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보건학 석사학위논문

Relation of Regional  
difference in Mental health  
state in Seoul using  
multilevel data analysis

다수준 분석을 이용한 서울시 정신건강 상태의  
소지역간 차이 및 지역특성과의 연관성

2015년 2월

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Abstract

Relation of Regional  
difference in Mental health  
state in Seoul using  
multilevel data analysis

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**Introduction** : Importance of mental health on our life has shown through lots of studies. Many results of research said the poor mental health makes one's life unhealthy. In Korea, however, prevalence of mental illness has been growing according to 2011 mental disorder survey. On the other hand, a lots of studies has shown the Neighborhood effect(Contextual effect) on mental health. Community level features influence one's mental health state. This study is conducted to examine the difference of

mental health state by small area in Seoul and find-out association between small area level factors and individual's mental health state.

**Methods** : The data for this study came from KCHS(Korean Community Health Study) of 2011, 2012, 2013. Adults living in Seoul(25 districts) are subjects of this study. Independent variables are determined by two level(Individual and Community) factors. Individual-level variables are including smoking, drinking, physical activity, self-perceived obese state, experience of disease, accident or poisoning. Community-level variables are calculated by proportion of female, elderly, specific marital status, under high-school educational level, manual worker, low household income(100man-won and less) population. Dependent variable(Mental health state) is evaluated by degree of stress and depression experience. Dependent variable(Mental health state) is evaluated by degree of stress and depression experience. To find-out the differences of mental health state by region, frequency analysis is performed. And finally generalized linear mixed model logistic analysis is performed to find-out the effect of community-level factors by using SAS program version 9.3.

**Results** : The total number of subjects for this study is 39,380 people. 12789 people of subjects answered they felt high-stress and 2255 people of them experienced depression. Community in Seoul can be divided into 25 gu and 424 dong. Average proportion of high-stress by community, named 'gu', is 29.3%. And depression experienced is 7.1% by each district. There is

significant( $p < 0.05$ ) association between mental health state and almost individual-level features including demographics and health-related factors. The results of generalized linear mixed model analysis, there are differences between region to region. Especially, experience of depression adjusted for all individual's and dong level factors has big percentage change of variance.

**Conclusion :** There is association between regional features and individual's mental health by comparing the differences between small area in Seoul and figuring the effect factors on mental health state. Especially, in the case of depression, there is a big association with area features. Therefore, it is necessary that establish community level approach and management to improve individual's mental health.

**Keywords :** mental health, stress, depression, community, multilevel data analysis, generalized linear mixed model analysis

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# Contents

<b>Chapter I . Introduction.....</b>	<b>1</b>
1-1 Background.....	1
1-2 Purpose.....	2
<b>Chapter II . Methods.....</b>	<b>3</b>
2-1 Study design and hypothesis.....	3
2-2 Data.....	5
2-3 Measures.....	6
2-4 Analysis.....	9
<b>Chapter III . Results.....</b>	<b>11</b>
3-1 Regional differences in mental health state.....	11
3-2 Demographic characteristics of subjects.....	13
3-3 Individual- and community-level factors.....	16
3-4 Multilevel data analysis.....	19
<b>Chapter IV . Discussion and Conclusion.....</b>	<b>29</b>
4-1 Discussion.....	29
4-2 Conclusion.....	30
<b>References.....</b>	<b>31</b>
<b>Abstract (Korean).....</b>	<b>37</b>



# Tables

[Table 1].....	7
Definition of community-level factors	
[Table 2].....	12
Regional(gu) differences in mental health state in Seoul	
[Table 3].....	14
Demographic characteristics of subjects by stress	
[Table 4].....	15
Demographic characteristics of subjects by depression	
[Table 5].....	17
Health-related behavior of subjects by stress	
[Table 6].....	17
Health-related behavior of subjects by depression	
[Table 7].....	18
Distribution of community level factors	
[Table 8].....	20
Multilevel data analysis : Stress, gu	
[Table 9].....	22
Multilevel data analysis : Stress, dong	
[Table 10].....	25
Multilevel data analysis : Depression, gu	
[Table 11].....	27
Multilevel data analysis : Depression, dong	

# Figures

<Figure 1>.....	3
Study Design	
<Figure 2>.....	10
Data structure	

# Chapter I . Introduction

## 1-1. Background

Importance of mental health on our life has shown through lots of studies. Most of results said the poor mental health makes one's life unhealthy(Jeon, 2003; Kim et al, 2006; Jung et al, 2007; Kim et al, 2008). Especially, the influence of stress and depression on individual's health have presented. Stress hormones was known as a factor that can influence on memory modulation(Oliver T. Wolf, 2007) and heart rate(J. Taelman et al., 2008). Depression also contributes to memory(L. Sand Stromgren, 1977; Carlo Cipolli et al., 1996) and cerebrovascular disease(K. Ranga Rama Krishnan, 2000). However, according to 2011 mental disorder survey in Korea, prevalence of mental illness has been growing. These problems cause social and national burden.

On the other hand, lots of studies has shown that individual's health effect were caused by many community level factors. It is called the Neighborhood effect(Robert J. Sampson et al., 2002; Ingrid G. Ellen et al, 2001). Mental health is also caused by mixing of individual and community level factors(Carol S. Aneshensel et al., 1996; Margaret O Caughy et al., 2003).

Therefore, this study can examine the difference of mental health state by small area and find-out the association between mental health state and community level features in Seoul, Korea.

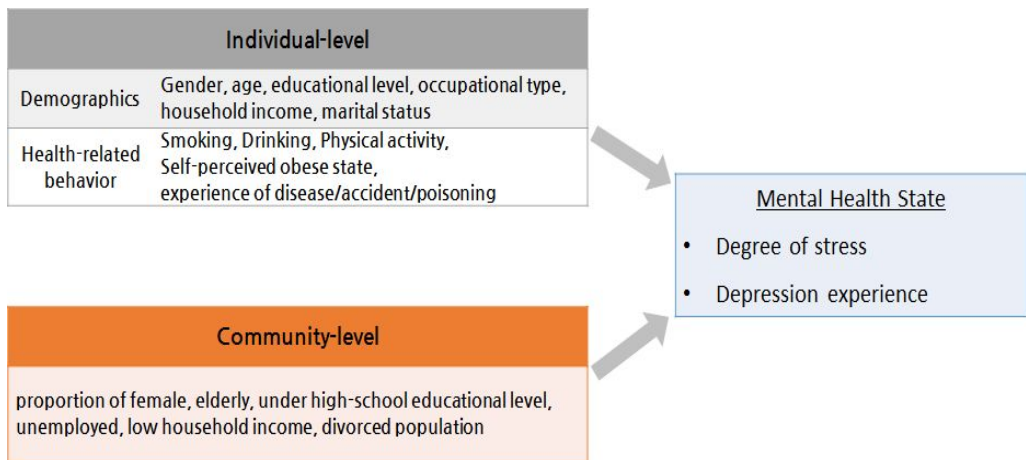
## 1-2. Purpose

The aims of this study are following. First, examining differences of mental health state by small area in Seoul. Second, find-out community features associated with individual's mental health state.

