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ORIGINAL ARTICLE

Contextual effects of community mobilization and communication capacity as a positive factor for self-rated health status: a multi-level analysis

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Abstract
Objectives We examined relationships between individual-level community participation, two types of contextual effects—community capacity for mobilization and capacity for health communication—and residents' self-reported health status in order to explore the role health communication may play in community building for health.
Methods To estimate multi-level effects of the community participation and the two contextual indicators with self-rated health status, we applied hierarchical generalized linear regression to crosssectional data from the Korean National Health and Nutrition Examination Survey.
Results After adjusting for individual- and community-level confounders, the likelihood of having high self-rated health status is significantly higher among those who live in a region with higher community capacity for mobilization, higher health communication capacity at the community level, and higher participation in community groups at the individual-level.
Conclusions Our findings suggest that living in a community characterized by higher levels of communication and mobilization capacity is beneficial to residents' self-rated health status—increasing the odds of high health status by up to 9 %. Thus, building community capacity in mobilization and health communication may help develop better health promotion campaigns.

Keywords Contextual effects · Community capacity · Health communication · South Korea

Introduction

One contextual factor that plays an important role in health promotion is community capacity—"the characteristics of communities that affect their ability to identify, mobilize, and address social and public health problems" (Goodman et al. 1998, p. 259). The concept of community capacity integrates ideas about local communities, civic engagement, public health, and solidarity among disparate social groups (Scheufele and Shah 2000; Minkler et al. 2008; Chaskin et al. 2001). In terms of contextual effects in local communities (Diez-Roux 2002), a community's capacity for dissemination of health information and provision of services can act as an important facilitator in health promotion (Randolph and Viswanath 2004; Viswanath et al. 2006). The ability of different sectors to network together to take collective action is another important component of community capacity (Ramanadhan et al. 2012).

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Community capacity for mobilization

Community capacity is related to, but distinct from social capital (see Jung and Viswanath 2013 for a delineation between community capacity and social capital). Community capacity reflects the social and organizational architecture within a community and is a potential asset in addressing community problems. Collaborations between residents and informal or formal community-based voluntary associations (CBOs) and grassroots organizations (Freudenberg 2004; Minkler et al. 2008; Smith 2005) activate community capacity and thus it is an emergent property of a community that arises from both relationships between individuals and relationships between individuals and organizations (Chaskin et al. 2001). This integral aspect of community capacity can be thought of as community capacity for mobilization (Jung and Viswanath 2013). Community capacity for mobilization has been shown to positively predict self-reported health status; this may be related in part to the role that community-based organizations play in generating and disseminating important information that may be useful to the population and individual health (Jung and Viswanath 2013).

Media utilization and community capacity

Along with interpersonal communication, media are a key element in a community's informational and social environment with implications for health and well-being (Viswanath 2008). Local media presents a means to convey community concerns, promote community events, and foster a sense of collective identity and community involvement (Jeffres et al. 2007). Utilization of local media by citizens is an indicator of community capacity, along with factors such as the number of CBOs and voluntary associations, types of social gatherings, and length of residency (Moy et al. 2004). Use of local media, particularly for informational purposes, is associated with outcomes relevant to community capacity for mobilization. Scholars have documented positive relationships between local print news community knowledge (Jeffres et al. 2012) and community participation/organizational membership (Paek et al. 2005), as well as between Internet access and community involvement (Dutta-Bergman 2005).

Health communication capacity

Many health promotion campaigns rely on one or more media channels, including local television, radio, and the Internet (Xiao et al. 2013). In cases where campaigns partner with CBOs or CBOs themselves have health missions and hold community events and advertise in or utilize local media, greater community communication capacity and CBO activity implies greater opportunities for health content in local media channels, and thus more exposure—a fundamental factor in campaign success (Randolph and Viswanath 2004). A wider array of local media channels in a community not only allows for increased reach and segmentation across demographic segments which may prefer to get their information through different channels (Holder and Treno 1997), but also increased opportunities for repeated exposure to health messages among residents who tune into more than one form of media. At the same time, individual-level participation in CBOs may help to reinforce messages that residents hear in local media by providing added opportunities for exposure at events and for message elaboration through interpersonal conversations.

