保健敎育 · 健康增進學會誌 第21卷, 第4號(2004. 12)
Journal of Korean Society for Health Education and Promotion
Vol. 21, No. 4, 2004, pp.75-97

Regional Contextual Factors and Self-Rated Health: a Multilevel Study of Korean Adults

Sang Gyu Lee

Department of preventive medicine and public health, College of medicine, Dankook university

CONTENTS

Ⅰ. Introduction

Geographic variations in health status of their residents have been described in numerous studies (Kitagawa and Hauser 1973; Britton 1990; Carstairs and Morris 1991; Senior 2000) and Korean studies also have shown theses geographic differences (Lee 2003; Han 2001; Chung 1991). In the meantime, many efforts have been made in the identification of factors responsible for the geographic differences in health status (Bentham 1984; Shouls et al 1996; Curtis and Jones 1998). However, little knowledge is presently available about what factors affect a resident's health status and what mechanisms are involved.

From the 1990s, several researchers have been trying to divide the health determinants generating health disparity between geographic locations into two kinds of effects: compositional effects and contextual effects (McIntyre and Ellaway 2000). The former suggests that the disparity of health status between geographic locations is attributable to the differences in individual characteristics. Specifically, the health status of one location

* The present research was conducted by the research fund of Dankook university in 2003.

Corresponding author: Sang Gyu Lee, San 29, Anseo-dong, Cheonan, Choongnam, Korea (330-714)
Tel: 82-41-550-3071, E-mail: leevan@dankook.ac.kr

is worse than that of other because the people with many predisposing or risk factors for diseases are likely to move to and/or live together in that location. Meanwhile, the contextual effect suggests that the unique social and physical environment of the location influences the health status of residents living in the location by a contextual effect itself or by interacting with the compositional effect. That is to say, two people will have different health status if they reside in different places, even though they have the same individual characteristics, including genetic factors, lifestyle, and socioeconomic status.

This differentiation has a very important implication for health policies including the health promotion policy. If the disparity of health status between geographic locations is mainly attributable to individual characteristics (compositional effects), a health policy focused on the individual in the residence should be planned and implemented. On the contrary, if contextual effect plays the key role in the disparity, other more macro approaches to health policies may be needed.

But, the data used in this kind of research usually has a hierarchical structure. Individual residents are grouped into their residing regions and there exists two or more different levels in the data structure. That is, individuals may be the level 1 units clustered within their residential regions, usually the county, that are the level 2 units and the regions may grouped into the provincial units that comprise level 3 and so on. Once groupings are established, even if their establishments are effectively random, they will tend to become differentiated, and this differentiation implies that the group and its members both influence and are influenced by the group membership. To ignore this relationship risks overlooking the importance of group effects, and may also render invalid many of the traditional statistical analysis techniques used for studying data relationships (Goldstein 1995).

In the 1980s a number of researchers began to see how to introduce systematic approaches to the statistical modelling and analysis of hierarchically structured data (Aitkin et al 1981; Aitkin and Longford 1986) and, by the early 1990s, a core set of established techniques and software packages such as MLwiN (Rashbash 2000) could be applied routinely. In this sense, this study examined the independent effects of individual compositional factors and regional contextual factors to the self-rated health of Korean adults with a multilevel statistical analysis.

Ⅱ. Methodology

1. Study data

A linked data set including information on individuals from raw data of the 1998 Korean National Health and Nutrition Survey (KNHNS) and information on the regions where the individuals lived from data contained in "Major statistical indices of *Si-Gun-Gu* (city-county-ward)" published by Korean Statistical Office(2000) was established.

1) Individual level data

The 1998 KNHNS consists of 4 surveys that are the health interview survey, the health belief and behavior survey, the nutrition survey, and the health examination survey. The health belief and behavior survey was conducted for both adults over 19 years old (survey Ⅰ) and adolescents between 10 and 19 (survey Ⅱ). In this study, the data from the health belief and behavior survey for adults over 19 years (survey Ⅰ, n=8,823) and data from their health interview survey were used as individual

Table 1. Individual level variables used in this study

Variable		Description	Source
Self-rated health		0. Good 1. Bad	Health belief and behavior survey (I)
Demographic	Age	real value (years old)	Health interview survey
	Sex	1. men 2. women	
	Residence	address of administrative districts	
Socioeconomic	Education (years)	1. Over 12 2. 10-12 3. 7-9 4. 6 and below	Health interview survey
	Household income per month (thousand won)	1. 1,500 and over 2. 1,000-1,490 3. 500-990 4. less than 500	Health interview survey
Helath belief and behavior	Smoking	1. Non-smoker 2. Ex-smoker 3. Light smoker 4. Heavy smoker	Health belief and behavior survey (I)
	Alcohol	1. Non or Ex-drinker 2. Mild drinker 3. Moderate drinker 4. Heavy drinker	Health belief and behavior survey (I)
	Stress feeling	1. seldom 2. sometimes 3. often 4. very often	Health belief and behavior survey (I)

level data. Of these 8,823 people, 875 people with whom the corresponding regional data could not be matched because of changes in administrative districts were excluded, and another 5 people whose monthly household income unknown were also excluded. So, the study subject was comprised with 7,943 people living in 232 administrative districts. The individual level variables used in this study are shown in Table 1.

2) Regional level data

"Major statistical indices of *Si-Gun-Gu*" (Korean Statistical Office 2000) contains 81 kinds of statistical indices under 10 categories