# Chapter II. Methods

## 2-1. Study design and hypothesis

The study was designed to analysis the association between one's individual mental state and community-level feature. <Figure 1> shows the design of current study. There are factors associated with mental health divided into two level.



<Figure 1> Study Design

First, there are individual-level factors including demographics and health-related behaviors. Then Community-level features are calculated.

## **Hypothesis**

Hypothesis are formulated according to this study model presented in <Figure 1>.

1. There are differences of individual mental health state by each region(community).
2. Individual-level factors affect individual's mental health state.
3. Area-level factors affect individual's mental health state.

## **2-2. Data**

### **Data source : Korean Community Health Survey(KCHS)**

The data for this study came from Korean Community Health Study of 2011, 2012, 2013.

Korean Community health Survey(KCHS), conducted by the Korea Center for Disease Control(KCDC), is the only existing community-based health statistic in Korea. It is an annual national cross-sectional survey and provide data for planning, implementing and evaluating to promote evidence-based community health policies. About 900 adults is selected from each 253 region in Korea and participate face-to-face interviews using CAPI(Computer Assisted Personal Interviewing) system with trained investigators. This survey covered 18 common question section including demographics, several health-related behaviors, experience of diagnosis and accident, quality of life, utilization of healthcare services and environmental factors.

### **Study Subjects**

Adults who are living in Seoul and participated KCHS of 2011, 2012 or 2013 are subjects of this study.

## 2-3. Measures

### **Independent variables**

: determined by Individual and Community level.

#### **- Individual level variables**

Demographic variables were used in this study including gender, age, marital status, educational level, occupational type, household income. Gender compared males with females. Age was categorized as 6 groups: '19-29', '30-39', '40-49', '50-59', '60-69' and '70 and older'. Marital status was categorized as 'Single', 'Married' and 'Others' including divorced, separated and widows. Educational level was classified into 3 groups: 'Uneducated', 'under highschool graduated' and 'highschool or higher'. Occupational type were grouped into 4 categories : 'Profession/Administration/Clerical workers' 'Services/Sales job', 'Manual job' and 'Unemployment'. Household income was divided by 5 groups : 'under 100 man-won', '101-200 man-won', '201-300 man-won', '301-400 man-won' and '400man-won or higher'.

Health-related behaviors were used including smoking, drinking, physical activity, self-perceived obese state, experience of disease, accident or poisoning. Smoking, drinking and experience of disease, accident or poisoning were derived from the KCHS questionnaire - "Do you smoke now?", "Have you drank alcohol within the past one month?", "Have you experienced disease, accident or poisoning within the past 2 weeks?". Physical activity was classified 2 groups : 'Do walking or moderate exercise



within the past 1 week’, ‘Do not any physical activity’ Self-perceived obese state variable was derived from the KCHS questionnaire - “How does your body do you think?” and sorted by subject’s answer into 2 groups : “obese” and “normal”

**- Area(community) level variables**

Community level variables are defined by proportion of female, elderly, specific marital status, under high-school educational level, manual worker, low household income population. Definition of each measures are represented in [Table 1].

[Table 1] Definition of community-level factors

<b>Definition of community-level factors(Unit : %)</b>	
Factor1	proportion of female population within region
Factor2	proportion of elderly(65 and older) population within region
Factor3	proportion of specific marital status including divorced, separated or widow population within region
Factor4	proportion of under highschool graduate educational level population within region
Factor5	proportion of manual population within region
Factor6	proportion of low household income(100 man-won and less) population within region

To find-out the effect of region feature, each proportion of factors were calculated using following formula.

$$\text{Standard-score}(Z) = (X - \text{mean}) / \text{standard deviation}$$

Then, each Z-score were summed by region. In other words, one region has only one region value.

### **Dependent variable**

Mental health state is evaluated by degree of stress and depression experience.

#### **- Self perceived stress extent**

Degree of stress was derived from the KCHS questionnaire - "How much do you feel stress in daily life?" and grouped into 'High' or 'Low' according to participant's answer.

#### **- Depression experience**

Depression experience is also collected from the KCHS questionnaire - "Have you ever experience depression continuously more than 2 weeks within the past one year?"

## 2-4. Analysis

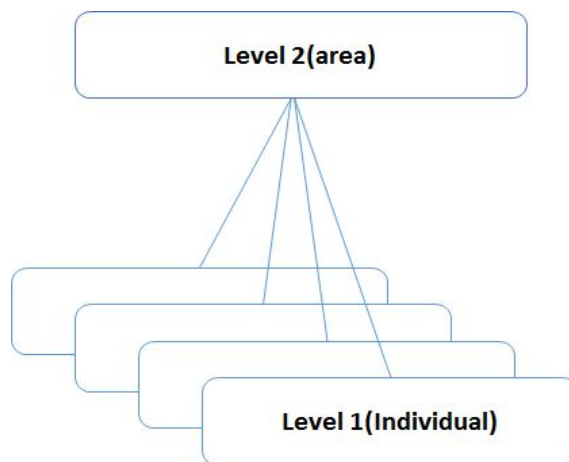
All analysis was conducted by using SAS program version 9.3.

### Frequency analysis

To find-out the difference mental health state by region, frequency analysis is performed. All variables are managed as binominal factor. Chi-square test was performed to analysis association between variables.

### Multilevel data analysis

Recently, it is a general concept that some events have several same causes based on hierarchy structures. In other words, individuals within the same group are likely to have similar attributes. In this study, the data has also hierarchical structure<Figure 2>. Level 1 can be matched individual and level 2 is suited to area.



<Figure 2> Data structure

Multilevel data analysis is effective way to apply this concept. In this study, especially generalized linear mixed(GLM) model, is applied to find influence of group level feature(Jian Dai et al, 2006) on individual's mental health. Random effect intercept model is used to find-out community-level effect on individual's mental health and odds ratio values are calculated. It is conducted by using proc glimmix procedure statement with "Method=LAPLACE" option.