Yet, while community involvement may positively affect the health of the individuals who are involved in community organizations by providing a richer social and informational environment, there may also be beneficial spillover effects on other non-participating residents. Communities with abundant opportunities for accessing health information may influence even those who do not tune into the media, seek out health information, or participate in CBOs themselves, suggesting a role for contextual effects. That is, greater health communication capacity and capacity for mobilization can affect residents through interpersonal communication with those who did encounter health messages in the media, i.e., word of mouth or two-step flow (Katz and Lazarsfeld 2006; Ackerson and Viswanath 2009). Thus, areas with not only a wide array of media channels, but also high use of the media for health information seeking, present an environment where even non-health conscious residents may come into contact with health information (Dermota et al. 2013). Furthermore, they may be better positioned to act on the information. Residents may reap health benefits from goods, services, and other elements of the built environment that exist due to the community assets generated through community mobilization and coverage, including health services. People who may not normally be interested in health may therefore be more likely to encounter health messages and health-inducing infrastructure serendipitously by virtue of their prevalence within the community. Consequently, health in communities may be affected both by the relationship between media utilization and community capacity, and the relationship between community capacity and health communication capacity (Viswanath 2008; Jung and Viswanath 2013) (Fig. 1).

Despite the close relationship between community capacity for mobilization and health communication capacity, the association of these two factors with self-rated health status has not yet been examined. We thus hypothesized that community capacity for mobilization is

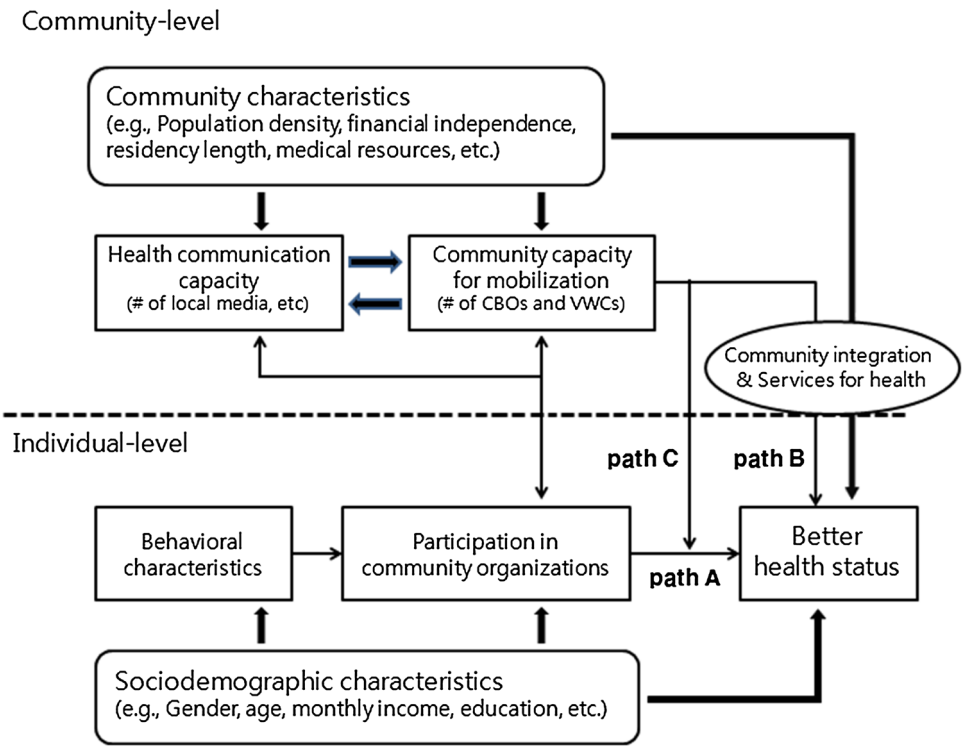

Fig. 1 A theoretical framework of the role of individual- and community-level factors that affect health status. This figure is based on Jung and Viswanath (2013); *CBOs* community-based organizations, *VWCs* volunteer work camps

activated by collaboration and communication between residents and informal or formal community-based voluntary associations (Minkler et al. 2008; Smith 2005). This is because their horizontal and vertical ties can deliver and amplify the potential utility of knowledge and information, as well as provide diverse resources and leadership (Provan et al. 2003; Jung and Rhee 2013). Using multi-level analysis, we examined the interrelationships among individual-level community participation and the two types of contextual effects—mobilization and health communication capacity—and their associations with self-rated health status.