Table 2. Regional socioeconomic indices used in this study

Category	Index	Description
Land/ Population	Resident registration population	Resident registration population
	Population density	persons / cubic kilometers
	Birth	No. of birth per 1,000 person
	Death	No. of death per 1,000 person
	Marriage	No. of marriage per 1,000 person
	Divorce	No. of divorce per 1,000 person
	Moving in	No. of moving in per 1,000 person
	Moving out	No. of moving out per 1,000 person
	Elderly percent	No. of elderly people ($\geq$65) / resident population
Agriculture	Farming household	No. of farming household / entire households
	Farming population	No. of farmers / resident population
	Area under cultivation	Per capita area under cultivation
Manufacturing industry	Manufacturing company	No. of manufacturing companies per 1,000 person
	Manufacturing employment	No. of manufacturing employment / resident population
	Manufacturing production	Per capita production from manufacturing industries
Housing/ Construction	Townhouse	No. of townhouses / entire houses
	Apartment	No. of apartments / entire houses
	Tenement house	No. of tenement houses / entire houses
	Owner occupied household	No. of owner occupied household / entire household
	Deposit basis lease household	No. of deposit basis lease household / entire household
	Monthly rent household	No. of monthly rent household / entire household
	Area of park	Per capita area of parks
	Length of roads	Per capita length of roads
	Population with water supply	Population with water supply / resident population
	Amount of water supplied	Per capita amount of water supplied
Transportation/ Communication	Cars	No. of cars per 100 person
	Privately owned cars	No. of privately owned cars per 100 person
Banking/ Service industry	Banks	No. of banks per 1,000 person
	Restaurant	No. of restaurant per 1,000 person
Health/Welfare	Medical institution	Number of hospitals and clinics per 1,000 person
	Physician	Number of physicians per 1,000 person
Education/Culture	Public library	No. of public library per 1,000 person
Public finance/ Public administration	Collected amount of local taxes	Collected amount of local taxes
	Share of local taxes	Per capita amount of local taxes
	General account expenditure	Expenditure from general account
	Financial independency rate	Financial independency rate

for all 232 basic administrative districts (*Si-Gun-Gu*) of Korea. In this study, 36 indices of 1998 under 9 categories were selected as basic regional level data (Table 2).

As it was anticipated that many regional variables would be interrelated, original variables were reduced to a number of significant factors through an factor analysis and the factor scores of each factor for all districts were retrieved. Then all the 232 districts were ranked according to their factor scores for each factor. That is, for each factor, the district with the highest factor score was ranked as 1st and with the lowest factor score as 232nd. And then all the districts were categorized into 5 groups according to rank as 1)highest 20%, 2)high 20%, 3)middle 20%, 4)low 20%, and 5)lowest 20% for each factor. So, factor score group variables (1 ~ 5) were generated for each factor and were used as regional level data.

3) Linkage of individual and regional level data

The regional level data, factor score groups for each factor, were linked with individual level data using the individual residential address (administrative districts) as an index.

2. Statistical Analysis

1) Univariate analysis

To investigate the relationship between self-rated health and other individual and regional variables, chi-square tests were done using SAS version 8.02.

2) Multilevel analysis

To examine the independent effects of individual compositional factors and regional contextual factors considering the hierarchical data structure, multilevel logistic regression analysis was conducted using MLwiN version 1.10 (Rashbash 2000). Individual level data were designated as the level 1 and regional data as level 2.

Ⅲ. Results

1. Conceptualization of factors

From the factor analysis, seven factors had Eigenvalues greater than 1.0 and 82.6% of the original variability in basic regional data could accounted for with these seven factors. Of these seven factors, four factors that had relatively high accountability were selected and they accounted for 71.9% of the original variability. The rotated factor patterns of regional socioeconomic indices are shown in Table 3.

Factor loadings greater than 0.5 are shaded in Table 3 and each factor was conceptualized as follows. As can be seen in Table 3, factor 1 seems to reflect the degree of urbanization reversely. So, more urbanized regions have

Table 3. Rotated factor patterns of regional socioeconomic indices

Index	Factor 1	Factor 2	Factor 3	Factor 4
Resident registration population	-0.68287	-0.07252	-0.06186	0.61297
Persons / cubic kilometers	-0.61836	0.18626	-0.18434	-0.01487
No. of birth per 1,000 person	-0.65628	-0.18430	0.46343	0.20176
No. of death per 1,000 person	0.94366	-0.08975	-0.11383	-0.17413
No. of marriage per 1,000 person	-0.71474	0.01373	0.36254	0.19651
No. of divorce per 1,000 person	-0.81677	0.16244	0.22846	-0.05868
No. of moving in per 1,000 person	-0.78998	0.06602	0.10926	0.26432
No. of moving out per 1,000 person	-0.85011	0.22438	0.00760	0.15917
No. of elderly people ($\geq$65) / resident population	0.94245	-0.06741	-0.16107	-0.13571
No. of farming household / entire households	0.93499	-0.18166	-0.00654	-0.03058
No. of farmers / resident population	0.93687	-0.17790	-0.02840	-0.03864
Per capita area under cultivation	0.90690	-0.17367	-0.07025	-0.03269
No. of manufacturing companies per 1,000 person	-0.03711	0.31539	0.77458	-0.02536
No. of manufacturing employment / resident population	-0.09854	0.00326	0.95447	0.00584
Per capita production from manufacturing industries	-0.09792	-0.08031	0.84356	0.06290
No. of townhouses / entire houses	0.90319	-0.00159	-0.06054	-0.27268
No. of apartments / entire houses	-0.82375	-0.04626	-0.00429	0.33091
No. of tenement houses / entire houses	-0.64599	-0.02368	0.17395	0.05546
No. of owner occupied household / entire household	0.86976	-0.19403	-0.08861	-0.07552
No. of deposit basis lease household / entire household	-0.77967	0.19985	-0.00679	0.05723
No. of monthly rent household / entire household	-0.71820	0.30408	0.04569	-0.06627
Per capita area of parks	-0.03647	-0.03148	-0.01021	-0.08942
Per capita length of roads	0.75026	-0.10151	-0.13628	-0.18991
Population with water supply / resident population	-0.78794	0.34881	-0.09248	0.03847
Per capita amount of water supplied	-0.20637	-0.01698	0.03181	0.09661
No. of cars per 100 person	-0.31729	0.27892	0.53603	0.22557
No. of privately owned cars per 100 person	-0.67911	0.22253	0.36762	0.33337
No. of banks per 1,000 person	-0.18483	0.90093	0.09497	0.09918
No. of restaurant per 1,000 person	0.05498	0.80002	0.18038	-0.15259
Number of hospitals and clinics per 1,000 person	-0.37492	0.81115	-0.05667	0.07519
Number of physicians per 1,000 person	-0.21607	0.84378	-0.06934	0.00800
No. of public library per 1,000 person	0.41843	0.06142	-0.22613	-0.15864
Collected amount of local taxes	-0.49707	0.34871	0.08306	0.70178
Per capita amount of local taxes	-0.14186	0.66279	0.24878	0.23521
Expenditure from general account	-0.10820	-0.04341	0.05133	0.87126
Financial independency rate	-0.68353	0.23852	0.26871	0.52729

lower factor scores and less urbanized regions have higher factor scores. Factor 2 seems to reflect the abundance of regional service and medical facilities and factor 3 seems to reflect the regional dependence on manufacturing industry. Factor 4 seems to reflect the scale of the regional government.

