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Association between community deprivation and practising health behaviours among South Korean adults: a survey-based cross-sectional study

Bich Na Jang ,[1] Hin Moi Youn,[1] Doo Woong Lee,[1] Jae Hong Joo,[1] Eun-Cheol Park [2]

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[1]Department of Public Health, Yonsei University Graduate School, Seodaemun-gu, Korea (the Republic of)
[2]Department of Preventive Medicine and Institute of Health Services Research, Yonsei University College of Medicine, Seodaemun-gu, Korea (the Republic of)

Correspondence to
Dr Eun-Cheol Park;
ecpark@yuhs.ac

ABSTRACT

Objectives This study aimed to determine the association between community deprivation and poor health behaviours among South Korean adults.

Design This was a survey-based cross-sectional study.

Setting and participants Data of 224 552 participants from 244 communities were collected from the Korea Community Health Survey, conducted in 2015.

Primary and secondary outcome measures We defined health behaviours by combining three variables: not smoking, not high-risk drinking and walking frequently. Community deprivation was classified into social and economic deprivation.

Results Multilevel logistic analysis was conducted to determine the association of poor health behaviours through a hierarchical model (individual and community) for the 224 552 participants. Among them, 69.9% did not practice healthy behaviours. We found that a higher level of deprivation index was significantly associated with higher odds of not-practising healthy behaviours (Q3, OR: 1.15, 95% CI: 1.00 to 1.31; Q4 (highest), OR: 1.22, 95% CI: 1.06 to 1.39). Economic deprivation had a positive association with not-practising health behaviours while social deprivation had a negative association.

Conclusion These findings imply that community deprivation levels may influence individual health behaviours. Accordingly, there is a need for enforcing the role of primary healthcare centres in encouraging a healthy lifestyle among the residents in their communities, developing national health policy guidelines for health equity and providing financial help to people experiencing community deprivation.

Strengths and limitations of this study

- This study was conducted using a large sample data, hence its results may be considered to be representative of South Korea.
- We used multilevel logistic analysis for determining the relationship between community deprivation and practising health behaviour to consider individual-level and community-level factors simultaneously.
- Community deprivation scale used in this study has been developed considering the South Korean society, it may need to be modified to suit the sociocultural context of other countries.

INTRODUCTION

According to WHO, health has been defined as 'a complete physical, mental and social well-being, and not merely the absence of disease or infirmity.'[1] There are many factors that sustain health, with health behaviour being one of the essential ones. Health behaviours include practices such as avoiding smoking and consuming alcohol, and exercising regularly. When it comes to health maintenance, people can practice health behaviours and reduce the risk of diseases.[2 3] On the other hand, an unhealthy lifestyle leads to unhealthy consequences such as cardiovascular diseases or increase in morbidity and mortality.[4 5] Health is affected not only by physical conditions and activities, but also by the surrounding environment.[6] It is well known that regional gaps in socioeconomic factors also result in health demerits.[7–11]

One of the most representative indicators reflecting regional disparity is the community deprivation index. It is a measurement of socioeconomic deprivation for a geographical area, and generally uses census variables. This index has been developed in various ways in multiple countries.[12–15] It is also widely used in health research to establish whether relationships are associated with deprivation, as universal health coverage is one of the primary goals of the WHO.[16] Health equities are also emphasised in the Sustainable Development Goals of the United Nations Organization.[17]

Studies on differences in health status due to community deprivation have been actively conducted in many countries. A previous study showed that neighbourhood deprivation in urban areas had an association with

unmet needs; however, this was not true for rural areas.[18] Another study found a positive relationship between physical and mental symptoms and community deprivation after adjusting the size of the areas.[19] Several studies have also revealed the relationship between a community's socioeconomic level and its health behaviours through a multilevel analysis.[20–23] However, few studies have used the community deprivation index and classified community deprivation into economic and social deprivation, while studying the relationship between deprivation and health behaviours.

Based on the results of the previous studies, we hypothesised that the community deprivation index will have a positive relationship with poor health behaviours. Therefore, the objective of this study was to find the association between community deprivation index and not-practising health behaviours. In addition, we classified the components of the community deprivation index into economic and social deprivation to determine which deprivation is related to not-practising health behaviours.

METHODS

Study population

We used data from the Korea Community Health Survey (KCHS), which was carried out in 2015. This survey has been conducted annually by the Korean Centers for Disease Control and Prevention for adults aged 19 years or older since 2008 to establish and evaluate regional health plans, and standardise the survey performance system to produce comparable regional health statistics.[24] The KCHS data used in this study included 198 questions across 19 fields including health behaviours, physical activities, medical service use and social environments. The KCHS distributes samples to each public health centre and targets an average of 900 people per public health centre. The participants, who accounted for 4% of the total population in South Korea were surveyed and samples were distributed proportionally by administrative region.