Methods

Study data

The data for this paper are drawn from multiple sources. One, the individual-level data were taken from the 4th Korean National Health and Nutrition Examination Survey (KNHANES IV-3; http://knhanes.cdc.go.kr), conducted by the Korea Centers for Disease Control and Prevention in 2009. This survey was a nationwide representative study using a stratified, multi-stage probability sampling design for the selection of household units. The overall response rate is reported as 82.8 %. A total of 10,211 individuals from these sampling frames were included in the health interview survey. Among them, 7,591 persons, adult men and women 20 years of age and older, were identified as respondents at the individual level. Two, the community-level data consisted of 132 regions in which the respondents of this study reside. The validity and reliability of the community-level indicators were based on the National Project, "Development of Measurement Indicators for Social Quality in South Korea" by the Institute for Social Development and Policy Research of Seoul National University (Institute for Social Development and Policy Research (ISDPR) 2013). Three, health communication indicators were taken from the Ministry of Government Administration and Home Affairs and the National Statistical Office of Korea. Other variables were based on data sources from the Ministry of Public Administration (Refer to ESM Appendix 1). All of the data are from 2009. We used the merged sample of the individual- and community-level dataset.

Study design

The contextual multi-level approach permits the simultaneous examination of how individual- and group-level predictors are related to individual-level health outcomes (Diez-Roux 2002). The contextual design of this study was based on Jung and Viswanath (2013), which employed three hypotheses: micro-level, multi-level, and macro-to-micro proposition. A micro-level proposition examines the causal effect between x and y in terms of a risk factor study, regardless of their contextual condition. However,

a multi-level proposition, what we call a contextual multi-level approach, shows the effect of the macro-level variable z on the micro-level variable y, controlling for the micro-level variable x. The macro-to-micro proposition is also known as the cross-level interaction: the relation between x and y is dependent on z.

Unit of analysis

A community can be viewed as a defended neighborhood: that is, an independent functional unit as well as the certain area sharing common traits (Rubin and Rubin 2008). The unit of this study is 132 dongs of South Korea, which is the administrative independent unit. Its average area is 421.8 ($\pm$369.6) km^2 and average population size is 220,023 ($\pm$210,493). A borough corresponds with the above conceptual definition of a community and can simultaneously ensure the reliability of the survey in South Korea (Parker et al. 2010). It therefore has the advantage of allowing a relatively easy comparison of differences between communities as well as within communities.

Measures

For the contextual effects model, we used two types of indicators showing the unique characteristics of community-level contextual effects. An aggregate indicator refers to the effect of a derived group-level variable on an individual-level outcome (e.g., mean neighborhood income). An integral indicator refers to the effect of group-level variables that can apply to any situation involving lower-level units nested within higher-level units (e.g., distribution of health-care facilities, gross regional domestic product (Diez-Roux 2002) (see ESM Appendix 2 for correlations among study variables).

Dependent variable

The health outcome of this study was residents' self-rated health (SRH) status. Respondents were asked to rate their own general health status on a 5-point Likert-type scale ranging from very good to very bad: "How is your health in general?", which was eventually grouped into two categories. Respondents reporting "very bad" or "bad" for health status were recorded 0, and were considered as a Low SRH group, while 1 was recorded for the group reporting "very good", "good" or "average" health status, and were considered as a High SRH group. In prospective studies, this general health question has been validated as a good predictor of morbidity and mortality, with a differential relationship between consecutive categorical ratings of SRH and probability of mortality (DeSalvo et al. 2005).

Individual-level independent variables

The level of participation in community organizations was measured by asking the respondents to indicate whether they are members of, have participated in, or have done voluntary work for nine different types of clubs or associations: religious organization, social club, grassroots organization, hobby club, sport club, voluntary service group, women's group, and political party. This variable was coded as active (involvement in one or more organization types) or non-active (not involved with any organization type).