2. General characteristics of study subjects and their self-rated health

General characteristics of 7,943 study subjects and their self-rated health are shown in Table 4. Overall, 23.5% of subjects had been reported that their health were bad and women had a higher tendency (28.9%) to report their health as bad than men (17.2%).

Table 4. General characteristics of study subjects and their self-rated health

	Category	Persons (%)	Self-rated health		p-value*
			Good (%)	Bad (%)	
Age	20-39	3,566 (44.9)	3,130 (87.8)	436 (12.2)	0.001
	40-59	2,867 (36.1)	2,080 (72.6)	787 (27.4)	
	60 and over	1,510 (19.0)	870 (57.6)	640 (42.4)	
Sex	Men	3,693 (46.7)	3,059 (82.8)	634 (17.2)	0.001
	Women	4,250 (53.5)	3,021 (71.1)	1,229 (28.9)	
Smoking	Non-smoker	4,473 (56.3)	3,347 (74.8)	1,126 (25.2)	0.001
	Ex-smoker	709 (8.9)	541 (76.3)	168 (23.7)	
	Light smoker	155 (2.0)	121 (78.1)	34 (21.9)	
	Heavy smoker	2,606 (32.8)	2,071 (79.5)	535 (20.5)	
Alcohol	Non or ex-drinker	2,685 (33.8)	1,758 (65.5)	927 (34.5)	0.001
	Light drinker	1,470 (18.5)	1,170 (79.6)	300 (20.4)	
	Moderate drinker	2,410 (30.3)	2,039 (84.6)	371 (15.4)	
	Heavy drinker	1,378 (17.4)	1,113 (80.8)	265 (19.2)	
Stress	Seldom	1,321 (16.6)	1,083 (82.0)	238 (18.0)	0.001
	Sometimes	3,722 (46.9)	3,087 (82.9)	635 (17.1)	
	Often	2,370 (29.8)	1,622 (68.4)	748 (31.6)	
	Very often	530 (6.7)	288 (54.3)	242 (45.7)	
Education	Over 12 years	1,801 (22.7)	1,624 (90.2)	177 (9.8)	0.001
	10-12 years	2,769 (34.9)	2,331 (84.2)	438 (15.8)	
	7-9 years	1,113 (14.0)	816 (73.3)	297 (26.7)	
	6 years and below	2,260 (28.5)	1,309 (57.9)	951 (42.1)	
Household income per month (thousand won)	1,500 and over	3,273 (41.2)	2,714 (82.9)	559 (17.1)	0.001
	1,000-1,490	1,883 (23.7)	1,499 (79.6)	384 (20.6)	
	500-990	1,548 (19.5)	1,117 (72.2)	431 (27.8)	
	less than 500	1,239 (15.6)	750 (60.5)	489 (39.5)	
Total		7,943(100.0)	6,080 (76.5)	1,863 (23.5)	

* Results from x^2 test

For education and economy, less educated or poorer individuals showed a higher tendency in reporting bad health.

3. Regional socioeconomic factors and their residents' self-rated health

The relationships between factor scores of districts and their residents' self-rated health are shown in Table 5. There were significant differences of self-rated health status according to factor score groups of each factor but could not find a certain trend except for factor 1 reflecting the urbanization.

4. Individual compositional effects on self-rated health: multilevel analysis

The results of the multilevel logistic regression analysis are shown in Table 6 and Table 7. The regional level variance was 0.033±0.017 after taking account of compositional factors in the model. Since the individual level variance was assumed 1.0 in the model, 3.2% of variability of self-rated health was attributed to the contextual factors. Table 6 shows the independent effects of individual level variables on self-rated health after controlling regional level variables in the

Table 5. Regional socioeconomic factors and their residents' self-rated health

	Factor score group*	Persons (%)	Self-rated health		p-value**
			Good (%)	Bad (%)	
Factor 1 Urbanization	1	827 (10.4)	545 (65.9)	282 (34.1)	0.001
	2	879 (11.1)	623 (70.9)	256 (29.1)	
	3	1,759 (22.1)	1,342 (76.3)	417 (23.7)	
	4	2,240 (28.2)	1,753 (78.3)	487 (21.7)	
	5	2,238 (28.2)	1,817 (81.2)	421 (18.8)	
Factor 2 Service & medical facilities	1	1,426 (17.9)	1,137 (79.7)	289 (20.3)	0.001
	2	1,086 (13.7)	845 (77.8)	241 (22.2)	
	3	1,547 (19.5)	1,124 (72.7)	423 (27.3)	
	4	1,848 (23.3)	1,385 (75.0)	463 (25.0)	
	5	2,036 (25.6)	1,589 (78.1)	447 (21.9)	
Factor 3 Manufacturing industry	1	1,666 (21.0)	1,278 (76.7)	388 (23.3)	0.005
	2	1,725 (21.7)	1,299 (75.3)	426 (24.7)	
	3	1,134 (14.3)	846 (74.6)	288 (25.4)	
	4	1,784 (22.5)	1,351 (75.7)	433 (24.3)	
	5	1,634 (20.6)	1,306 (79.9)	328 (20.1)	
Factor 4 Scale of regional government	1	2,808 (35.4)	2,208 (78.6)	600 (21.4)	0.001
	2	1,474 (18.6)	1,072 (72.7)	402 (27.3)	
	3	1,484 (18.7)	1,095 (73.8)	389 (26.2)	
	4	1,286 (16.2)	996 (77.5)	290 (22.5)	
	5	891 (11.2)	709 (79.6)	182 (20.4)	
Total		7,943(100.0)	6,080 (76.5)	1,863 (23.5)	

* 1. highest 20%, 2. high 20%, 3. middle 20%, 4. low 20%, and 5. lowest 20%
** Results from x^2 test

multilevel analysis model. With one year increase of age, there was a 2.3% of increase of risk of reporting bad self-rated health, and women had about two times greater risk than men. In relation to health behaviors, more smoking yielded poorer health, but alcoholic drinkers showed relatively good health than non or ex-drinkers. Less educated or poorer individuals showed higher risk of reporting bad health as expected.