In this study, to analysis generalized linear mixed model following models are structured.

Model 0 : Null model.

Model 1 : Only individual-level factors are adjusted.

Model 2 : Only community-level features are adjusted.

Model 4 : All factors are adjusted.

## Chapter III. Results

### 3-1. Regional differences in mental health state

In Seoul, there are 25 gu(community-level). Average participant of each district(gu) is 2566 people. Maximum value is 2720 in Geumcheon-gu. Minimum value is 2350 in Mapo-gu.

In the 25 region(gu), average proportion of high self-perceived stress population is 29.3%. Maximum proportion of high self-perceived stress population is 31.0% in 3 community(gu) named Gangdong, Songpa and Jongno. Minimum value is 26.7% in Jung-gu.

On the other hand, average proportion of having depression continuously more than 2 weeks within the past 1 year population is 7.1%. Maximum value is 9.6% in Dongjak-gu. Minimum value is 5.2% in Eunpeong-gu.

Distribution of high-stress and depression experience by each community is presented in [Table 2].

[Table 2] Regional(gu) differences in mental health state in Seoul

Community (gu, N=25)	Total (N)	Stress		Depression	
		High		Experienced	
		N	%	N	%
Gangnam	1448	501	34.60	77	5.32
Gangdong	1634	540	33.05	97	5.94
Gangbuk	1590	549	34.53	93	5.85
Gangseo	1547	515	33.29	73	4.72
Gwanak	1630	508	31.17	87	5.34
Gwangjin	1665	548	32.91	67	4.02
Guro	1705	536	31.44	118	6.92
Geumcheon	1677	517	30.83	113	6.74
Nowon	1629	540	33.15	88	5.40
Dobong	1430	447	31.26	87	6.08
Dongdaemun	1600	538	33.63	63	3.94
Dongjak	1589	502	31.59	123	7.74
Mapo	1524	520	34.12	89	5.84
Seodaemun	1610	541	33.60	104	6.46
Seocho	1460	497	34.04	80	5.48
Seongdong	1631	510	31.27	94	5.76
Seongbuk	1650	549	33.27	86	5.21
Songpa	1685	580	34.42	124	7.36
Yangcheon	1449	444	30.64	78	5.38
Yeongdeungpo	1652	494	29.90	119	7.20
Yongsan	1468	458	31.20	80	5.45
Eunpeong	1592	524	32.91	66	4.15
Jongno	1460	497	34.04	97	6.64
Jung	1533	454	29.62	71	4.63
Jungnang	1522	480	31.54	81	5.32
Total(N)	39380	12789	100.00	2255	100.00

## 3-2. Demographic characteristics of subjects

The total number of subjects is 39380(people). 12789 people feel 'high' stress in their daily life and 26591 people are in 'low' stress group. 2255 people experienced depression, meanwhile 37125 people are not. General demographic characteristics and distribution of subjects by mental health state are presented in [Table 3] and [Table 4].

According to [Table 3], there are significances between stress and demographic variables except for household income. The older age group has more percentage of low-stress than the younger one. Married people has lowest high-stress percentage and more than one-third single felt high-stress. In case of educational level characteristic, elementary or middle school graduate level has lowest percentage of high-stress. And having 'services/sales' job shows the highest percentage of high-stress.

On the other hands, depression experience presented on [Table 4] has a little bit different trend compared with degree of stress. All of variables has a big significance between individual's demographics and depression experience. Each variable has prominent group. In case of gender, female has more than double percentage of depression experience. Others group on marital status including divorced, separated and widow shows also prominent value compared with married or single person. 11.59% of uneducated people experienced depression.

[Table 3] Demographic characteristics of subjects by stress

	Total (N)	Low		High		p
		N	%	N	%	
<b>Gender</b>						
Female	17932	11833	65.99	6099	34.01	<.0001
Male	21448	14758	68.81	6690	31.19	
<b>Age_10</b>						
19-29	5974	3811	63.79	2163	36.21	<.0001
30-39	10282	6558	63.78	3724	36.22	
40-49	10391	6794	65.38	3597	34.62	
50-59	8270	5941	71.84	2329	28.16	
60-69	3530	2750	77.90	780	22.10	
70≤	933	737	78.99	196	21.01	
<b>Marital status</b>						
Married	26148	17943	68.62	8205	31.38	<.0001
Single	9770	6346	64.95	3424	35.05	
Others	3462	2302	66.49	1160	33.51	
<b>Education</b>						
Uneducated	561	372	66.31	189	33.69	<.0001
Ele/Mid	5417	3942	72.77	1475	27.23	
High	33402	22277	66.69	11125	33.31	
<b>Household income</b>						
≤100	2961	2014	68.02	947	31.98	0.5092
101-200	6677	4497	67.35	2180	32.65	
201-300	8261	5619	68.02	2642	31.98	
301-400	6017	4089	67.96	1928	32.04	
401≤	15464	10372	67.07	5092	32.93	
<b>Occupation</b>						
Manual	10250	7384	72.04	2866	27.96	<.0001
Prof/Admin/Cler	19673	12993	66.04	6680	33.96	
Services/Sales	9457	6214	65.71	3243	34.29	
<b>Total</b>	<b>39380</b>	<b>26591</b>	<b>100.0</b>	<b>12789</b>	<b>100.0</b>	



[Table 4] Demographic characteristics of subjects by depression

	<b>Total (N)</b>	<b>Non-experienced</b>		<b>Experienced</b>		<b>p</b>
		<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>	
<b>Gender</b>						
Female	17932	16528	92.17	1404	7.83	<.0001
Male	21448	20597	96.03	851	3.97	
<b>Age_10</b>						
19-29	5974	5554	92.97	420	7.03	<.0001
30-39	10282	9747	94.80	535	5.20	
40-49	10391	9834	94.64	557	5.36	
50-59	8270	7772	93.98	498	6.02	
60-69	3530	3338	94.56	192	5.44	
70≤	933	880	94.32	53	5.68	
<b>Marital status</b>						
Married	26148	24925	95.32	1223	4.68	<.0001
Single	9770	9120	93.35	650	6.65	
Others	3462	3080	88.97	382	11.03	
<b>Education</b>						
Uneducated	561	496	88.41	65	11.59	<.0001
Ele/Mid	5417	5047	93.17	370	6.83	
High	33402	31582	94.55	1820	5.45	
<b>Household income</b>						
≤100	2961	2678	90.44	283	9.56	<.0001
101-200	6677	6189	92.69	488	7.31	
201-300	8261	7771	94.07	490	5.93	
301-400	6017	5715	94.98	302	5.02	
401≤	15464	14772	95.53	692	4.47	
<b>Occupation</b>						
Manual	10250	9639	94.04	611	5.96	<.0001
Prof/Admin/Cler	19673	18660	94.85	1013	5.15	
Services/Sales	9457	8826	93.33	631	6.67	
<b>Total</b>	<b>39380</b>	<b>26591</b>	<b>100.0</b>	<b>12789</b>	<b>100.0</b>	

### 3-3. Individual- and community-level factors

#### 3-3-1. Individual level : Health-related behaviors

Association between individual health-related behaviors and mental health state is presented on [Table 5] and [Table 6].