Community-level independent variables

Regarding health communication capacity, we measured three variables: the number of local media (LM), percentage of Internet membership (IM), and health information-seeking behavior (HISB). LM is the aggregate number of local television/radio stations, local newspapers, and local cable channels. These media are usually operated by local private organizations, which provide various types of regional information (Jung and Rhee 2013). IM is an aggregate average number of people who subscribe to an Internet service provider according to region. It enables a subscriber to browse the Web freely at regular rates. HISB is an aggregate average time that people spend searching for health information per week by communities.

Community capacity for mobilization was measured with two indicators: the number of CBOs and number of VWCs in a dong. A CBO, largely composed of inhabitants, is defined as a self-funded autonomous group that is engaged in community service and action working toward the improvement of health, education, the environment, personal growth, social welfare, or other community needs (Smith 2005; Maclellan-Wright et al. 2007). Meanwhile, community volunteering is defined as collective contributions to enhance community well-being in which the residents live, led by grassroots volunteering groups who play a key role in building a sense of community (Cordingley 2000). The VWCs of this study referred to the number of volunteering camps sponsored by municipal volunteer service centers in which community residents can freely participate.

Control variables

The individual-level confounders were gender, age, monthly income, educational attainment, and four health behaviors such as smoking, drinking, obesity, and physical exercise. Age was divided into 20, 30, 40, 50, and 60 s or above. Household monthly income, adjusted by the number of members in the family, was divided into below 1,000,

1,001–2,000, 2,001–3,000, 3,001–4,000, 4,001–5,000, and 5,001 or above in US dollars. The highest level of education completed was collapsed into the following categories: less than elementary school, elementary school, middle school, high school, high school/associate degree, 4-year college degree, postgraduate degree. In addition, the dichotomous responses of "yes" and "no" were used as the health behavior variables of smoking, drinking alcohol, obesity, and regular physical activity. A value of 0 was assigned to those who responded as current smokers, drank alcohol during the 3 months before the survey, had a body mass index (BMI) of more than 25 for overweight, and did not do moderate exercise regularly for physical activity; all other responses were considered to be those of smokers, non-heavy drinkers, non-overweight, and moderate exercisers who were differentiated by assigning a value of 1.

The community-level confounders were population density, residency length, financial independence ratio, and medical resources. The financial independence ratio of local governments was calculated according to the following formula: (local tax + non-tax revenue + local shared tax)/general account budget. A higher level of financial independence may facilitate greater budgetary discretion for various pending issues and local governmental support for community welfare. The medical resource factor comprised two measures. The number of physicians is the aggregate number of certified physicians per 1,000 people in a certain region. The number of general hospitals was computed by utilizing the geographical information system (GIS) method, so that we can take into consideration the availability of hospitals in neighboring regions to measure medical accessibility.

Standardization of community-level variables

Community-level indicators were inputted after two-stage computations were calculated. First, we standardized the z score of each indicator by means of the transformation formula of the European Social Survey (ESS; http://essedunet.nsd.uib.no) to unify the units of measurement and form a normal distribution. The ESS methods enable us to minimize the bias of outlier observations as well as model complexity by transforming an indicator's minimum and maximum values into 0 and 10, respectively, and its average into approximately 5.

$$t = \frac{5z(\max - \min)}{z(\min + \max) - 2\min \times \max} + 5$$

Second, in the case of the community capacity, health communication, and medical resource variables, we extracted the covariance from each group by utilizing principal component analysis to prevent multicollinearity and form a robust model. The factors used to construct the information capacity index presented eigenvalues greater than 1 and factor loadings greater than 0.40. A single factor was drawn from each group of variables: One factor, community capacity for mobilization, accounted for 50.4 % of the total variance (Cronbach's $\alpha = 0.73$), which consisted of two community capacity indicators: CBOs and VWCs; another factor, health communication capacity, accounted for 34.2 % of the total variance (Cronbach's $\alpha = 0.69$), which consisted of three health communication indicators: LM, IM, and HISB; and yet another factor, medical resources, accounted for 57.3 % of the total variance (Cronbach's $\alpha = 0.82$), which consisted of two medical resource indicators: the number of physicians and GIS-based general hospitals. We inputted the above three factors into the multi-level models.