5. Regional contextual effects on self-rated health: multilevel analysis

The main results of this study are shown in Table 7. For factor 1 which reflects the urbanization reversely, the residents who lived in the group 2, 3, 4 regions had a significant higher risk of reporting bad self-rated health compared to the most urbanized regions' residents (group 5). But, the least urbanized regions' residents didn't

Table 6. Individual compositional effects on self-rated health: multilevel analysis**

		Category	Odds ratio	95% CI	Test for trend	
					Odds ratio	95% CI
Compositional factors	Age		1.023*	1.020 - 1.026		
	Sex	Women	1.000			
		Men	0.492*	0.447 - 0.542		
	Smoking	Non-smoker	1.000		1.151*	1.115-1.189
		Ex-smoker	1.442*	1.271 - 1.636		
		Light smoker	1.732*	1.384 - 2.166		
		Heavy smoker	1.597*	1.445 - 1.765		
	Alcohol	Non or ex-drinker	1.000		0.829*	0.803-0.855
		Mild drinker	0.757*	0.695 - 0.825		
		Moderate drinker	0.582*	0.536 - 0.632		
		Heavy drinker	0.640*	0.580 - 0.707		
	Stress feeling	Seldom	1.000		1.908*	1.840-1.978
		Sometimes	1.721*	1.568 - 1.889		
		Often	3.629*	3.304 - 3.987		
		Very often	6.178*	5.447 - 7.008		
	Education	Over 12 years	1.000		1.416*	1.362-1.473
		10-12 years	1.470*	1.331 - 1.623		
		7-9years	2.286*	2.036 - 2.568		
		6 years and below	2.821*	2.494 - 3.190		
	Household income per month (thousand won)	1,500 and over	1.000		1.094*	1.063-1.126
		1,000-1,490	1.103*	1.017 - 1.196		
		500-990	1.166*	1.073 - 1.269		
		less than 500	1.328*	1.213 - 1.455		

* p-value < 0.05
** adjusted for regional level variables

show the significant difference (Figure 1). For factor 2 which reflects the abundance of regional service and medical facilities, when factor scores were decreased, a significant increasing trend of risk was found and the residents of two lower groups (group 4, 5) had significant increased risk of bad health compared to individuals who lived in regions that had the most abundant service and medical facilities (Figure 2). For factor 3 reflecting regional dependence on manufacturing industry, residents of group 2, 3, 4, 5 regions showed significant higher risk of bad health compared to residents of the most manufacturing industry dependent regions (Figure 3). Finally, for factor 4 which reflects the scale of the regional government, the residents under mid-scale regional government (group 3) had reported the poorest health and residents under the largest (group 1) or smallest (group 5) scale regional governments showed better health (Figure 4).

Table 7. Regional contextual effects on self-rated health: Multilevel analysis**

		Group	Odds ratio	95% CI	Test for trend	
					Odds ratio	95% CI
Contextual factors	Factor 1 Urbanization	1. Highest	1.042	0.919 - 1.182	0.982	0.954-1.011
		2. High	1.213*	1.069 - 1.376		
		3. Middle	1.318*	1.184 - 1.467		
		4. Low	1.223*	1.105 - 1.353		
		5. Lowest	1.000			
	Factor 2 Service & medical facilities	1. Highest	1.000		1.096*	1.067-1.126
		2. High	1.088	0.964 - 1.228		
		3. Middle	1.114	0.994 - 1.249		
		4. Low	1.347*	1.212 - 1.498		
		5. Lowest	1.418*	1.262 - 1.592		
	Factor 3 Manufacturing industry	1. Highest	1.000		1.029*	1.005-1.054
		2. High	1.257*	1.129 - 1.401		
		3. Middle	1.202*	1.060 - 1.363		
		4. Low	1.358*	1.217 - 1.516		
		5. Lowest	1.134*	1.018 - 1.264		
	Factor 4 Scale of regional government	1. Highest	0.828*	0.749 - 0.915	0.981	0.957-1.006
		2. High	0.901*	0.818 - 0.993		
		3. Middle	1.000			
		4. Low	0.813*	0.732 - 0.903		
		5. Lowest	0.736*	0.652 - 0.830		

* p-value < 0.05
** adjusted for individual level variables

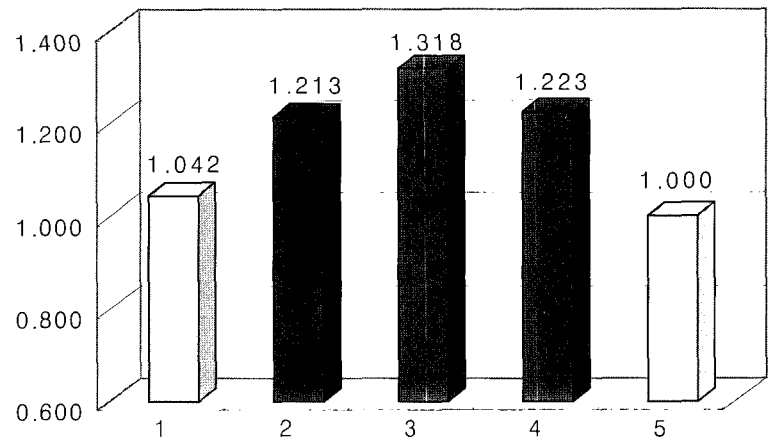

Figure 1. Risk of bad self-rated health according to Factor 1
(1. Least urbanized - 5. Most urbanized)
* shaded bars indicate p-value < 0.05

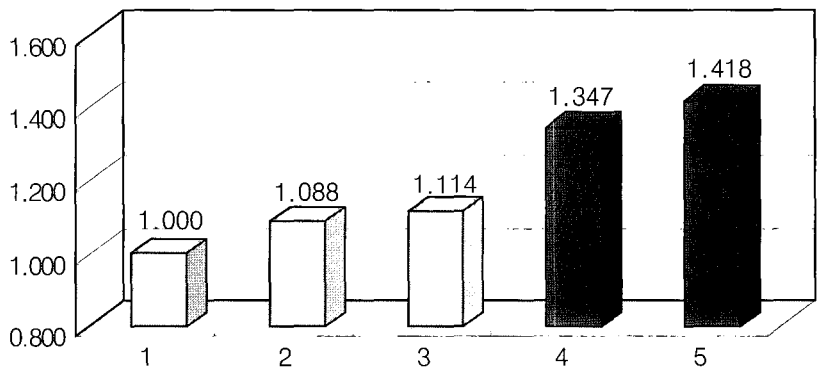

Figure 2. Risk of bad self-rated health according to Factor 2
(1. More service & medical facilities - 5. Less service & medical facilities)
* shaded bars indicate p-value < 0.05