The data of 228 558 participants were evaluated; we excluded those who answered 'do not know', gave invalid responses to the questions, or did not answer all the questions included in this study (n=4006). Finally, data of 224 552 participants (100 998 men, 123 554 women) were analysed in the study.

Variables

To define health behaviours, we combined three variables suggested by the KCHS survey: no smoking, not belonging to the high-risk drinking group and walking frequently. No smoking was reflected when a participant was not smoking at the time of investigation and had experienced a '0' pack-year. Pack-year is a method of measuring the number of cigarettes a person has smoked; it is calculated by multiplying the number of packs of cigarette smoked per day by the number of years of continued smoking. We combined these two indicators to assess the exact status of smoking for each participant. Not belonging to the high-risk drinking group was defined as being a non-drinker, or drinking under five shots (for women) or under seven shots (for men) in a single sitting and consuming alcohol less than once per week. Walking frequently was defined as walking for over 30 min daily more than 5 days in the last week. Participants who met all three of these conditions were categorised into the practising-health-behaviour group, while those who failed to meet one or over of the above conditions were categorised into the not-practising-health-behaviour group.

The community deprivation index is a measure of the influence of socioeconomic status at the regional level. The index used in this study was developed by the Korea Institute for Health and Social Affairs which is the national research institution in South Korea. The index was developed based on data from 10% of the 2015 population census in Korea.[15] It is composed of nine indicators and is further classified into economic and social deprivation according to results of factor analysis.[25] Economic deprivation is composed of low socioeconomic level, poor quality of housing, low educational level and the number of elder people, while social deprivation is composed of not owning a car, the portion of divorced or bereaved, the number of one-person households, female householder, and not living in an apartment. Each variable was calculated at the municipal level of Si (city), Gun (county) and Gu (borough) using z-scores and all the values were combined.[15] Then we categorised the index into four quartiles: quartile 1 (Q1) was reflective of the lowest level of community deprivation, while quartile 4 (Q4) was reflective of the highest level (Q1 <6.52, –6.52≤Q2<–1.24 to –1.24≤Q3<5.37, Q4 >5.37). Since the KCHS survey was conducted in 254 public health

Figure 1 Directed Acyclic Graph representing the relationship between community deprivation and not-practising health behaviours.

Table 1 General characteristics of the study population

	Practising health behaviours*						
	Total						
	Total		Yes		No		
Variables	N	%	N	%	N	%	P value
Total (n=224 552)	224 552	100.0	67 506	30.1	157 046	69.9	
Community level							
Region							<0.0001
Metropolitan	62 063	27.6	23 346	37.6	38 717	62.4	
Urban	64 034	28.5	18 616	29.1	45 418	70.9	
Rural	98 455	43.8	25 544	25.9	72 911	74.1	
Community Deprivation Index							<0.0001
Quartile 1 (lowest)	56 554	25.2	17 946	31.7	38 608	68.3	
Quartile 2	54 983	24.5	17 897	32.6	37 086	67.4	
Quartile 3	56 097	25.0	16 356	29.2	39 741	70.8	
Quartile 4 (highest)	56 918	25.3	15 307	26.9	41 611	73.1	
Individual level							
Age (years)							<0.0001
19–29	24 323	10.8	8950	36.8	15 373	63.2	
30–39	32 006	14.3	7903	24.7	24 103	75.3	
40–49	41 235	18.4	10 152	24.6	31 083	75.4	
50–59	44 618	19.9	13 158	29.5	31 460	70.5	
≥60	82 370	36.7	27 343	33.2	55 027	66.8	
Sex							<0.0001
Men	100 998	45.0	23 305	23.1	77 693	76.9	
Women	123 554	55.0	44 201	35.8	79 353	64.2	
Marital status							<0.0001
Living with spouse	153 408	68.3	45 501	29.7	107 907	70.3	
Living without spouse	71 144	31.7	22 005	30.9	49 139	69.1	
Occupational categories†							<0.0001
White	43 391	19.3	12 199	28.1	31 192	71.9	
Pink	29 412	13.1	8693	29.6	20 719	70.4	
Blue	70 032	31.2	18 065	25.8	51 967	74.2	
Inoccupation	81 717	36.4	28 549	34.9	53 168	65.1	
Educational level							<0.0001
Middle school or less	81 205	36.2	25 223	31.1	55 982	68.9	
High school	64 154	28.6	17 838	27.8	46 316	72.2	
College or over	79 193	35.3	24 445	30.9	54 748	69.1	
Household income							<0.0001
Low	48 532	21.6	14 523	29.9	34 009	70.1	
Mid-low	79 827	35.5	24 045	30.1	55 782	69.9	
Mid-high	61 005	27.2	17 883	29.3	43 122	70.7	
High	35 188	15.7	11 055	31.4	24 133	68.6	
Obesity status (BMI)‡							<0.0001
Underweight and Normal range	114 557	51.0	35 994	31.4	78 563	68.6	
Overweight	53 022	23.6	16 109	30.4	36 913	69.6	
Obese	56 973	25.4	15 403	27.0	41 570	73.0	
Practising exercise							<0.0001