Statistical analysis

The intercepts- and slopes-as-outcomes model of the hierarchical generalized linear model (HGLM) was performed for binary variables, using Bernoulli response and logit link. Based on this model, the relationships between community-level contextual effects and SRH were reviewed for statistical significance after controlling for confounders. At the same time, the interaction effects between individual-level community participation and community-level capacities were identified.

Individual-level model

$$\ln\left(\frac{p}{1-p}\right)_{ij} = a_{0j} + a_{1j} \times (\text{socioeconomic and behavioral confounders}) + a_{2j} \times (\text{community participation}) + e_{ij}^{*} p = \text{prob}(\text{SRH} = 1 | a_{ki}),\ k = 0, \ldots, n$$

Community-level model

$$a_{0j} = \gamma_{00} + \gamma_{01} \times (\text{community confounders}) + \gamma_{02} \times (\text{community capacity}) + \gamma_{03} \times (\text{health communication}) + u_{0j}$$

$$a_{1j} = \gamma_{10} + \gamma_{11} \times (\text{community confounders})$$

$$a_{2j} = \gamma_{20} + \gamma_{21} \times (\text{community capacity}) + \gamma_{22} \times (\text{health communication}) * \text{Var}(u_{0j}) = \tau_{00}$$

The HGLM analysis result is a numerical value that reflects the sampling weight of the survey. In the logistic models, we calculated the intra-class correlation (ICC) by using the formula: $\sigma^2/(\sigma^2 + 3.29)$, where σ^2 is the area-level variance (Jung and Viswanath 2013). The estimated size of the ICC based on the above model was 5.36 %. This figure compares well with that of previous studies using

HGLM (Mohnen et al. 2011; Snelgrove et al. 2009; Poortinga 2006).

The analysis procedure occurred in the following order: descriptive statistics, bivariate analysis, and HGLM analysis. In the HGLM, model 1 was unconditional, models 2 and 3 included sociodemographic and socioeconomic confounders, and model 4 accounted for health risk factors. models 5–7 added the community-level variables along with individual-level ones: model 5 included the community-level confounders, model 6 took the contextual indicators into account, and model 7 added the interaction effects to both the individual- and community-level models. Statistical analyses were conducted by using SPSS v.17.0 (IBM SPSS Institute, Chicago, IL) and HLM for windows v.6.0 (Scientific Software International, Lincolnwood, IL).

Results

Descriptive statistics of the sample

At the individual level, a considerable number of respondents earned less than 1,000 USD per month (28.2 %), had a college degree (27.5 %), were non-smokers (78.6 %), were non-heavy drinkers (69.2 %), were non-overweight (69.8 %), and did non-moderate exercise (96.3 %). Among the total respondents surveyed, 77.0 % participated in at least one community organization and 23.6 % perceived their health status as poor or very poor (Table 1).

At the community level, the population density was 3.97 (±6.5) m^2, the length of residency in the same community was 92.0 (±33.9) months, and the ratio of financial independence was 32.8 % (±17.8). The number of physicians was 3.4 (±1.7) and the number of general hospitals was 1.7 (±1.9). Regarding community-level capacity, the numbers of CBOs and VWCs were 49.2 (±49.0) and 12.8 (±4.8), respectively. The number of local media was 8.4 and the percent of Internet membership was 31.7 % (±3.5). Lastly, the aggregate time for health information seeking was 13.2 (±37.0) minutes per week.

Differences in individual-level characteristics by SRH status

The High SRH group had more men and the members were relatively younger compared to those in the low SRH group ($P < 0.001$). The members of the high SRH group had relatively higher income and had received more education than those in the low SRH group ($P < 0.001$). Of those who smoked or drank heavily, 20.4 and 16.3 % belonged to the low SRH group, respectively. Among the people with a BMI of 25 or above, 26.5 % belonged to the low SRH group, whereas among those who engaged in moderate physical activity, 71.6 % were considered to belong to the high SRH group (Table 2). People who participated in community organizations were more likely to belong to the high SRH group ($P < 0.001$).