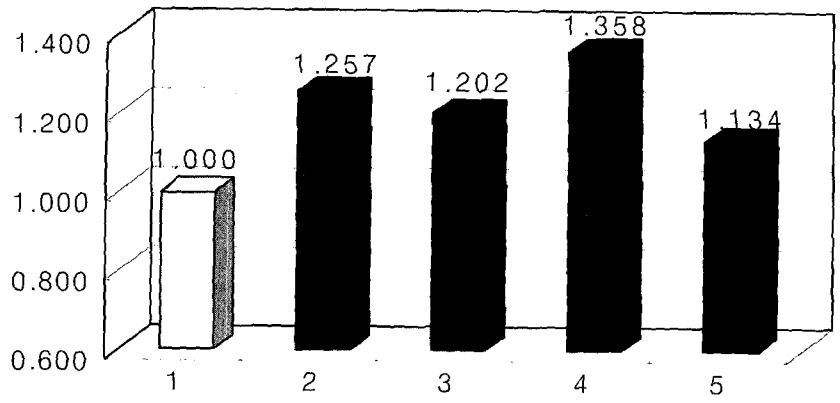

Figure 3. Risk of bad self-rated health according to Factor 3
(1. More manufacturing industries - 5. Less manufacturing industries)
* shaded bars indicate p-value < 0.05

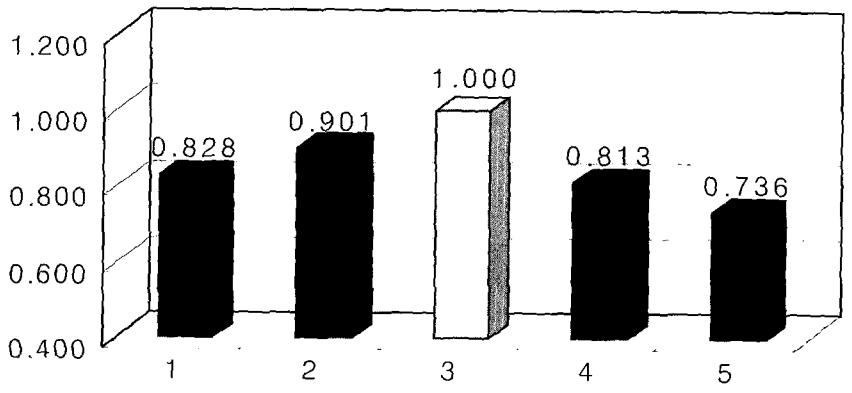

Figure 4. Risk of bad self-rated health according to Factor 4
(1. Bigger regional government - 5. Smaller regional government)
* shaded bars indicate p-value < 0.05

Ⅳ. Discussion

1. Discussion for study methods

Self-rated health status was used as an dependent variable in this study. Self-rated health is a commonly used outcome measure in health surveys and health research, particularly in studies in which other forms of health information are lacking. The strength of this measure lies in its predictive value of health outcomes, especially survival (Baron-Epel, Shemy, and Carmel 2004; Heistaro et al 2001; Burstrom and Fredlund 2001; Idler and Benyamini 1997; Appels et al 1996; Idler and Angel 1990). Moreover, studies using a follow-up design show that poor self-rated health is a good predictor of subsequent greater disability (Idler and Kasl 1995; Kaplan et al 1993; Mor et al 1994), morbidity (Ferraro, Farmer, and Wybraniec 1997; Shadbolt 1997), and utilization of medical care (Miilunpalo et al 1997; Idler 1993).

Since this study used the cross sectional data of 1998, there exist certain limitations to draw an inference about the causal relationship from the results. When we want to examine the effects of regional socioeconomic factors on regional health status, we should consider the lag time during which regional factors affect health status. So, it may be more appropriate to see the relations between the health status at a certain time and the socioeconomic factors at some time earlier, but still very limited information about how long the lag time is known. In relation to this matter, Blakely et al (2000) reported that the regional income inequality up to 15 years previously might be more strongly associated with self-rated health than measured contemporaneously for people aged 45 years and older, although not conclusive.

The regional data used in this study were generated through the factor analysis of various regional socioeconomic indices. McIntyre and Ellaway (2000) proposed five types of features of local areas which might influence health: 1) physical features of the environment shared by all residents in a locality, 2) availability of healthy environment at home, work, and play, 3) services provided, publicly or privately, to support people in their daily lives, 4) sociocultural features of a neighborhood, 5) the reputation of an area. As can be seen previously, this study did not contain the 4th and 5th type of regional variables that McIntyre proposed. Moreover, to reflect the regional socioeconomic status more accurately, serial data that could show the change of each indices would be more desirable, but this study used data all collected in 1998. Measuring regional level variables at one point in time ignores potential effects of stability and change in a given community

on the health of individual residents (Sampson 1991).

Most of the methodological limitations of this study have most likely led to an underestimation of regional level effects on health (Robert 1998). First, the effects of regional level variables on self-rated health may have been underestimated in this study because this study could not fully consider how long people lived in their communities. People living in a community for a long time are more exposed to their community than people who recently moved there. Those exposed for longer periods are probably more likely to have their health affected by their community's characteristics. The second is related to the measures of community boundaries. The administrative districts (*Si-Gun-Gu*) used in this study do not necessarily correspond with the self-defined communities of individual respondents. Though physical and service environments may be more appropriately characterized at these administrative districts, the social patterns of individuals often do not correspond with these areas. Some individuals may have social networks and interactions that are bounded within a very small neighborhood area (such as *Eup-Myun-Dong*), while the social patterns of others may transcend large geographical boundaries. Third is about the possibility of over-controlling. For example, if regional level variables affect one's education or income level, then controlling for individual level education and income in this study may have over-controlled for any indirect effects of regional level variables on health through education and income.

2. Discussion for study results

It is true that interest in geographical variations in health has a long history (Barrett 2000), but the importance given to the examination of area differences has varied over the years. With few exceptions, the focus on individual-level risk factors over the past few decades was generally associated with little interest in area characteristics (Diez Roux 2001). However, the notion that "place" may be important to health reemerged in a handful of publications in the 1980s and early 1990s (Jones and Duncan 1995; Diehr et al 1993; Humphreys and Carr-Hill 1991; Carstairs and Morris 1989; Haan, Kaplan, and Camacho 1987), and interest has increased sharply in recent years. So, numerous reports on regional contextual effects in self-rated health using multilevel techniques have recently appeared (Stafford et al 2004; Lopez 2004; Browning, Cagney, and Wen 2003; Patel et al 2003; Blakely, Lochner, and Kawachi 2002; Reijneveld 2002; Subramanian, Kim, and Kawachi 2002; Subramanian, Kawachi, and Kennedy 2001; Reijneveld 1998).