[Table 5] shows the distribution and results of chi-square test between variables and extent of perceived stress. All variables have association with the individual's degree of stress.

Then following [Table 6] presents the association between several health-related behaviors and depression experience. There is a significant p-value except for smoking variable.

[Table 5] Health-related behavior of subjects by stress

	Total(N)	Low		High		p
		N	%	N	%	
<b>Smoking</b>						
no	29057	20212	69.56	8845	30.44	<.0001
yes	10323	6379	61.79	3944	38.21	
<b>Drinking</b>						
no	12357	8623	69.78	3734	30.22	<.0001
yes	36622	17968	66.49	9055	33.51	
<b>Physical Activity</b>						
no	15367	10072	65.54	5295	34.46	<.0001
Yes	24013	16519	68.79	7494	31.21	
<b>Self-perceived obese state</b>						
normal	23285	16287	69.95	6998	30.05	<.0001
obese	16095	10304	64.02	5791	35.98	
<b>Diagnosis/Accident/Poisoning</b>						
no	36622	25088	68.51	11534	31.49	<.0001
yes	2758	1503	54.50	1255	45.50	

[Table 6] Health-related behavior of subjects by depression

	Total(N)	Non-experienced		Experienced		p
		N	%	N	%	
<b>Smoking</b>						
no	29057	27363	94.17	1694	5.83	<.0001
yes	10323	9762	94.57	561	5.43	
<b>Drinking</b>						
no	12357	11565	93.59	792	6.41	<.0001
yes	36622	25560	94.59	1463	5.41	
<b>Physical Activity</b>						
no	15367	14478	94.21	889	5.79	<.0001
Yes	24013	22647	94.31	1366	5.69	
<b>Self-perceived obese state</b>						
normal	23285	22038	94.64	1247	5.36	<.0001
obese	16095	15087	93.74	1008	6.26	
<b>Diagnosis/Accident/Poisoning</b>						
no	36622	34774	94.95	1848	5.05	<.0001
yes	2758	2351	85.24	407	14.76	

### 3-3-2. Community level factors

Community level features are calculated by 6 criteria. Following [Table 7] presents the distribution of each factor by area(gu).

[Table 7] Distribution of community level factors by gu

Community(gu)	%female	%elderly	%mai*	%education	%manual	%inc**
Gangnam	42.96	4.35	9.19	3.31	8.22	3.94
Gangdong	44.06	3.61	9.79	12.97	28.03	6.92
Gangbuk	46.67	8.81	9.81	25.41	35.35	10.50
Gangseo	43.31	4.65	7.95	11.89	26.31	5.43
Gwanak	45.21	6.26	10.12	16.81	26.93	9.51
Gwangjin	44.38	4.74	8.11	14.29	25.83	7.39
Guro	43.46	5.69	6.22	15.66	29.97	6.33
Geumcheon	45.50	5.13	10.55	19.44	35.78	8.17
Nowon	46.90	4.30	9.21	15.16	24.49	6.51
Dobong	45.31	6.36	10.77	17.20	29.72	9.02
Dongdaemun	46.25	7.31	9.50	19.69	27.69	7.75
Dongjak	46.95	6.36	7.30	14.10	22.97	6.54
Mapo	47.24	6.23	8.46	13.19	22.18	7.28
Seodaemun	47.83	5.47	8.88	13.73	25.90	9.07
Seocho	43.56	3.42	5.62	3.49	8.08	2.67
Seongdong	44.70	6.13	8.77	18.03	27.77	7.73
Seongbuk	45.82	5.94	6.85	16.48	27.94	7.94
Songpa	43.92	3.68	6.11	8.01	16.02	4.87
Yangcheon	47.48	4.21	9.04	14.56	26.64	8.76
Yeongdeungpo	43.83	5.39	7.75	15.13	25.48	7.81
Yongsan	48.37	5.99	9.67	14.37	22.28	7.36
Eunpeong	44.97	6.85	11.68	13.94	30.34	7.22
Jongno	47.33	8.63	10.62	19.04	26.58	8.90
Jung	43.71	6.78	8.81	21.59	31.31	9.39
Jungnang	49.28	4.99	9.53	20.76	36.14	10.91

\* %mar : including divorced, separated and widowers

\*\* %inc : 100 man-won or less household income

## 3-4. Multilevel data analysis

### 3-4-1. Stress

The results of multilevel data analysis (GLM model) are presented in [Table 8] and [Table 9].

In [Table 8], level 1 is matched to individuals and level 2 is matched to area 'gu'. Each model in [Table 8] has very small variance and model 2 adjusted for area level variable has smallest variance among 4 models. Model 4 shows the significance between every individual factor and stress. Female has larger OR value (1.29, CL : 1.22-1.36) than male. And younger group has smaller estimate than older. Married shows more bigger odds ratio (1.12, CL : 1.04-1.20) than single and others group has biggest high-stress odds ratio (1.25, CL : 1.13-1.39). Manual job group is presented smallest OR values (0.83, CL : 0.78-0.89).

In [Table 9], level 1 is matched to individuals and level 2 is matched to area 'dong'. Null model in [Table 9] has variance between group to group. Reference to null model, percentage change of variance on model 1 is 6.26(%). And in case of model 2, it's percentage change of variance is 8.83 (%). Finally model 3 adjusted for every individual and area level factors has 12.58% change of variance reference to null model. Also, on model 3, the community group has significant odds ratio between group 1 (1.08, CL : 1.00 - 1.16) and 4 (reference).