Contextual multi-level effects of community capacity and health communication on the high SRH status

The contextual effect HGLM, model 6, revealed that the likelihood of belonging to the high SRH group was greater with increasing community capacity for mobilization [odds ratio (OR) 1.09; 95 % confidence interval (CI) 1.02–1.17], health communication capacity (OR 1.05; 95 % CI 1.01–1.08), and medical resources (OR 1.06; 95 % CI 1.01–1.13) at the community level (Table 3). Also, the likelihood of belonging to the high SRH group was greater with increasing participation in community organizations (OR 2.08; 95 % CI 1.65–2.58) at the individual level. The likelihood was also greater for males (OR 1.44; 95 % CI 1.36–1.51), non-smokers (OR 1.42; 95 % CI 1.19–1.70), and non-overweight people (OR 1.28; 95 % CI 1.14–1.45). That is, in the multi-level model where the related confounding variables were included together, community capacity and health communication were predictive of the SRH status of individuals, suggesting that the likelihood of health vulnerability increases as community-level capacity declines. The interaction effect HGLM (model 7) showed that the odds ratio of the main effects was attenuated, but remained significant. At the same time, the interaction terms between the two levels were marginally significant ($P < 0.10$).

Discussion

This study found support for a positive association between mobilization and health communication capacity and SRH status after controlling for covariates at both the individual and community levels. It is consistent with the results of some contextual studies using cross-sectional multi-level analysis, which found that aggregate variables had significant preventive effects (Mohnen et al. 2011; Snelgrove et al. 2009; Poortinga 2006; Giordano et al. 2012). However, the previous literature had not demonstrated the significance of integral variables and explored the role of health communication capacity. The major findings of this study suggest that living in a community characterized by higher levels of community-level mobilization and health communication capacity is beneficial to residents' health, increasing the odds of high SRH status by up to 9 % compared to those who live in a community with low community-level mobilization and health communication

Table 1 Descriptive statistics for measures in a population-based analysis of the sample in South Korea, 2009

Characteristics	Category	Sample	Range		Percent or mean[a]
			Min.	Max.	
Individual level (level-1, $n = 7{,}591$)					
Gender	Male	3,314			43.70
	Female	4,277			56.30
Age (years)			20	95	39.2 (±22.6)
Monthly income, USD[b]	<1,000	2,138			28.20
	1,000–1,999	1,742			23.00
	2,000–2,999	1,663			21.90
	3,000–3,999	799			10.40
	>4,000	1,249			16.50
Educational attainment	Less than elementary school	532			7.00
	Elementary school	1,778			23.40
	Middle school	878			11.60
	High school	2,078			27.40
	College	2,088			27.50
	Postgraduate	237			3.10
Smoking	Current smoker	1,624			21.40
	Non-smoker	5,967			78.60
Drinking alcohol	Heavy drinker[c]	2,337			30.80
	Non-heavy drinker	5,254			69.20
Obesity	Overweight (BMI ≥25)	2,296			30.20
	Non-overweight (BMI <25)	5,295			69.80
Physical exercise	Non-moderate exercise	7,309			96.30
	Moderate exercise[c]	282			3.70
Participation in comm. orgs.	No	1,744			23.00
	Yes	5,847			77.00
Self-rated health (SRH) status	Low (poor group)	1,794			23.60
	High (satisfied group)	5,797			76.40
Community level (level-2, $J = 132$)					
Population density (m^2)[e]		132	0.03	28.7	3.97 (±6.5)
Residency length (months)[d]		132	53.3	200.8	92.0 (±33.9)
Financial independence ratio[e]		132	8.60 %	82.90 %	32.8 (±17.8)
Medical resources					
# of hospitals[e]		132	0	7.96	3.4 (±1.7)
# of physicians (per 1,000)[e]		132	0.43	16.9	1.7 (±1.9)
Health communication capacity					
# of local media[e]		132	0	47	8.4 (±8.1)
% of Internet membership[d]		132	24.20 %	37.90 %	31.7 (±3.5)
Health information seeking (min.)[d]		132	0	510	24.2 (±22.1)
Community capacity for mobilization					
# of CBOs[e]		132	2	369	49.2 (±49.0)
# of VWCs[e]		132	6.8	39.3	12.8 (±4.8)

CBOs community-based organizations, *VWCs* volunteer work camps

[a] Continuous variables are presented in mean (±standard deviation) and categorical variables in percent (%)

[b] Equivalized household monthly income; USD $1 = KRW (Korean Won) 1,135.35 (May 28, 2012)