Continued

Table 1 Continued

Variables	Practising health behaviours*						
	Total						
	Total		Yes		No		
	N	%	N	%	N	%	P value
Moderate or over	51 273	22.8	18 734	36.5	32 539	63.5	
No	173 279	77.2	48 772	28.1	124 507	71.9	
The no of comorbid diseases§							<0.0001
0	135 133	60.2	39 971	29.6	95 162	70.4	
1	50 076	22.3	15 360	30.7	34 716	69.3	
≥2	39 343	17.5	12 175	30.9	27 168	69.1	
Perceived health status							<0.0001
Good	83 533	37.2	27 089	32.4	56 444	67.6	
Bad	141 019	62.8	40 417	28.7	100 602	71.3	
Perceived stress							<0.0001
Much	57 668	25.7	14 803	25.7	42 865	74.3	
Less	166 884	74.3	52 703	31.6	114 181	68.4	

Inoccupation group includes housewives.
*Those who were classified under health behaviours group met all of three conditions: not smoking, not in high-risk drinking group and walking for 30 min over 5 days per week.
†The three groups (white, pink, blue) were based on the International Standard Classification Occupations codes.
‡BMI/obesity status defined by BMI based on the 2018 Clinical Practice Guidelines for Overweight and Obesity in Korea.
§Comorbid diseases included hypertension, diabetes mellitus, hyperlipidaemia and arthritis. The number of comorbid diseases is the sum of the number of diagnosed above diseases.
BMI, body mass index.

centres, we divided administrative areas according to the unit of the public health centre.

Other covariates were also included in the analysis as potential confounding variables. At the individual level, these variables were sex, age, marital status, occupation category, educational level, household income, body mass index, comorbidity, perceived health status and perceived stress level. At the community level, these variables were region and the community deprivation index. Region was categorised into three entities: metropolitan, urban and rural. In South Korea, the metropolitan cities have a population of over 1 million and comprise small entities referred to as 'Dong', while the other cities have a population of more than 50 000 and comprise smaller entities reffered to as 'Dong', 'Eup' and 'Myeon'. A 'Dong' is named assigned to a small unit in an urban area, an 'Eup' has a population of over 20 000, and a 'Myeon' is the smallest unit of these three. We defined 'Dongs' in the metropolitan cities as metropolitan regions, 'Dongs' in the other cities as the urban regions; further, the rural regions included 'Eups' and 'Myeons'. The variable of occupation was categorised according to the Korean version of the Standard Classification of Occupations, based on the International Standard Classification of Occupations by the International Labour Organization. We recategorised occupations into four categories: white (office work), pink (sales and service), blue (agriculture, forestry, fishery and armed forces) and inoccupation (those with no jobs, housewives and students). Comorbidities included in the study were hypertension, diabetes mellitus, hyperlipidemia and arthritis, and we calculated the number of comorbid diseases that a person had simultaneously.

The theorised relationship between community deprivation, not-practising health behaviours, and other covariates are represented through a Directed Acyclic Graph (DAG) (figure 1). In this DAG, all covariates are potential confounders of the association between community deprivation and not-practising health behaviours.

Statistical analysis

The χ^2 test was used to assess for significant differences in all the covariates between those who practised health behaviours and those who did not. Differences were considered statistically significant at $p<0.05$. We also conducted multilevel logistic regression (participants nested within communities) through hierarchical generalised linear models, because the outcome variable was categorical and non-normally distributed. The analysis used in this study was based on the conceptual framework proposed by Ene *et al*.[26]

We established three models for the analysis. The first model, model 1, was a null model, which meant that it did not include any variables. This model was used to calculate the intraclass correlation coefficient (ICC), which measures how much variation in the outcome variable

Table 2 ORs for community deprivation and not-practising health behaviours using multilevel