[Table 8] Multilevel data analysis : Stress, gu

		Model0			Model1			Model2			Model3		
					OR	95% CI		OR	95% CI		OR	95% CI	
<b>Individual-level factors</b>													
<b>Gender</b>	<b>Female</b>	<b>1.29</b>	<b>1.22</b>	<b>1.36</b>							<b>1.29</b>	<b>1.22</b>	<b>1.36</b>
	<b>Male</b>				1.00						1.00		
<b>Age</b>	<b>19-29</b>	<b>2.38</b>	<b>1.96</b>	<b>2.89</b>							<b>2.37</b>	<b>1.95</b>	<b>2.88</b>
	<b>30-39</b>	<b>2.17</b>	<b>1.81</b>	<b>2.61</b>							<b>2.17</b>	<b>1.80</b>	<b>2.60</b>
	<b>40-49</b>	<b>1.99</b>	<b>1.66</b>	<b>2.38</b>							<b>1.99</b>	<b>1.66</b>	<b>2.38</b>
	<b>50-59</b>	<b>1.51</b>	<b>1.26</b>	<b>1.80</b>							<b>1.50</b>	<b>1.26</b>	<b>1.80</b>
	<b>60-69</b>	<b>1.11</b>	<b>0.92</b>	<b>1.34</b>							<b>1.11</b>	<b>0.92</b>	<b>1.33</b>
	<b>70≤</b>				1.00						1.00		
<b>Marital Status</b>	<b>Others</b>	<b>1.26</b>	<b>1.13</b>	<b>1.39</b>							<b>1.25</b>	<b>1.13</b>	<b>1.39</b>
	<b>Married</b>	<b>1.12</b>	<b>1.04</b>	<b>1.20</b>							<b>1.12</b>	<b>1.04</b>	<b>1.20</b>
	<b>Single</b>				1.00						1.00		
<b>Education</b>	<b>High</b>	<b>0.63</b>	<b>0.52</b>	<b>0.77</b>							<b>0.63</b>	<b>0.52</b>	<b>0.77</b>
	<b>Ele/Mid</b>	<b>0.65</b>	<b>0.53</b>	<b>0.79</b>							<b>0.64</b>	<b>0.53</b>	<b>0.79</b>
	<b>Uneducated</b>				1.00						1.00		
<b>Household Income</b>	<b>&lt;100</b>	<b>1.16</b>	<b>1.05</b>	<b>1.28</b>							<b>1.16</b>	<b>1.06</b>	<b>1.28</b>
	<b>101-200</b>	<b>1.07</b>	<b>1.00</b>	<b>1.15</b>							<b>1.08</b>	<b>1.01</b>	<b>1.15</b>
	<b>201-300</b>	<b>0.98</b>	<b>0.92</b>	<b>1.04</b>							<b>0.98</b>	<b>0.92</b>	<b>1.04</b>
	<b>301-400</b>	<b>0.96</b>	<b>0.90</b>	<b>1.03</b>							<b>0.96</b>	<b>0.90</b>	<b>1.03</b>
	<b>401≤</b>				1.00						1.00		
<b>Occupation</b>	<b>Manual</b>	<b>0.83</b>	<b>0.78</b>	<b>0.89</b>							<b>0.83</b>	<b>0.78</b>	<b>0.89</b>
	<b>Prof/Admin /Cler</b>	<b>0.98</b>	<b>0.93</b>	<b>1.04</b>							<b>0.98</b>	<b>0.92</b>	<b>1.04</b>
	<b>Services/Sales</b>				1.00						1.00		

[Table 8] Continued

<b>Smoking</b>	no	<b>0.63</b>	<b>0.59</b>	<b>0.67</b>		<b>0.63</b>	<b>0.59</b>	<b>0.67</b>
	yes	1.00				1.00		
<b>Drinking</b>	no	<b>0.90</b>	<b>0.86</b>	<b>0.95</b>		<b>0.90</b>	<b>0.86</b>	<b>0.95</b>
	yes	1.00				1.00		
<b>Physical Activity</b>	no	<b>1.14</b>	<b>1.08</b>	<b>1.19</b>		<b>1.14</b>	<b>1.08</b>	<b>1.19</b>
	yes	1.00				1.00		
<b>Self-perceived Obese state</b>	no	<b>0.78</b>	<b>0.75</b>	<b>0.82</b>		<b>0.78</b>	<b>0.75</b>	<b>0.82</b>
	yes	1.00				1.00		
<b>Experience of disease or accident</b>	no	<b>0.54</b>	<b>0.49</b>	<b>0.58</b>		<b>0.54</b>	<b>0.49</b>	<b>0.58</b>
	yes	1.00				1.00		
<b>Community-level factors</b>								
	1				1.03	0.96	1.12	1.03
	2				0.98	0.91	1.05	0.96
	3				0.95	0.88	1.02	0.95
	4				1.00			1.00
<b>Variance of random intercept(S.E)</b>	0.001645(0.001)	0.002102(0.001)	0.000752(0.001)	0.000912(0.001)				
<b>Percentage change of variance**</b>	REF	-27.78%	54.29%	44.56%				
<b>-2 Log Likelihood</b>	49647.75	48386.80	49641.98	48380.20				
<b>AIC</b>	49651.75	48432.8	49651.98	48432.2				

\* Model 0 : Null model.

\* Model 1 : Only individual-level factors are adjusted.

\* Model 2 : Only area(community)-level features are adjusted.

\* Model 4 : All individual- and area-level factors are adjusted

\* NOTE: **BOLD** indicates statistically significance at 5% level

\*\* Percentage change of variance =  $[v(\text{null}) - v(\text{complex model})] / v(\text{null}) * 100$