[c] By the definition of WHO

[d] Aggregate variables

[e] Integral variables

Table 2 The differences of individual-level characteristics by self-rated health status in South Korea, 2009

Characteristic	Low SRH (n = 1,794), %	High SRH (n = 5,797), %	P (χ^2)
Gender			
Male	18.6	81.4	<0.001
Female	27.6	72.4	
Age (years)			
20–29	13.9	86.1	<0.001
30–39	12.7	87.3	
40–49	17.3	82.7	
50–59	24.4	75.6	
60–69	32.9	67.1	
≥70	44.7	55.3	
Monthly income[a]			<0.001
First quintile (lowest 20 %)	36.8	63.2	
Second quintile	27.3	72.2	
Third quintile	20.5	79.5	
Fourth quintile	19.0	81.0	
Fifth quintile (highest 20 %)	14.2	85.8	
Educational attainment			<0.001
Less than elementary school	52.8	47.2	
Elementary school	31.9	68.1	
Middle school to associate	30.3	69.7	
High school to associate	17.9	82.1	
College	13.4	86.6	
Postgraduate	12.7	87.3	
Smoking			<0.001
Current smoker	20.4	79.6	
Non-smoker	24.5	75.5	
Drinking alcohol			<0.001
Heavy drinker[b]	16.3	83.7	
Non-heavy drinker	26.9	73.1	
Obesity			<0.001
Overweight (BMI ≥25)	26.5	73.5	
Non-overweight (BMI <25)	22.4	77.6	
Physical exercise			<0.05
Non-moderate exercise	23.5	76.5	
Moderate exercise[b]	28.4	71.6	
Participation in comm. orgs.			<0.001
No	47.7	52.3	
Yes	16.5	83.5	

SRH self-rated health, *BMI* body mass index

[a] Equivalized household monthly income

[b] By the definition of WHO

capacity. These figures may not seem substantial in terms of individual-level risk factors, but having come from a contextual multi-level analysis, they underscore the importance of a population-based approach.

Organized efforts to promote the health of the public, such as health promotion campaigns, often work within the communication environment of the community and utilize mass media (Kang and Kwak 2003; Holder and Treno 1997; Viswanath and Finnegan 2002; Xiao et al. 2013). Nonetheless, this collective action for health promotion does not work effectively if the characteristics of the community are not adequately taken into consideration. Accordingly, it is important to look into the contextual effects such as community capacity in various countries and societies. In fact, in the event of reduction in health-care services due to budget cuts by the central government, a community of higher community capacity for mobilization voluntarily creates supportive services for the community members, whereas others of lower mobilization capacity cannot afford such a voluntary supportive reaction (Minkler et al. 2008).

Table 3 Contextual multi-level effects of community capacity for mobilization and health communication capacity on the high self-rated health status in South Korea, 2009

