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Multilevel Analysis of Health Care Service Utilization among Medical Aid Beneficiaries in Korea

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Purpose: The current study was done to identify individual- and group-level factors associated with health care service utilization among Korean medical aid beneficiaries by applying multilevel modeling. **Methods:** Secondary data analysis was performed using data on health care service reimbursement and medical aid case management progress from 15,948 beneficiaries, and data from 229 regions were included in the analysis. **Results:** Results of multilevel analysis showed an estimated intraclass correlation coefficient (ICC) of 18.1%, indicating that the group level accounted for 18.1% of the total variance in health care service utilization, and that beneficiaries within the region are more likely to share common features with regard to health care service utilization. At the individual level, existence of disability and types of medical aid beneficiaries showed a significant association, while, at the group level, social deprivation index, and the number of beneficiaries and case managers within the region showed a significant association with health care service utilization. **Conclusion:** The significant influence of group level variables in health care service utilization found in this study indicate a need for group level approaches, such as policy change and/or promotion of community awareness.

Key words: Multilevel analysis; Medical assistance; Health services; Case management

INTRODUCTION

As one of Korea's social welfare programs, the medical aid program was introduced in 1977 as a public medical assistance program targeted at the poor. Due to an increase in the number of beneficiaries and expansion of services, as well as increased prevalence of chronic disease and an aging population, health care expenditure reimbursements for medical aid beneficiaries have continued to rise (Lee, Oh, & Choi, 2010). A previous study reported that the top 10% of beneficiaries who utilized a large amount of health care services expended almost 60% of total medical aid expenditures; thus, these heavy users are regarded as targets of case management services to promote appropriate use of health care services (Lee et al., 2010).

In Korea, a case management program for medical aid beneficiaries was initiated in 2003, in order to promote appropriate use, to ensure provision of quality health care services, and to safeguard health care resources. Development of effective case management services requires elucidation of factors associated with use of health care services. Few such studies have been conducted for identification of factors associated with health care service utilization among medical aid beneficiaries in Korea (Ahn et al., 2011; Shin, Kim, Park, & Lee, 2010a; Shin et al., 2010b).

Ahn et al. (2011) sought to figure out factors associated with overuse and underuse of health care services targeting medical aid beneficiaries, and others examined factors contributing overutilization of healthcare

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services among medical aid beneficiaries, however, these studies considered only individual level variables employing single-level model in the analysis of factors associated with health care service utilization (Ahn et al., 2011; Shin et al., 2010a; Shin et al., 2010b), while studies examined community-level factors associated with health care service utilization of medical aid beneficiaries have not been conducted in Korea. Single-level model only explains a limited portion of the variability in behavior (Berben, Dobbels, Engberg, Hill, & de Geest, 2012). The aim of this study was to identify individual- and group-level factors associated with overutilization of health care services among medical aid beneficiaries in Korea by application of multilevel modeling to provide baseline data in the development of case management intervention programs for beneficiaries.

1. Theoretical framework

The theoretical model guiding this study was based on ecological model. Ecological models of health behavior emphasize the environmental and policy context of behavior, consider multiple level influences in the development of interventions, and stimulate need for comprehensive populationwide approaches to changing behaviors (Sallis, Owen, & Fisher, 2008). Ecological model posits that multiple level factors can influence health behavior, including intrapersonal, interpersonal, organizational, community, and public policy levels (Sallis et al.). Applying ecological model, Bae et al. (2008) analyzed factors associated with gastric cancer screening behavior of Koreans, and they found that intrapersonal (age), interpersonal (recommendation from family and family screening habits), and community (community health education, and social norm) level factors were significantly associated with gastric cancer screening behavior.

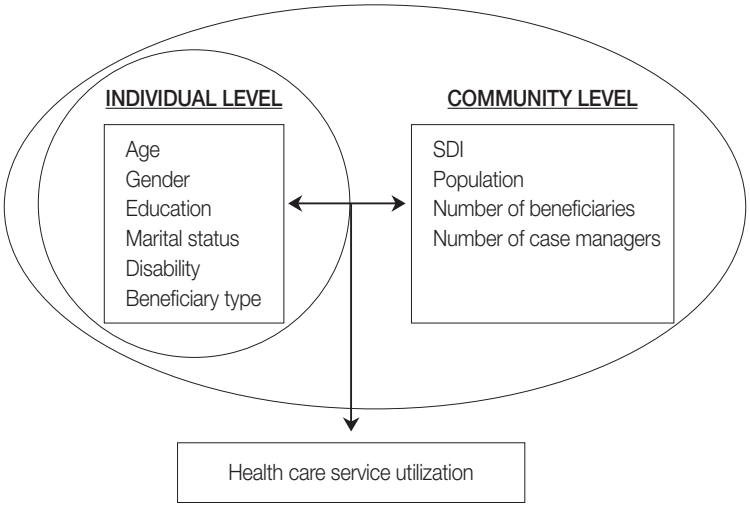
World Health Organization (2002) argued that individual (biological and personal history factors), relationship (relationships with peers, intimate partners, and family members), community (community context in which social relationships are embedded), and societal (societal norms, policies, and cultural beliefs) factors interplay and influence behavior, thus ecological model provides key points for prevention and interventions. Therefore, utilizing ecological model, the current study sought to elucidate individual and group (community) level factors simultaneously that influence overutilization of health care services among medical aid beneficiaries in Korea (Figure 1).