	Not-practising health behaviours*		
	Total		
Variables	Model 1 (Null)	Model 2 OR (95% CI)	Model 3 OR (95% CI)†
Fixed effects			
Intercept (SE)	0.87‡(0.03)	0.48‡(0.04)	0.03‡(0.07)
Community level			
Region			
Metropolitan			1.00
Urban			1.57 (1.41 to 1.75)
Rural			1.73 (1.55 to 1.93)
Community Deprivation Index			
Quartile 1 (lowest)			1.00
Quartile 2			1.02 (0.89 to 1.17)
Quartile 3			1.15 (1.00 to 1.31)
Quartile 4 (highest)			1.22 (1.06 to 1.39)
Individual level			
Age (years)			
19–29		1.00	1.00
30–39		1.82 (1.75 to 1.90)	1.82 (1.74 to 1.89)
40–49		1.75 (1.67 to 1.82)	1.74 (1.67 to 1.82)
50–59		1.23 (1.18 to 1.28)	1.23 (1.18 to 1.28)
≥60		0.87 (0.83 to 0.91)	0.86 (0.83 to 0.90)
Sex			
Men		1.00	1.00
Women		0.48 (0.47 to 0.49)	0.48 (0.47 to 0.49)
Marital status			
Living with spouse		1.00	1.00
Living without spouse		1.18 (1.15 to 1.21)	1.18 (1.15 to 1.21)
Occupational categories§			
White		1.00	1.00
Pink		0.98 (0.94 to 1.01)	0.97 (0.94 to 1.01)
Blue		0.98 (0.95 to 1.02)	0.98 (0.94 to 1.01)
Inoccupation		0.89 (0.86 to 0.92)	0.89 (0.86 to 0.92)
Educational level			
Middle school or less		1.27 (1.22 to 1.31)	1.26 (1.21 to 1.30)
High school		1.16 (1.13 to 1.20)	1.16 (1.13 to 1.19)
College or over		1.00	1.00
Household income			
Low		0.99 (0.95 to 1.03)	0.98 (0.95 to 1.02)
Mid-low		0.94 (0.91 to 0.97)	0.93 (0.90 to 0.96)
Mid-high		0.98 (0.95 to 1.01)	0.98 (0.95 to 1.01)
High		1.00	1.00
Obesity status (BMI)¶			
Underweight and normal range		1.00	1.00
Overweight		0.95 (0.93 to 0.97)	0.95 (0.93 to 0.97)
Obese		1.04 (1.02 to 1.07)	1.04 (1.02 to 1.07)

Continued

Table 2 Continued

Variables	Not-practising health behaviours* Total Model 1 (Null)	Model 2 OR (95% CI)	Model 3 OR (95% CI)†
Practising exercise			
Moderate or over		1.00	1.00
No		1.62 (1.59 to 1.66)	1.62 (1.59 to 1.66)
The no of comorbid diseases**			
0		1.00	1.00
1		0.99 (0.96 to 1.01)	0.98 (0.96 to 1.01)
≥2		1.06 (1.03 to 1.09)	1.06 (1.03 to 1.09)
Perceived health status			
Good		1.00	1.00
Bad		1.23 (1.20 to 1.26)	1.23 (1.21 to 1.26)
Perceived stress			
Much		1.31 (1.28 to 1.34)	1.31 (1.28 to 1.34)
Less		1.00	1.00
Error variance			
Level-2 intercept (SE)	0.18‡(0.02)	0.20‡(0.02)	0.13‡(0.01)
Model fit			
−2LL	267225.3	256614.4	256514.9
Pearson χ^2/DF	1.00	1.00	1.00

*Those who were classified under the practising health behaviours group met all of three conditions: not present smoking, not in high-risk drinking group and walking for 30 min over 5 days per week.
†Best fitting model.
‡P<0.05; intraclass correlation coefficient: 0.05289 (<0.0001).
§Three groups (white, pink, blue) based on the International Standard Classification Occupations codes. Inoccupation group includes housewives.
¶BMI/obesity status defined by BMI based on the 2018 Clinical Practice Guidelines for Overweight and Obesity in Korea.
**Comorbid diseases included hypertension, diabetes mellitus, hyperlipidaemia and arthritis. The number of comorbid diseasese is the sum of the number of diagnosed above diseases.
BMI, body mass index.

remains between level-two units. The following equation was used for calculating ICC:

$$ICC = \frac{\tau_{00}}{\tau_{00} + \frac{\pi^2}{3}}$$

$\tau_{00}$is the community level variance and $\frac{\pi^2}{3}$ corresponds to individual level variance, because this study has a dichotomous outcome variable.

The second model, model 2, included model 1 and the variables at the individual level. The results of this model indicated the relationship between the individual variables and the outcome. The third model, model 3, was the final model; it included model 2 and variables at the community level. The results of this model indicated the relationship between the community variables and the outcome. The results were reported using ORs and CIs. All statistical analyses were performed using SAS software (V.9.4, SAS Institute=).

Patient and public involvement

No patient involved.