Although many authors caution that the finding of apparent contextual effects may be due to unmeasured individual characteristics, imprecision of measurement, misspecification of models or residual confounding (Davey Smith et al. 1998; Diez-Roux et al 1997; Hart et al. 1997; Humphreys and Carr-Hill 1991), most conclude that contextual influences may be real and not simply statistical artifacts. But it is also true that previous researches showed that regional contextual effects on their residents' health were relatively small (Humphreys and Carr-Hill 1991; Duncan et al. 1993; Rice et al. 1998; Jones et al. 2000). Robert (1998) argued that this relatively weak association between regional level socioeconomic indices and health may be masking stronger associations for subgroups of the population. For example, gerontological research suggests that the regional environment may be more important to the lives of older adults than those of younger adults and the health of the poor population is more susceptible to the socioeconomic environments (Marmot and Wilkinson 2000). If so, regional level socioeconomic status may be a particularly salient predictor of health for older adults or poor people, as compared to younger adults or rich people.

This study showed that residents who lived in regions with mid-range urbanization had a higher risk of bad health compared to the most urbanized regions' residents after controlling the individual level variables. Although the differentiation between city and rural area is somewhat arbitrary, most of the foreign studies, mainly conducted in European countries, of the difference of health status between city and rural area have shown that the health status of the rural region is better than that of the urban region (Britton et al 1990; Carstairs and Morris 1991; Fox and Goldblatt 1982), while some studies (Bentham 1984) have reported that the residents of outer cities or rural towns had the highest health status and the residents of deep rural or inner cities the lowest. Senior et al (2000) reported that when the geographic location was subdivided into more detail, such as deep rural, rural, rural town, small town, large town, and city, it was the deep rural and city which showed the highest health status, and the small and large towns which showed the lowest health status and this finding corresponds with this study. Summarizing these results, the relationship between health status and urbanization may not seem to be linear (Bentham 1984). Such a nonlinear relationship indicates that the socioeconomic factors affecting the health status of residents operate with different mechanisms or degree according to the geographic locations (Shouls et al 1996). Curtis and Jones (1998) pointed out that the

socioeconomic factors affecting the rural residents' health status could operate either positively or negatively, and that these factors did not show the same effects in all rural areas, so the characteristics of each region and the balance between positive and negative effects should be considered (Table 8).

For example, lower levels of industrial and traffic pollution are balanced against other forms of pollution from agricultural activity. The tranquillity, social support and cohesion of rural social life needs to be set against the problems of lack of stimulation, tensions between long-term residents and newer and sometimes less permanent 'incomers', and socal isolation and exclusion which can develop in small communities. Naturally, these balancing and interacting aspects may be different according to the characteristics of each community and, of course, between countries due to the sociocultural settings of their own. Perhaps the different findings between existing studies conducted in European countries and several Korean studies, including this one may be due to the difference of this balance and the interactions among such positive and negative factors and sociocultural settings.

For factor 2 reflecting regional service and medical facilities, a significant increasing trend of risk of bad health was found when the number of facilities decreased and the residents whose community had the lower or the lowest number facilities had significant increased risk compared to the individuals who had the most abundant service and medical facilities in their communities. The services provided, publicly or privately, to support people in their daily lives including medical services are one of the most commonly proposed regional socioeconomic factors that affect the residents' health

Table 8. Health experience of rural areas: theoretical frameworks

Type of landscape	Health advantage	Health disadvantage
Ecological landscapes	· lower industrial pollution	· pollution by agricultural industry
Materialist landscape	· cheaper, less crowed accommodation	· lack of employment opportunities · limited housing stock · housing lacking amenities · lack of personal mobility
Landscapes of consumption	· better access to green space · cheap 'at source' food outlets	· lack of public transportation · lack of access to facilities
Therapeutic landscapes	· the rural idyll · tranquillity · natural settings	· social isolation · lack of cultural stimulation

Source : Curtis and Jones 1998

(McIntyre and Ellaway 2000; Curtis and Jones 1998). But little evidence supports the hypothesis that the increase of a region's health resources directly affects their residents' health status. McIntyre et al. (1993) described that health services may not be a major determinant of variations in healh status between areas, but, inaccessible or poorly resourced local health services may be an additional stressor for people already stressed by other personal and local circumstances. McIntyre and Ellaway (2000) conceptualized the regional features including the features aggregated in the factor 2 of this study as "opportunity structures", that is, socially constructed and socially patterned features of the physical and social environment which may promote or damage health either directly or indirectly through the possibilities they provide for people to live healthy lives. The significant difference in health status according to factor 2 groups in this study may signify that the regional opportunity structures for the features contained in factor 2 interact with or indirectly affect the individual characteristics rather than directly affect the health status of an individual. Further researches are required to elucidate the relationship between these regional opportunity structures and the individual features in Korea.

According to the degree of regional dependence on the manufacturing industry (factor 3), all residents who lived in relatively less dependent regions showed significant higher risk of bad health compared to the most dependent regions. This also can be seen as the balance structure between positive and negative effects. As mentioned above, the socioeconomic factors affecting health status could operate either positively or negatively, and these factors did not show the same effects in all areas (Curtis and Jones 1998). The positive and negative aspects of the manufacturing industry may directly or indirectly influence individual health status with different mechanisms and magnitudes according to the degree of dependence. Factor 4 which reflects the scale of the regional government showed very similar patterns with factor 1 reflecting urbanization. This may mean that the two factors share some features of the community or certain common mechanisms are involved, but more detailed research about these are required.

It is true that most health promotion strategies have focused their efforts on individual behaviors (compositional effects), but, the idea of contextual effects is not new in the health promotion field (Peltomäki et al 2003; Janer et al 2002). This realization of contextual effects in the process of health promotion may give some meaningful suggestions to current health promotion strategies. Contemporary health promotion emphasizes a community-based approach, but

the evidence from the past 20 years indicates that many community-based programs have had only a modest impact (Merzel and Joanna 2003). Although health promotion is usually of the behavior of individuals, the fact is that behavior at the societal levels can also promote health and health promotion by individuals cannot be understood without an understanding of how the society affects the ability and the willingness of the individual to pursue health promotion (Abelin et al 1987). So, the integration of lifestyle modification, injury control, and environmental enhancement strategies of health promotion are substantial (Slokols 1992). Through the incorporation of contextual effects into health promotion strategies may broaden the strategic scope of health promotion from "strengthening individuals in disadvantaged circumstances" to "strengthening disadvantaged communities", "improving access to essential facilities and services", and "encouraging macro-economic and cultural change" (Picavet 2002). But, to make these approaches possible, more elaborate researches considering the sociocultural environments of Korea will be required.