[Table 9] Multilevel data analysis : Stress, dong

		Model0			Model1			Model2			Model3		
		OR			95% CI			OR			95% CI		
<b>Individual-level factors</b>													
<b>Gender</b>	<b>Female</b>	<b>1.29</b>	<b>1.22</b>	<b>1.36</b>				<b>1.29</b>	<b>1.22</b>	<b>1.36</b>			
	<b>Male</b>	1.00						1.00					
<b>Age</b>	<b>19-29</b>	<b>2.39</b>	<b>1.97</b>	<b>2.90</b>				<b>2.38</b>	<b>1.96</b>	<b>2.89</b>			
	<b>30-39</b>	<b>2.17</b>	<b>1.81</b>	<b>2.61</b>				<b>2.17</b>	<b>1.81</b>	<b>2.61</b>			
	<b>40-49</b>	<b>1.99</b>	<b>1.67</b>	<b>2.38</b>				<b>1.99</b>	<b>1.66</b>	<b>2.38</b>			
	<b>50-59</b>	<b>1.51</b>	<b>1.26</b>	<b>1.80</b>				<b>1.51</b>	<b>1.26</b>	<b>1.80</b>			
	<b>60-69</b>	1.11	0.92	1.33				1.11	0.92	1.33			
	<b>70≤</b>	1.00						1.00					
<b>Marital Status</b>	<b>Others</b>	<b>1.26</b>	<b>1.14</b>	<b>1.39</b>				<b>1.26</b>	<b>1.14</b>	<b>1.39</b>			
	<b>Married</b>	<b>1.12</b>	<b>1.04</b>	<b>1.20</b>				<b>1.12</b>	<b>1.04</b>	<b>1.20</b>			
	<b>Single</b>	1.00						1.00					
<b>Education</b>	<b>High</b>	<b>0.63</b>	<b>0.52</b>	<b>0.77</b>				<b>0.63</b>	<b>0.52</b>	<b>0.77</b>			
	<b>Ele/Mid</b>	<b>0.65</b>	<b>0.53</b>	<b>0.79</b>				<b>0.65</b>	<b>0.53</b>	<b>0.79</b>			
	<b>Uneducated</b>	1.00						1.00					
<b>Household Income</b>	<b>&lt;100</b>	<b>1.16</b>	<b>1.05</b>	<b>1.27</b>				<b>1.17</b>	<b>1.06</b>	<b>1.29</b>			
	<b>101-200</b>	<b>1.08</b>	<b>1.01</b>	<b>1.15</b>				<b>1.08</b>	<b>1.01</b>	<b>1.16</b>			
	<b>201-300</b>	0.98	0.92	1.04				0.98	0.92	1.04			
	<b>301-400</b>	0.96	0.90	1.03				0.97	0.91	1.03			
	<b>401≤</b>	1.00						1.00					
<b>Occupation</b>	<b>Manual</b>	<b>0.83</b>	<b>0.78</b>	<b>0.89</b>				<b>0.83</b>	<b>0.78</b>	<b>0.89</b>			
	<b>Prof/Admin /Cler</b>	0.98	0.93	1.03				0.97	0.92	1.03			
	<b>Services/Sales</b>	1.00						1.00					



[Table 9] Continued

<b>Smoking</b>	no	<b>0.63</b>	<b>0.59</b>	<b>0.66</b>		<b>0.63</b>	<b>0.59</b>	<b>0.66</b>
	yes	1.00				1.00		
<b>Drinking</b>	no	<b>0.90</b>	<b>0.86</b>	<b>0.95</b>		<b>0.90</b>	<b>0.86</b>	<b>0.95</b>
	yes	1.00				1.00		
<b>Physical Activity</b>	no	<b>1.13</b>	<b>1.08</b>	<b>1.19</b>		<b>1.13</b>	<b>1.08</b>	<b>1.19</b>
	yes	1.00				1.00		
<b>Self-perceived Obese state</b>	no	<b>0.78</b>	<b>0.75</b>	<b>0.82</b>		<b>0.78</b>	<b>0.75</b>	<b>0.82</b>
	yes	1.00				1.00		
<b>Experience of disease or accident</b>	no	<b>0.54</b>	<b>0.50</b>	<b>0.58</b>		<b>0.54</b>	<b>0.50</b>	<b>0.58</b>
	yes	1.00				1.00		
<b>Community-level factors</b>								
	1				<b>1.08</b>	<b>1.01</b>	<b>1.16</b>	<b>1.08</b>
	2				1.06	0.99	1.14	1.04
	3				1.00	0.93	1.07	0.99
	4				1.00			1.00
<b>Variance of random intercept(S.E)</b>	0.01677(0.005)	0.01572(0.005)	0.01529(0.004)	0.01466(0.005)				
<b>Percentage change of variance**</b>	REF	6.26%	8.83%	12.58%				
<b>-2 Log Likelihood</b>	49629.27	48373.25	49621.49	48367.94				
<b>AIC</b>	49633.27	48419.25	49631.49	48419.94				

\* Model 0 : Null model.

\* Model 1 : Only individual-level factors are adjusted.

\* Model 2 : Only area(communit)-level features are adjusted.

\* Model 4 : All individual- and area-level factors are adjusted

\* NOTE: **BOLD** indicates statistically significance at 5% level

\*\* Percentage change of variance =  $[v(\text{null})-v(\text{complex model})]/v(\text{null})\times 100$

### 3-4-2. Depression

The results of generalized linear mixed model analysis about individual's experience of depression are presented in [Table 10] and [Table 11].

In [Table 10], level 1 is matched to individuals and level 2 is matched to area 'gu'. Each model in [Table 10] about individual's depression has bigger group to group variance than degree of stress presented on [Table 8] and [Table 9]. In the case of depression, there are not significance between individual's health-related behavior 'drinking', 'physical activity' and occupation. Female has twice bigger OR values(2.03, CL : 1.80-2.21) than male. Marital status shows little bit difference trend with individual's stress. Married group has smallest(0.87, CL : 0.74-0.98) and others including divorced, separated and widowers have biggest(1.48, CL : 1.23-1.77) estimates. And the odds ratio of 'experience of chronic disease, accident or poisoning' is 0.38(CL : 0.32-0.41).

In [Table 11], level 1 is matched to individuals and level 2 is matched to area 'dong'. Null model in [Table 11] has variance between group to group. Reference to null model, percentage change of variance on model 3 adjusted for all individual and area-level factor is 8.37(%). And the community group divided by community factors has significant difference between group 1(1.22, CL : 1.04-1.44) and 4(reference, 1.00).

