and does not affect the QoL of grandparents. In addition, since the participants of this study are

grandparents who helped raise children before 10 years of age, if their grandchildren go to elementary school instead of childcare center, they will have no relation with the supply rate of childcare center. Therefore, future research is needed to confirm the effect of the supply rate of childcare center by limiting the age of grandchildren more specifically. Finally, the number of the elderly leisure welfare facilities was not statistically significant in the multi-level analysis, and this is because the elderly leisure welfare facilities are mainly used by the elderly over 65 years old, and younger grandparents under 65 years of age are included among the participants, it is believed that it had no effect at all. However, considering the heavy effect of the elderly's leisure on the QoL, future research is needed only on healthy grandparents over 65 years of age who are raising grandchildren.

This study is a secondary data analysis research using the data from the Korean Longitudinal Study of Aging (KLoSA) and the National Statistical Office (NSO). The research was conducted on the participants of grandparents who not only currently caring for their grandchildren but also having experiences about caring for their grandchildren, and there is a limitation that the age range is large before 10 years old. In addition, there is a limitation in that it cannot grasp the interpersonal effect more specifically because it involves a limitation of care and family characteristics such as conflict with children, parenting stress, and social support which have an important effect on the QoL of grandparents. Also, this study used a multi-level analysis method to verify individual-level and community-level factors affecting the QoL of grandparents but the effect of interaction between each factor was not identified. And this study, a cross-sectional survey research, should be careful to estimate temporal context and causal relationship.

However, this study provides concrete evidence for the development of a multilevel intervention program to improve the QoL of grandparents caring for their grandchildren by verifying objective community variables that affect the QoL of grandparents. In addition, as the multi-level analysis method using ecological models is useful for the statistical analysis of the hierarchically established data such as individuals and organizations, it can be said that the utilization is high in the future.

CONCLUSION

This study is a secondary data analysis research that investigates factors affecting the QoL of grandparents caring for grandchildren using the data of the Korean Longitudinal Study of Aging (KLoSA). From the results of this study, the QoL of grandparents was 62.63, similar to those of previous studies, but there were regional differences. Individual level factors affecting the QoL of grandparents were subjective health status, household gross income, religious gatherings, and travel or outings last year, and the community level factor was the number of children's parks per 100,000 population. This study is meaningful in that by utilizing multi-level analysis, differences in not only individual characteristics but also regional characteristics about the QoL of grandparents are identified.

Based on the results of this study, the following suggestions are to be made. First, to improve the QoL of grandparents, it is necessary to maintain physical and mental health. In this regard, considering the subjective health status and the number of children's parks in the community have a significant effect on the QoL of grandparents, it is necessary to provide the grandparents who take care of their grandchildren with the opportunity to exercise regularly. On the whole, it is possible to increase the number of facilities such as children's parks in the community, or to find out how to install sports facilities that can be used by grandparents near the childcare center. Also, public health centers and welfare centers should give direct-indirect effects to improve physical and mental health and the QoL of grandparents by providing exercise programs that allow grandchildren and grandparents to work together regularly and programs that enhance mental health and cognitive function. Second, as grandparents' leisure activities should be considered as an important factor for improving the QoL, it is necessary to increase opportunities of participation and encourage and support their participation at family and national level. As the QoL of grandparents caring for their grandchildren is important not only in terms of individual matters but also is an important factor affecting the QoL of their family members and national economic activities and birth rate, the national government needs to make actively effort to improve their QoL.

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