V. Conclusion

From the above results, it is concluded that there exists regional contextual effects on the residents' health after controlling the individual compositional effects in Korea. But, to make policies to tackle these contextual effects possible, more elaborate researches to find more specific factors and to explain the mechanisms of how health is influenced by the contextual factors are needed.

(Received: Nov., 1, 2004; Accepted: Dec., 8, 2004)

References

Abelin T, Brzezinski ZJ, Carstairs VDL. Measurement in health promotion and protection. WHO. Regional Publications. European Series; No.22. Copenhagen: WHO Regional Office for Europe. 1987.

Aitkin M, Longford N. Statistical modeling in school effectiveness studies. Journal of the Royal Statistical Society 1986; A149:1-43.

Aitkin M, Anderson D, Jinde J. Statistical modeling of data on teaching styles. Journal of the Royal Statistical Society 1981;A144:148-61.

Appels A, Bosma H, Grabauskas V, Gostautas A and Sturmans F. Self-rated health and mortality in a Lithuanian and a Dutch population. Soc Sci Med 1996; 42(5): 681-9.

Baron-Epel O, Shemy G, and Carmel S. Prediction of survival: a comparison between two subjective health measures in an elderly population. Soc Sci Med 2004;58:2035-43.

Barrett FA. Finke's 1792 map of human diseases: the first world disease map? Soc Sci Med 2000;50:915-21.

Bentham G. Mortality rates in the more rural areas of England and Wales. Area 1984;16:219-26.

Blakely TA, Lochner K and Kawachi I. Metropolitan area income inequality and self-rated health--a multi-level study. Soc Sci Med, 2002;54(1):65-77.

Blakely TA, Kennedy BP, Glass R, and Kawachi I. What is the lag time between income inequality and health status? J Epidemiol Community Health 2000;54: 318-9.

Britton M. Mortality and geography: a review in the mid-1980s England and Wales. London: Office of Population Censuses and Surveys. 1990.

Britton M, Fox A, Goldblatt P, Jones K, and Rosato M. The influences of socio-economic and environmental factors on geographic variation in mortality. In: Britton M.(ed). Mortality and geography: a review in the mid-1980s England and Wales. London: Office of Population Censuses and Surveys: 1990, 57-78.

Browning CR, Cagney KA, and Wen M. Explaining variation in health status across space and time: implications for racial and ethnic disparities in self-rated health. Soc Sci Med 2003;57:1221-35.

Burstrom B and Fredlund P. Self rated health: Is it as good a predictor of subsequent mortality among adults in lower as well as in higher social classes? J Epidemiol Community Health 2001;55(11): 836-40.

Carstairs V and Morris R. Deprivation and health in Scotland. Aberdeen: Aberdeen University Press. 1991.

Carstairs V and Morris R. Deprivation and mortality: an alternative to social class? Community Med 1989;11:210-9.

Chung HK. A study on the impact of community-level characteristics on the mortality level. J Institute Health Environ Sci 1991;1(1):17-50.

Curtis S, and Jones IR. Is there a place for geography in the analysis of health inequality? Sociol Health Illness 1998; 20(5):645-72.

Davey Smith G, Hart C, Watt G, Hole D, and Hawthorne V. Individual social class, area-based deprivation, cardiovascular disease risk factors, and mortality: the Renfrew and Paisley study. J Epidemiol Community Health 1998;52:399-405.

Diehr P, Koepsell T, Cheadle A, Psaty BM, Wagner E, and Curry S. Do communities differ in health behaviors? J Clin Epidemiol 1993;46:1141-9.

Diez-Roux AV. Investigating neighborhood and area effects on health. Am J Public Health 2001;91:1783-9.

Diez-Roux AV, Nieto FJ, Muntaner C, Tyroler HA, Comstock GW, Shahar E, Cooper LS, Watson RL, and Szklo M. Neighborhood environments and coronary heart disease: a multilevel analysis. Am J Epidemiol 1997;146(1): 48-63.

Duncan C, Jones K and Moon G. Do places matter? A multi-level analysis of regional variations in health-related behaviour in Britain. Soc Sci Med 1993; 37(6):725-33.

Ferraro KF, Farmer MM, and Wybraniec JA. Health trajectories: long-term dynamics among black and white adults. J Health Soc Behav 1997;38(1):38-54.

Fox A and Goldblatt P. The longitudinal study: socio-demographic mortality differentials. OPCS Series L5.1. London: HMSO. 1982.

Goldstein H. Multilevel statistical models. 2nd ed. London: Arnold. 1995.

Haan M, Kaplan G, and Camacho T. Poverty and health: prospective evidenced from the Alameda County Study. Am J Epidemiol 1987;125:989-98.

Han SH. A study of regional difference of death structure in Korea. Master's thesis, Seoul national university school of public health. 2001

Hart C, Ecob R, and Davey Smith G. People, places and coronary heart disease risk factor: a multilevel analysis of the Scottish Heart Health Study archive. Soc Sci Med 1997;45:893-902.

Heistaro S, Jousilahti P, Lahelma E, Vartiainen E and Puska P. Self rated health and mortality: a long term prospective study in eastern Finland. J Epidemiol Community Health 2001; 55(4):227-32.

Humphreys K and Carr-Hill R. Area variations in health outcomes: artefact or ecology. Int J Epidemiol 1991;20(1): 251-8.

Idler EL and Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. J Health Soc Behav 1997;38(1):21-37.

Idler EL and Kasl S. Self-ratings of health: do they also predict change in functional ability? Soc Sci Med 1995;50(6): S344-53.

Idler EL. Age differences in self-assessments of health: age changes, cohort differences, or survivorship? J Gerontol 1993;48(6):S289-300.

Idler EL and Angel RJ. Self-rated health and mortality in the NHANES-I Epidemiologic Follow-up Study. Am J Public Health, 1990;80(4):446-52.

Janer G, Sala M, and Kogevinas M. Health promotion trials at worksites and risk factors for cancer. Scandinavian Journal of Work and Environmental Health

2002;28:141-157.