	Model 1 OR (95 % CI)	Model 2 OR (95 % CI)	Model 3 OR (95 % CI)	Model 4 OR (95 % CI)	Model 5 OR (95 % CI)	Model 6 OR (95 % CI)	Model 7 OR (95 % CI)
Constant	3.13 (2.78–3.52)***	3.54 (3.22–3.89)***	3.64 (3.32–3.98)***	3.65 (3.33–4.00)***	3.64 (3.34–3.97)***	3.73 (3.41–4.09)***	3.80 (3.46–4.19)***
Level-1 ($n = 7{,}591$)							
Gender (ref: female)		1.40 (1.34–1.46)***	1.35 (1.28–1.42)***	1.38 (1.30–1.45)***	1.39 (1.30–1.49)***	1.44 (1.36–1.51)***	1.44 (1.37–1.51)***
Age		0.71 (0.68–0.74)***	0.79 (0.75–0.83)***	0.80 (0.76–0.84)***	0.80 (0.76–0.84)***	0.81 (0.77–0.85)***	0.80 (0.77–0.84)***
Monthly household income			1.16 (1.11–1.21)***	1.16 (1.11–1.21)***	1.16 (1.10–1.21)***	1.15 (1.10–1.20)***	1.14 (1.10-1.20)***
Educational attainment			1.13 (1.07–1.19)***	1.14 (1.08–1.20)***	1.12 (1.05–1.18)***	1.06 (0.99–1.13)†	0.99 (0.93–1.05)
Non-smoking (ref: current smoking)				1.33 (1.12–1.57)***	1.33 (1.12–1.57)***	1.42 (1.19–1.70)***	1.42 (1.20–1.70)***
Non-heavy drinking (ref: heavy drinking)				0.84 (0.72–0.97)*	0.83 (0.71–0.97)*	0.97 (0.83–1.13)	0.97 (0.83–1.12)
Non-overweight (ref: BMI ≥25)				1.20 (1.07–1.34)**	1.20 (1.07–1.35)**	1.28 (1.14–1.45)***	1.30 (1.16–1.47)***
Moderate exercise (ref: <moderate)				0.86 (0.66–1.12)	0.85 (0.65–1.12)	0.86 (0.65–1.14)	0.86 (0.65–1.14)
Participation in comm. orgs. (PCOs)						2.08 (1.65–2.58)***	2.07 (1.65–2.56)***
Level-2 ($J = 132$)							
Population density					0.99 (0.99–1.01)	0.99 (0.98–1.01)	1.00 (0.98–1.01)
Residency length					0.99 (0.99–0.99)**	0.99 (0.98–0.99)***	0.99 (0.98–0.99)**
Financial independence					1.00 (0.99–1.01)	1.00 (0.99–1.00)	1.00 (0.99–1.00)
Medical resources					1.03 (0.97–1.09)	1.06 (1.01–1.13)*	1.06 (1.00–1.13)*
Health communication capacity (HCC)						1.05 (1.01–1.08)*	1.02 (0.98–1.06)†
Comm. capacity for mobilization (CCM)						1.09 (1.02–1.17)**	1.09 (1.03–1.17)*
Cross-level interaction							
Age × *residency length*							0.99 (0.99–1.00)*
PCOs × *HCC*							1.04 (1.00–1.08)†
PCOs × *CCM*							1.06 (1.00–1.13)†
U0	0.346***	0.208***	0.162***	0.156***	0.127***	0.151***	0.148***

Variables in italics are grand-mean centered

OR odds ratio, *CI* confidence interval

† $P < 0.10$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$

The results of this study are significant in three aspects. First, this research adopted a multi-level contextual approach to study the contextual effects of integral indicators for community characteristics. Until now, community-based participatory research (CBPR) was generally applied to look into how the local community changes in response to a specific health issue (Wallerstein and Duran 2006). However, efforts have recently been made to study the community capacity effect and its regional differences, which have actively adopted the multi-level approaches complete with measurement indexes at a detailed level for the convenience of general application (Kang and Kwak 2003; Jung and Viswanath 2013). Community capacity building means a process of demonstrating the strength of weak ties such as social capital by invoking a sense of community and cementing cohesiveness (Viswanath 2008; Jung and Viswanath 2013). We found the number of CBOs and VWCs to be strong predictors of the SRH status of community and have consequently shown the significance of voluntarily associations in capacity building.

Second, relatively few studies have been done to examine the influential factors for regional differences in health communication capacity, whereas numerous studies have dealt with the theoretical and practical significance of health communication and health promotion. We analyzed whether or not people in a higher communication capacity borough have a higher SRH status by measuring the communication variables at a local community level rather than at the individual level. From the perspective of community capacity, we found that the likelihood of SRH status is greater in communities where local media access and use are more robust. Furthermore, from the perspective of community participation and network expansion promoting information change, we found that health communication capacity can be a good link between participation in community organizations and residents' health status (Jeffres et al. 2007).

Finally, as a result of this study, we suggest that more care be given to communication inequality to control for health disparities by communities. People with high community participation may be in a higher socioeconomic status and may have more opportunity to learn health information as compared with others who lack such opportunities (Kang and Kwak 2003). Therefore, if social inequality deepens, communication inequality among the communities will also increase (Viswanath 2006) since voluntarily associations such as CBOs are strongly inclined to promote the distribution and dissemination of new information (Smith 2005; Chaskin et al. 2001). Thus, it is worth considering developing media campaigns while taking a close account of the disparities in community capacity.

This study shows that living in a community characterized by higher levels of communication and mobilization capacity is beneficial to residents' self-rated health status. Thus, it is necessary to pay attention to the implications of community capacity-building approaches and health communication.

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