RESULTS

Table 1 shows the general characteristics of the study population. Among the 224552 study participants, 157046 (69.9%) participants did not practice at least one of the health behaviours. A total of 244 administrative areas were included in this study; the percentage of rural, urban, and metropolitan areas was 43.8%, 28.5% and 27.6%, respectively,

The ORs for factors associated with not-practising health behaviours were determined using multilevel logistic regression analysis and are shown in table 2. The ICC value was 0.05289, indicating that 5.3% of the variability in the rate of not-practising health behaviours can be accounted for by communities, and that the odds of not-practising health behaviours vary significantly among community levels. The percentage change of variance was 27.8% ((0.18–0.13)/0.18×100) and the log likelihood ratio was 256514.9, indicating that model 3 was the best fitting model in this study. In model 3, a higher level of deprivation index was significantly associated with higher

Table 3 Subgroup analysis of not-practising health behaviours by interesting variable*

Variables	Not-practising health behaviours† OR (95% CI)
Economic Deprivation Index	
Quartile 1 (lowest)	1.00
Quartile 2	1.27 (1.12 to 1.45)
Quartile 3	1.34 (1.15 to 1.57)
Quartile 4 (highest)	1.80 (1.46 to 2.20)
Social Deprivation Index	
Quartile 1 (lowest)	1.00
Quartile 2	0.93 (0.81 to 1.07)
Quartile 3	0.87 (0.75 to 1.01)
Quartile 4 (highest)	0.81 (0.67 to 0.98)

*Multilevel logistic analysis adjusted for variables including age, marital status, occupation, household income, BMI, the number of chronic diseases, perceived health status, perceived stress and region.
†Those who were classified under the practising health behaviours group met all of three conditions: not present smoking, not in high-risk drinking group, and walking for 30 min over 5 days per week.
BMI, body mass index.

odds of not-practising health behaviours (Q3, OR: 1.15, 95% CI: 1.00 to 1.31; Q4, OR: 1.22, 95% CI: 1.06 to 1.39). Moreover, living in rural areas was most significantly associated with not-practising health behaviours (urban, OR: 1.57, 95% CI: 1.41 to 1.75; rural, OR: 1.73, 95% CI: 1.55 to 1.93). Individual level variables associated with not-practising health behaviours were: ages 30–59 years, living without a spouse, having completed only high school or less, obesity, two or more comorbid diseases, bad perceived health status, and high perceived stress. In contrast, individual variables found to have a positive association with practising health behaviours were: ages 60 years and above, being a woman, not being professionally employed, having mid-low household income and being overweight.

Table 3 presents the subgroup analysis of the community deprivation index. Results in this table were adjusted for all the variables that we used in this study. The results showed that economic deprivation was more associated with not-practising health behaviours than social deprivation. Moreover, the higher the economic deprivation, the greater was the association with not-practising health behaviours (Q2, OR: 1.27, 95% CI: 1.12 to 1.45; Q3, OR: 1.34, 95% CI: 1.15 to 1.57; Q4, OR: 1.80, 95% CI: 1.46 to 2.20). Interestingly, in the social deprivation index, the highest level of social deprivation showed greater association with practising health behaviours than the other levels and the OR for this association was significant (Q4, OR: 0.81, 95% CI: 0.67 to 0.98).

Table 4 shows the combined effect of community deprivation and other independent variables. The difference in the community deprivation index between the lowest and the highest quartile was greater for women than for men. A similar tendency was seen in those living with a spouse; not professionally employed; having completed middle school or less, or college and over; and having low or high income.

DISCUSSION

This study was designed to determine the association between community deprivation level and health behaviours using multilevel logistic analysis. The primary outcome of the study was the association found between higher community deprivation level and not-practising health behaviours; these results were significant in Q3 and Q4 of community deprivation. After classifying community deprivation into economic and social deprivation, we found a positive relationship between economic deprivation and poor health behaviours, and a negative relationship between social deprivation and poor health behaviours.

Although the relationships between community deprivation and each variable of health behaviours were not significantly associated in this study (see online supplemental table S1), previous studies have found positive relationships between each of these variables.[21–23 27] These studies have also evaluated regional and environmental effects among individuals. Some places can influence poor health behaviours even in areas with lower community deprivation as compared with areas with higher community deprivation.

Several studies support this study's hypothesis. A meta-analysis confirmed that the greater the number of physical facilities in one's surroundings, more is the amount of physical activity performed by people.[28] Furthermore, people who live in deprived neighbourhoods and have peers in their surroundings are more prone to being heavy drinkers than those living in non-deprived neighbourhoods.[23] The behaviour of smoking is particularly affected by the surrounding environment, and a study has determined a difference in the degree to which people are affected by the surrounding environment depending on the socioeconomic level of the area in which they live.[20]

Meanwhile, this study obtained different results in comparison to previous studies. The results highlight the difference between material and social deprivation in terms of health; the material index can be said to be a more accurate estimate of estimating variations in health inequality within an urban area.[29] Another previous study focused on the influence of material difference on health inequality.[30] Since it is hard to differentiate economic from social deprivation, it is necessary to improve both conditions to achieve health equity.[31] However, people with high economic status are more likely to practice health behaviours and this could enable social participation.[32] Thus, it can be suggested that financial support is needed to overcome health inequality.