Jones K, Gould MI and Duncan C. Death and deprivation: an exploratory analysis of deaths in the health and lifestyle survey. Soc Sci Med 2000;50(7-8):1059-79.

Jones K and Duncan C. Individuals and their ecologies: analysing the geography of chronic illness within a multilevel modelling framework. Health Place 1995;1(1):27-40.

Kaplan GA, Strawbridge WJ, Camacho T, and Cohen RD. Factors associated with change in physical functioning in the elderly: a six-year prospective study. J Aging Health 1993;5:40-53.

Kitagawa EM and Hauser PM. Differential mortality in the United States. Cambridge: Harvard university press; 1973, 114-150.

Korean Statistical Office. Major statistical indices of Si-Gun-Gu. Seoul: Korean Statistical Office. 2000.

Lee SG. Korean regional mortality differences according to geographic location. J Korean Society for Health Education and Promotion 2003;20(4): 51-65.

Lopez R. Income inequality and self-rated health in US metropolitan areas: a multi-level analysis. Soc Sci Med 2004;59(12):2409-19.

Marmot M, and Wilkinson RG. Social determinants of health. New York: Oxford University Press. 2000.

McIntyre S, and Ellaway A. Ecological approaches: rediscovering the role of the physical and social environment. In: Berkman LF, Kawachi I. (ed). 2000. Social epidemiology. New York: Oxford University Press: 2000, 332-48.

McIntyre S, Maciver S, and Sooman A. Area, class and health: should we be focusing on places or people? J Soc Policy 1993; 22(2):213-34.

Merzel C, Joanna D. Reconsidering community-based health promotion: Promise, performance, and potential. Am J Pub Health 2003;93(4):557-574.

Miilunpalo S, Vuori I, Oja P, Pasanen M, and Urponen H. Self-rated health status as a health measure: the predictive value of self-reported health status on the use of physician services and on mortality in the working-age population. J Clin Epidemiol 1997;50(5):517-28.

Mor V, Wilcox V, Rakowski W, and Hiris J. Functional transitions among the elderly: patterns, predictors, and related hospital use. Am J Pub Health 1994; 84(8):1274-80.

Patel KV, Eschbach K, Rudkin LL, Peek MK, and Markides KS. Neighborhood context and self-rated health in older Mexican Americans. Ann Epidemiol 2003;13(9):620-8.

Peltomäki P et al. Social context for workplace health promotion: feasibility considerations in Costa Rica, Finland,

Germany, Spain and Sweden. Health Promotion International 2003;18(2): 115-126.

Picavet HSJ. Perspectives on health inequity. J Epidemiol Community Health 2002; 56(1):80.

Rasbash J. Browne I, Goldstein H, Yang M, Plewis I, Healy M, Woodhouse G, Draper K, Langford I, and Lewis T. A user's guide to MLwiN. London: Center for Multilevel modelling, Institute of education, University of London. 2000.

Reijneveld SA. Neighbourhood socioeconomic context and self reported health and smoking: a secondary analysis of data on seven cities. J Epidemiol Community Health 2002; 56(12):935-42.

Reijneveld SA. The impact of individual and area characteristics on urban socioeconomic differences in health and smoking. Int J Epidemiol 1998;27(1): 33-40.

Rice N, Carr-Hill R, Dixon P and Sutton M. The influence of households on drinking behaviour: a multilevel analysis. Soc Sci Med 1998;46(8):971-9.

Robert SA. Community-level socioeconomic status effects on adult health. J Health Soc Behav 1998;39:18-37.

Sampson RJ. Linking the micro-and macrolevel dimensions of community social organization. Social Forces 1991; 70(1):43-64.

Senior M, Williams H, and Higgs G. Urban-rural mortality differentials: controlling for material deprivation. Soc Sci Med 2000;51(2):289-305.

Shadbolt B. Some correlates of self-rated health for Australian women. Am J Public Health 1997;87(6):951-6.

Shouls S, Congdon P and Curtis S. Modelling inequality in reported long term illness in the UK: combining individual and area characteristics. J Epidemiol Community Health 1996;50(3):366-76.

Slokols D. Establishing and Maintaining Healthy Environments: Toward a Social Ecology of Health Promotion. American Psychologist 1992;47(1):6-22.

Subramanian SV, Kim DJ, and Kawachi I. Social trust and self-rated health in US communities: a multilevel analysis. J Urban Health 2002;79(4S1):S21-34.

Subramanian SV, Kawachi I, and Kennedy BP. Does the state you live in make a difference? Multilevel analysis of self-rated health in the US. Soc Sci Med 2001;53(1):9-19.

Stafford M, Martikainen P, Lahelma E, and Marmot M. Neighbourhoods and self rated health: a comparison of public sector employees in London and Helsinki. J Epidemiol Community Health 2004;58(9):772-8.

ABSTRACT

Objectives: To examine whether the socioeconomic characteristics of communities (contextual effects) are related to the self-rated health of community residents after controlling individual characteristics (compositional effects).

Methods: A linked data set including information on individuals from raw data of 1998 Korean National Health and Nutrition Survey(KNHNS) and information on the regions where the individuals lived from the socioeconomic statistical indices of *Si-Gun-Gu* (city-county-ward) in 1998 was established. The contextual factors of communities were generated from these socioeconomic indices through factor analysis. The contextual effects of community over and above the individual characteristics on the self-rated health were investigated using multilevel analysis.

Results: The contextual factors of the community expressed as the factor scores have influence on the self-rated health of their residents above the compositional factors. When the communities were categorized into 5 groups (highest, high, middle, low, lowest) according to each of their factor scores, for factor 1 reflecting urbanization reversely, the residents of the communities that had the high, middle, and low factor scores showed significantly poor subjective health status than the residents of the lowest (most urbanized) group. For factor 2 reflecting community services and health resources, the subjective health status of the residents gradually became poorer when the group went from the highest to the lowest, and the low and lowest groups showed a significant difference. For factor 3 reflecting the manufacturing industry, as compared with the communities that have the highest factor scores, the other 4 groups showed significantly poorer subjective health status. And for factor 4 reflecting the scale of the regional government, as compared with the middle group, the rest of the 4 groups showed significantly better self-rated health.

Conclusions: There existed regional contextual effects on their residents' health in Korean adults. To make policies tackling these contextual effects possible, more elaborate researches to find more specific factors and to explain the mechanisms of how health is influenced by the contextual factors are needed.

Key Words: Self-rated Health, Contextual Factor, Compositional Factor, Multilevel Analysis