[Table 10] Multilevel data analysis : Depression, gu

		Model0		Model1		Model2		Model3		
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	
<b>Individual-level factors</b>										
<b>Gender</b>	<b>Female</b>	2.03	1.80	2.28				2.03	1.80	2.28
	<b>Male</b>	1.00						1.00		
<b>Age</b>	<b>19-29</b>	1.74	1.21	2.51				1.73	1.20	2.50
	<b>30-39</b>	1.48	1.05	2.09				1.48	1.05	2.09
	<b>40-49</b>	1.44	1.03	2.02				1.44	1.03	2.01
	<b>50-59</b>	1.46	1.05	2.02				1.46	1.05	2.02
	<b>60-69</b>	1.18	0.85	1.65				1.18	0.85	1.65
	<b>70≤</b>	1.00						1.00		
<b>Marital Status</b>	<b>Others</b>	1.48	1.24	1.78				1.48	1.23	1.77
	<b>Married</b>	0.86	0.74	0.99				0.85	0.74	0.98
	<b>Single</b>	1.00						1.00		
<b>Education</b>	<b>High</b>	0.67	0.49	0.93				0.67	0.49	0.92
	<b>Ele/Mid</b>	0.71	0.52	0.96				0.71	0.52	0.96
	<b>Uneducated</b>	1.00						1.00		
<b>Household Income</b>	<b>&lt;100</b>	1.74	1.47	2.06				1.75	1.47	2.07
	<b>101-200</b>	1.47	1.28	1.67				1.47	1.29	1.68
	<b>201-300</b>	1.26	1.11	1.43				1.26	1.11	1.43
	<b>301-400</b>	1.10	0.96	1.27				1.11	0.96	1.28
	<b>401≤</b>	1.00						1.00		
<b>Occupation</b>	<b>Manual</b>	0.94	0.83	1.07				0.94	0.83	1.07
	<b>Prof/Admin /Cler</b>	0.91	0.81	1.02				0.91	0.81	1.01
	<b>Services/Sales</b>	1.00						1.00		

[Table 10] Continued

<b>Smoking</b>	no	<b>0.70</b>	<b>0.62</b>	<b>0.80</b>				<b>0.70</b>	<b>0.62</b>	<b>0.80</b>
	yes	1.00						1.00		
<b>Drinking</b>	no	0.96	0.87	1.06				0.96	0.87	1.06
	yes	1.00						1.00		
<b>Physical Activity</b>	no	1.03	0.94	1.13				1.03	0.94	1.13
	yes	1.00						1.00		
<b>Self-perceived Obese state</b>	no	<b>0.87</b>	<b>0.79</b>	<b>0.95</b>				<b>0.86</b>	<b>0.79</b>	<b>0.95</b>
	yes	1.00						1.00		
<b>Experience of disease or accident</b>	no	<b>0.36</b>	<b>0.32</b>	<b>0.41</b>				<b>0.36</b>	<b>0.32</b>	<b>0.41</b>
	yes	1.00						1.00		
<b>Community-level factors</b>										
	1				0.99	0.80	1.21	1.13	0.91	1.41
	2				1.08	0.88	1.34	1.14	0.92	1.42
	3				0.91	0.73	1.12	0.95	0.76	1.18
	4				1.00			1.00		
<b>Variance of random intercept</b>		0.02332(0.010)	0.02878(0.012)		0.01953(0.009)			0.02216(0.010)		
<b>Percentage change of variance**</b>		REF	-23.41%		16.25%			4.97%		
<b>-2 Log Likelihood</b>		17254.78	16441.84		17251.93			16437.55		
<b>AIC</b>		17258.78	16487.84		17261.93			16489.55		

\* Model 0 : Null model.

\* Model 1 : Only individual-level factors are adjusted.

\* Model 2 : Only area(communitiy)-level features are adjusted.

\* Model 4 : All individual- and area-level factors are adjusted

\* NOTE: **BOLD** indicates statistically significance at 5% level

\*\* Percentage change of variance =  $[v(\text{null}) - v(\text{complex model})] / v(\text{null}) * 100$

[Table 11] Multilevel data analysis : Depression, dong

		Model0			Model1			Model2			Model3		
					OR	95% CI		OR	95% CI		OR	95% CI	
<b>Individual-level factors</b>													
<b>Gender</b>	<b>Female</b>				2.03	1.81	2.27				2.03	1.81	2.27
	<b>Male</b>				1.00						1.00		
<b>Age</b>	<b>19-29</b>				1.75	1.22	2.52				1.76	1.22	2.53
	<b>30-39</b>				1.49	1.06	2.10				1.49	1.06	2.10
	<b>40-49</b>				1.44	1.03	2.01				1.44	1.03	2.01
	<b>50-59</b>				1.47	1.06	2.03				1.46	1.06	2.03
	<b>60-69</b>				1.19	0.86	1.66				1.19	0.85	1.66
	<b>70≤</b>				1.00						1.00		
<b>Marital Status</b>	<b>Others</b>				0.85	0.74	0.98				0.85	0.74	0.98
	<b>Married</b>				1.48	1.24	1.76				1.48	1.24	1.76
	<b>Single</b>				1.00						1.00		
<b>Education</b>	<b>High</b>				0.71	0.52	0.96				0.71	0.52	0.96
	<b>Ele/Mid</b>				0.68	0.49	0.92				0.67	0.49	0.92
	<b>Uneducated</b>				1.00						1.00		
<b>Household Income</b>	<b>&lt;100</b>				1.74	1.47	2.06				1.78	1.50	2.11
	<b>101-200</b>				1.45	1.27	1.66				1.48	1.30	1.69
	<b>201-300</b>				1.26	1.11	1.42				1.28	1.12	1.45
	<b>301-400</b>				1.10	0.95	1.27				1.11	0.96	1.28
	<b>401≤</b>				1.00						1.00		
<b>Occupation</b>	<b>Manual</b>				0.94	0.83	1.07				0.95	0.84	1.08
	<b>Prof/Admin/Cler</b>				0.91	0.81	1.02				0.90	0.81	1.01
	<b>Services/Sales</b>				1.00						1.00		

[Table 11] Continued

<b>Smoking</b>	<b>no</b>	<b>0.71</b>	<b>0.63</b>	<b>0.80</b>		<b>0.71</b>	<b>0.63</b>	<b>0.80</b>		
	<b>yes</b>	1.00				1.00				
<b>Drinking</b>	<b>no</b>	0.96	0.87	1.06		0.96	0.87	1.06		
	<b>yes</b>	1.00				1.00				
<b>Physical Activity</b>	<b>no</b>	1.04	0.95	1.14		1.04	0.95	1.14		
	<b>yes</b>	1.00				1.00				
<b>Self-perceived Obese state</b>	<b>no</b>	<b>0.86</b>	<b>0.79</b>	<b>0.94</b>		<b>0.86</b>	<b>0.79</b>	<b>0.94</b>		
	<b>yes</b>	1.00				1.00				
<b>Experience of disease or accident</b>	<b>no</b>	<b>0.36</b>	<b>0.32</b>	<b>0.40</b>		<b>0.36</b>	<b>0.32</b>	<b>0.40</b>		
	<b>yes</b>	1.00				1.00				
<b>Community-level factors</b>										
	<b>1</b>				0.92	0.79	1.08	<b>1.22</b>	<b>1.04</b>	<b>1.44</b>
	<b>2</b>				0.94	0.81	1.09	1.07	0.92	1.24
	<b>3</b>				0.92	0.79	1.07	1.01	0.87	1.17
	<b>4</b>				1.00			1.00		
<b>Variance of random intercept(S.E)</b>		0.1061(0.022)	0.1062(0.022)		0.1057(0.022)			0.09722(0.022)		
<b>Percentage change of variance**</b>		REF	-0.09%		0.38%			8.37%		
<b>-2 Log Likelihood</b>		17233.79	16430.58		17232.27			16422.88		
<b>AIC</b>		17237.79	16476.58		17242.27			16474.88		

\* Model 0 : Null model.