Table 4 Subgroup analysis of not-practising health behaviours by independent variables*

	Not-practising health behaviours†			
	Community Deprivation Index			
	Quartile 1 (lowest)	Quartile 2	Quartile 3	Quartile 4 (highest)
Variables	OR	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age (years)				
19–29	1.00	0.96 (0.83 to 1.10)	1.04 (0.90 to 1.21)	1.06 (0.90 to 1.25)
30–39	1.00	1.14 (0.98 to 1.32)	1.27 (1.10 to 1.48)	1.46 (1.23 to 1.73)
40–49	1.00	1.02 (0.88 to 1.20)	1.21 (1.04 to 1.42)	1.24 (1.05 to 1.47)
50–59	1.00	0.94 (0.81 to 1.09)	1.06 (0.91 to 1.23)	1.12 (0.96 to 1.31)
≥60	1.00	1.09 (0.94 to 1.26)	1.18 (1.03 to 1.36)	1.23 (1.06 to 1.41)
Sex				
Men	1.00	0.99 (0.87 to 1.12)	1.12 (0.99 to 1.27)	1.17 (1.03 to 1.34)
Women	1.00	1.06 (0.91 to 1.23)	1.18 (1.02 to 1.36)	1.27 (1.09 to 1.47)
Marital status				
Living with spouse	1.00	1.03 (0.90 to 1.19)	1.18 (1.03 to 1.35)	1.23 (1.07 to 1.42)
Living without spouse	1.00	1.02 (0.89 to 1.17)	1.10 (0.96 to 1.26)	1.20 (1.04 to 1.38)
Occupational categories‡				
White	1.00	1.00 (0.86 to 1.15)	1.12 (0.97 to 1.30)	1.15 (0.98 to 1.35)
Pink	1.00	1.04 (0.89 to 1.21)	1.15 (0.98 to 1.34)	1.13 (0.96 to 1.34)
Blue	1.00	0.99 (0.83 to 1.17)	1.17 (0.98 to 1.38)	1.31 (1.10 to 1.55)
Inoccupation	1.00	1.07 (0.95 to 1.21)	1.15 (1.02 to 1.30)	1.19 (1.05 to 1.35)
Educational level				
Middle school or less	1.00	1.01 (0.87 to 1.18)	1.16 (1.00 to 1.36)	1.24 (1.06 to 1.44)
High school	1.00	1.01 (0.87 to 1.16)	1.09 (0.94 to 1.25)	1.12 (0.96 to 1.29)
College or over	1.00	1.05 (0.92 to 1.18)	1.16 (1.02 to 1.31)	1.19 (1.04 to 1.36)
Household income				
Low	1.00	1.06 (0.90 to 1.23)	1.17 (1.00 to 1.36)	1.30 (1.11 to 1.52)
Mid-low	1.00	1.01 (0.88 to 1.16)	1.14 (0.99 to 1.31)	1.17 (1.01 to 1.35)
Mid-high	1.00	1.02 (0.88 to 1.18)	1.13 (0.98 to 1.31)	1.15 (0.99 to 1.34)
High	1.00	1.04 (0.89 to 1.22)	1.22 (1.03 to 1.44)	1.20 (1.00 to 1.44)

Inoccupation group includes students, housewives and those with no jobs.
*Multilevel logistic analysis adjusted for variables including age, marital status, occupation, household income, BMI, the number of chronic diseases, perceived health status, perceived stress and region.
†Those who were classified under the practising health behaviours group met all of three conditions: not present smoking, not in high-risk drinking group, and walking for 30 min over 5 days per week.
‡Three groups (white, pink, blue) were based on the International Standard Classification Occupations codes.
BMI, body mass index.

Another finding was the influence of sex in determining the extent to which community deprivation related to health behaviours. This study found a greater difference in the association of bad health behaviours between women living in the more deprived areas and less deprived areas than that between men from similar areas. A previous study focusing on the association between neighbourhood differences in self-rated health supports this result.[33] In addition, women are more susceptible to the effect of neighbourhood socioeconomic deprivation than men. Women who live in socioeconomically deprived areas are more likely to be stressed and less likely to practise health behaviours.[34 35] As seen in our results, women were more likely to practice health behaviours and were more vulnerable to deprived environments compared with men.

While the findings of the study shed important light on how individual and community-level variables relate to poor health behaviours, this study has several limitations. First, factors of health behaviour were self-reported. As such, the participants had to respond based on their memory, and their responses might not have been accurate. Second, we considered only three factors of health behaviour. Other health behaviours such as physical

activity and diet habits may also be affected by community deprivation. Thus, we adjusted them as covariates in this study. Third, because of a lack of questions, we did not consider the intensity or purpose of walking in this study. Fourth, since this is a cross-sectional study, we did not consider any change in the practice of health behaviour and causal relationships. Last, since the community deprivation scale used in this study has been developed considering the South Korean society,[15] it may need to be modified to suit the sociocultural context of other countries.