\* Model 1 : Only individual-level factors are adjusted.

\* Model 2 : Only area(communitiy)-level features are adjusted.

\* Model 4 : All individual- and area-level factors are adjusted

\* NOTE: **BOLD** indicates statistically significance at 5% level

\*\* Percentage change of variance =  $[v(\text{null})-v(\text{complex model})]/v(\text{null})*100$

## Chapter IV. Discussion and Conclusion

### 4-1. Discussion

There are many researches that show the association between region features and individual's health state. The mental health, especially depression, is also affected by area-level factors.

In this study, the results of multilevel data analysis, in other words generalized linear mixed model analysis, presents the association between individual's mental health state and community-level features. When the community has more female, elderly, specific marital status, under high-school educational level, manual worker, low household income(100man-won and less) population, the community has more high-stress or depression experienced people. Therefore, area-level variables can explain the difference of stress and depression prevalence among community 'gu' and 'dong'. This results are similar to prior researches(Jeon, 2003; Jung et al, 2007; Kim et al, 2008).

Especially 'dong' level, more than 'gu' level, can explain the association between area features and individual's mental health state. It shows similar to the result of Kim's report(2006). Also depression is more affected by area than degree of stress. Because depression is a key index of one's health, it's management through community care can be good way to improve area health level.

## 4-2. Conclusion

There is association between regional features and individual's mental health by comparing the differences between small area in Seoul and figuring the effect factors on mental health state. Therefore, it is necessary that establish community level approach and management to improve individual's mental health.



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## 국문초록

# 다수준 분석을 이용한 서울시 정신건강 상태의 소지역별 차이 및 지역특성과의 연관성

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**배경 및 목적** : 정신건강이 우리 삶에 미치는 영향은 지금까지 많은 연구를 통해 알려져 왔다. 하지만, 2011년 정신질환실태 역학조사에 따르면 알코올과 니코틴 사용장애를 제외한 모든 정신장애에서 유병률이 증가하는 추세이며, 이에 대한 관심 및 관리가 부족하다고 나타났다. 한편 개인 건강에 미치는 지역효과에 대해 수많은 연구를 통해 밝혀져 왔으며 정신건강 역시 이러한 맥락효과에 영향을 받는다고 알려져 있다. 이에 본 연구에서는 서울특별시 소지역별 정신건강 상태의 차이를 확인하고, 이를 지역사회 수준에서의 영향 요인을 밝혀 정신건강 개선을 위한 접근 및 관리를 위한 기초 자료를 생산하고자 한다.

**방법** : 2011, 2012, 2013년 지역사회건강조사 자료를 이용하였으며, 서울시 25개 구의 성인을 대상으로 하였다. 현재까지 연구를 통해 밝혀진 정신건강에 미치는 영향 요인으로 개인 수준에서 건강행태 요인으로 흡연, 음주, 운동, 비만인지, 질환 및 사고중독 경험을 정의하고, 지역 수준에서의 변수로는 여성, 노인, 결혼상태 ‘이혼/사별/미망인’, 고졸미만 학력, 육체 노동자, 가구 소득 100만원 이하 인구의 비율을 정의하였다. 정신건강 상태를 확인

하기 위한 변수로는 주관적 스트레스 인지 정도와 우울감 경험률 변수를 사용하였다. 서울시 내 소지역별 차이를 확인하기 위해 빈도 분석을 실시하고 정신건강 영향 요인의 수준을 확인하기 위해 다수준 분석을 시행하였다. 모든 분석절차는 SAS 통계 프로그램 9.3 버전으로 진행되었다.

**결과** : 연구에 포함된 대상자는 서울에 거주하는 19세 이상 성인으로 2011, 2012, 2013년 지역사회건강조사에 참여한 39,380명이다. 높은 스트레스 인지에 해당하는 사람은 12,789명이며, 최근 1년 이내에 우울감 경험이 있다고 응답한 대상자는 2255명으로 나타났다. 서울시를 25개 구와 424개 동의 행정단위로 나눌 수 있었으며, 구 단위로 나누어 살펴보았을 때 일상 생활에서 높은 스트레스를 인지하는 평균 인구 비율은 29.3%, 평균 우울감 경험 인구 비율은 7.1%로 확인하였다. 또한, 정신건강 변수와 개인의 인구학적 변수 간 연관성을 살펴보았을 때 스트레스는 모든 개인 변수가, 우울감의 경우는 직업과 건강관련 행동 중 음주, 운동습관을 제외한 변수에서 유의하게 나타났다( $p < 0.05$ ). 다수준분석 결과, 구와 동 수준 모두 지역간 차이가 나타나고 있었으며, 스트레스보다는 우울감에서 지역간 차이가 큰 것으로 나타났다. 특히 개인의 우울감에 대한 동별 차이는 지역변수를 고려한 경우 크게 설명 되고 있었다.

**고찰** : 본 연구에서는 개인의 정신건강의 지역별 차이를 비교해보고, 그 영향 요인을 개인 수준과 지역 수준으로 나누어 살펴보았다. 스트레스 인지 정도와 우울감 경험 모두 지역 특성과의 연관성이 나타났으며, 특히 우울감 경험의 경우 지역의 특성에 더 큰 영향을 받는 것으로 나타났다. 즉, 개인의 좋은 정신건강 상태를 위한 방법으로 개인 차원 개선뿐만 아니라, 지역 차원의 관심과 접근이 필요하며 이를 관리하기 위한 근거기반의 지역 사업 및 정책 마련이 필요하다.

**주요어** : 정신건강, 스트레스, 우울감, 지역사회, 다수준 분석

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