Despite these limitations, our study has several strengths. First, this study was conducted using a large sample data; hence, its results may be considered to be representative of the South Korean society. Second, we analysed and found a positive association between community deprivation level and not-practising health behaviours using multilevel logistic regression to consider two-level variables, including those at the individual and community level. Thus, our results imply the influence of the community in individual health behaviours.

Based on these results, there is a need to enforce the role of primary healthcare centres in encouraging a healthy life for residents within communities, and to invest in education and awareness on the practice of health behaviour. At the national level, devoting adequate resources (eg, public sports facilities, healthcare providers or financial aids) for deprived area and developing health policies are required to achieve health equity.[36] Considering that women are more affected in socioeconomically deprived areas than men, it is necessary to design customised healthcare strategies for the underprivileged (eg, elderly, single-parent families or those living in a low residential environment). Furthermore, an integrated model between the central and local administration is needed to manage people's health systematically.[37 38] Accordingly, further research is required to construct a health model to achieve health equity, to measure the effectiveness of the input resources, and to develop policies. Moreover, longitudinal study to determine the impact of how changing the community deprivation levels might affect residents' health behaviour and health status, is warranted.

Contributors BNJ designed this study, performed statistical analysis, drafted and completed the manuscript. HMY and DWL contributed to the concept and design of the study, and provided statistical expertise and interpretation. JHJ revised the manuscript critically for important intellectual content. E-CP conceived, designed and directed this study. All authors read and approved the final manuscript.

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Data availability statement The data that support the findings of this study are openly available in the Korea Community Health Survey at http://chs.kdca.go.kr/.

ORCID iDs
Bich Na Jang http://orcid.org/0000-0002-4660-9044
Eun-Cheol Park http://orcid.org/0000-0002-2306-5398

REFERENCES

1 World Health Organization. Constitution of World Health Organization. Available: https://www.who.int/about/who-we-are/constitution [Accessed 21 Jul 2020].
2 Blair SN, Cheng Y, Holder JS. Is physical activity or physical fitness more important in defining health benefits? *Med Sci Sports Exerc* 2001;33:S379–99.
3 Lee L-L, Arthur A, Avis M. Evaluating a community-based walking intervention for hypertensive older people in Taiwan: a randomized controlled trial. *Prev Med* 2007;44:160–6.
4 Ockene IS, Miller NH. Cigarette smoking, cardiovascular disease, and stroke: a statement for healthcare professionals from the American heart association. *Circulation* 1997;96:3243–7.
5 Laatikainen T, Manninen L, Poikolainen K, *et al*. Increased mortality related to heavy alcohol intake pattern. *J Epidemiol Community Health* 2003;57:379–84.
6 Sartorius N. The meanings of health and its promotion. *Croat Med J* 2006;47:662–4.
7 Malmström M, Sundquist J, Johansson SE. Neighborhood environment and self-reported health status: a multilevel analysis. *Am J Public Health* 1999;89:1181–6.
8 Stimpson JP, Ju H, Raji MA, *et al*. Neighborhood deprivation and health risk behaviors in NHANES III. *Am J Health Behav* 2007;31:215–22.
9 Hoffman A, Holmes M. Regional differences in rural and urban mortality trends. Chapel Hill (NC) NC Rural Health Research Program; 2017. https://www.ruralhealthresearch.org/alerts/185 [Accessed 23 Jul 2020].
10 Detollenaere J, Hanssens L, Vyncke V, *et al*. Do we reap what we sow? exploring the association between the strength of European primary healthcare systems and inequity in unmet need. *PLoS One* 2017;12:e0169274.
11 Youn HM, Lee DW, Park E-C. Association between community outpatient clinic care accessibility and the uptake of diabetic retinopathy screening: a multi-level analysis. *Prim Care Diabetes* 2020;14:616–21.
12 Townsend P. Deprivation. *J Soc Policy* 1987;16:125–46.
13 Pampalon R, Hamel D, Gamache P, *et al*. A deprivation index for health planning in Canada. *Chronic Dis Can* 2009;29:178–91.
14 Salmond C, Crampton P, Sutton F. NZDep91: a New Zealand index of deprivation. *Aust N Z J Public Health* 1998;22:835–7.
15 Kim D, Lee S, Ki M. Developing health inequalities indicators and monitoring the status of health inequalities in Korea. Seoul Korea Institute for Health and Social Affairs; 2013: 166–79.
16 World Health Organization. Univeral health coverage. Available: https://www.who.int/news-room/fact-sheets/detail/universal-health-coverage-(uhc) [Accessed 21 Jul 2020].
17 The United Nations. About the sustainable development goals. Available: https://www.un.org/sustainabledevelopment/sustainable-development-goals/ [Accessed 21 Jul 2020].
18 Lee SE, Yeon M, Kim C-W, *et al*. Neighborhood deprivation and unmet health care needs: a multilevel analysis of older individuals in South Korea. *Osong Public Health Res Perspect* 2019;10:295–306.
19 Reijneveld SA, Verheij RA, de Bakker DH. The impact of area deprivation on differences in health: does the choice of the

geographical classification matter? *J Epidemiol Community Health* 2000;54:306–13.
20 Adams RJ, Howard N, Tucker G, *et al*. Effects of area deprivation on health risks and outcomes: a multilevel, cross-sectional, Australian population study. *Int J Public Health* 2009;54:183–92.
21 Moore GF, Littlecott HJ. School- and family-level socioeconomic status and health behaviors: multilevel analysis of a national survey in Wales, United Kingdom. *J Sch Health* 2015;85:267–75.
22 Wen M, Browning CR, Cagney KA. Neighbourhood deprivation, social capital and regular exercise during adulthood: a multilevel study in Chicago. *Urban Studies* 2007;44:2651–71.
23 Fone DL, Farewell DM, White J, *et al*. Socioeconomic patterning of excess alcohol consumption and binge drinking: a cross-sectional study of multilevel associations with neighbourhood deprivation. *BMJ Open* 2013;3:e002337.
24 Kang YW, Ko YS, Kim YJ, *et al*. Korea community health survey data profiles. *Osong Public Health Res Perspect* 2015;6:211–7.
25 Choi D-W, Lee SA, Lee DW, *et al*. Effect of socioeconomic deprivation on outcomes of diabetes complications in patients with type 2 diabetes mellitus: a nationwide population-based cohort study of South Korea. *BMJ Open Diab Res Care* 2020;8:e000729.
26 Ene M, Leighton EA, Blue GL, Bell BA. Multilevel models for categorical data using SAS® PROC GLIMMIX: the basics SAS Global Forum; 2015. Multilevel models for categorical data using SAS® PROC GLIMMIX
27 Duncan C, Jones K, Moon G. Smoking and deprivation: are there neighbourhood effects? *Soc Sci Med* 1999;48:497–505.
28 Humpel N, Owen N, Leslie E. Environmental factors associated with adults' participation in physical activity: a review. *Am J Prev Med* 2002;22:188–99.
29 Testi A, Ivaldi E. Material versus social deprivation and health: a case study of an urban area. *Eur J Health Econ* 2009;10:323–8.
30 Benach J, Yasui Y, Borrell C, *et al*. Material deprivation and leading causes of death by gender: evidence from a nationwide small area study. *J Epidemiol Community Health* 2001;55:239–45.
31 Marmot M. The health gap: the challenge of an unequal world. *The Lancet* 2015;386:2442–4.
32 Marmot M. The influence of income on health: views of an epidemiologist. *Health Aff* 2002;21:31–46.
33 Stafford M, Cummins S, Macintyre S, *et al*. Gender differences in the associations between health and neighbourhood environment. *Soc Sci Med* 2005;60:1681–92.
34 Grimaud O, Lapostolle A, Berr C, *et al*. Gender differences in the association between socioeconomic status and subclinical atherosclerosis. *PLoS One* 2013;8:e80195.
35 Alves L, Silva S, Severo M, *et al*. Association between neighborhood deprivation and fruits and vegetables consumption and leisure-time physical activity: a cross-sectional multilevel analysis. *BMC Public Health* 2013;13:1–9.
36 Dover DC, Belon AP. The health equity measurement framework: a comprehensive model to measure social inequities in health. *Int J Equity Health* 2019;18:1–12.
37 Morrin L, Britten J, Davachi S, *et al*. Alberta Healthy Living Program--a model for successful integration of chronic disease management services. *Can J Diabetes* 2013;37:254–9.
38 Jang S-nang, Lee JH, Kim C-O. Developing key indicators of health equity and strategies for reducing health disparity in national health plan. *Korean Journal of Health Education and Promotion* 2017;34:41–57.

Materials Included:

Table S1. Subgroup analysis of not-practicing health behaviors stratified by dependent variable

Table S1. Subgroup analysis of not-practising health behaviors stratified by dependent variable*

Variables	Not-practicing health behaviors[a]		
	Smoking	Drinking	Not walking frequently
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Community deprivation index			
Quartile 1 (lowest)	1.00	1.00	1.00
Quartile 2	1.03 (0.97 - 1.09)	1.04 (0.97 - 1.12)	1.01 (0.87 - 1.17)
Quartile 3	1.05 (0.99 - 1.11)	1.14 (1.06 - 1.23)	1.11 (0.96 - 1.29)
Quartile 4 (highest)	0.96 (0.90 - 1.02)	1.00 (0.92 - 1.08)	1.25 (1.08 - 1.45)

*Multilevel logistic analysis adjusted for variables including age, marital status, occupation, household income, BMI, the number of chronic diseases, perceived health status, perceived stress, and region.
[a]Those who were classified under the practicing health behaviors group met all of three conditions: not present smoking, not in high-risk drinking group and walking for 30 minutes over 5 days per week.