METHODS

1. Sampling and setting

Secondary data analysis was performed using data on health care service reimbursement and medical aid case management progress from 16,370 beneficiaries who were heavy users of health care services, and who obtained medical aid case management services from 232 local offices during the first half of 2009. After data cleaning and deletion of incomplete data, data on 15,948 (97.4%) beneficiaries from 229 local offices were used for analysis.

Heavy users were selected by case managers based on health care ser-



SDI=Social deprivation index.

Figure 1. Theoretical framework of the study based on ecological model.

vice utilization data incurred during the previous year, thus for selection of 2009 case management target, data incurred during 2008 were assessed. Case managers received previous year's health care service utilization data of all medical aid beneficiaries residing in their region from National Health Insurance Corporation (NHIC) for use with establishment of case management plan. Using the sorting menu of the Excel program, case managers ranked health care service utilization data from highest to lowest. Variables included in the sorting were total health care costs, length of health care service utilization and hospitalization, overlapping days of medication (prescription of drugs with identical components exceeding 365 days within a year), and number of health care organizations visited during the previous year.

Those ranked higher in most of the categories were assigned to the heavy user group, and case managers review individual medical record using integrated information support system, in order to assess whether or not beneficiaries utilized health care services inappropriately considering their disease status, and whether or not they need case management services. Those ranked higher in most of the categories, but have multiple severe health conditions that need long-term and expensive health care services, and appropriately utilized health care services were not included as targets of case management services, and in turn excluded from the current study. The study was approved by the institutional review board of Yonsei University Wonju College of Medicine.

2. Dataset

Data on health care service utilization incurred during the first half of 2009 were provided by the NHIC. Data related to socio-demographic and medical aid were provided by the Medical-Aid Case Management Center (MACMC), retrieved from center's database, which were collected by case managers during the case management services in 2009. Data of the 229 regions were retrieved from the Statistics Korea website (Statistics Korea, 2009), and government report (Shin et al., 2009). Data on health care service utilization included total number of days of health care service utilization during the first half of 2009, including clinic visits, hospitalization, and duration of drug prescription. Total number of days of health care utilization was used as an outcome variable, because it is an important indicator in the management of beneficiary qualifications, and the beneficiaries should obtain approval from the local government if they need to use health care services exceeds 365 days within a year (Korea Ministry of Health & Welfare, 2010).

Individual data included socio-demographic, medical aid beneficiary type, and existence of disability. Socio-demographic characteristics included age, gender, marital status, and education level. Medical aid beneficiary types include types 1 (those who have no copayments) and 2 (those who have upto 15% copayment rates), and those for persons of national merit, refugees, servicemen, and victims of natural disasters. Beneficiaries with disabilities were defined based on the physicians' diagnosis and disability registration record of local offices across Korea; disabilities included all types of impairment, including physical, sensory, and intellectual disabilities. Group data included social deprivation index (SDI), population size, and the number of medical aid beneficiaries and case managers within the region in 2009. The number of case managers was included as the group data, because the number of case managers was associated with competencies of case managers (Song, 2011). The SDI for Korea was developed by Shin et al. (2009), considering low socio-economic class, size of aged population, education level below high school, poor living environment, apartment houses, automobile ownership, single household family, and women as head of household. Mean z-scores of above indicators were used in the estimation of SDI with higher scores indicated more deprived regions. The Korean SDI was developed based on 2005 census data of Korea, and after review of SDI for England, Canada, New Zealand, and Scotland. Verification of the construct and concurrent validity of the Korean SDI was provided by Shin et al.

3. Data analysis

SPSS 19.0 was used for analysis. Descriptive statistical analysis was performed in order to illustrate individual-level and group-level data. Multilevel analysis was performed at two levels. In the analysis, individual beneficiaries were conceptualized as being nested within 229 regions. First, the null model without covariates was used to partition the total variance at the two levels. Second, analysis was performed for examination of associations between individual level variables and health care service utilization (Model 1). In model 2, group variables were added for simultaneous examination of the effects of individual and group level variables.

Null model

Level 1: $Y_{ij} = \beta_{0j} + e_{ij}$

Level 2: $\beta_{0j} = \alpha + u_j$

$Y_{ij} = \alpha + u_j + e_{ij}$

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Y_{ij} denoted the value of the variable for health care service utilization for *i*th beneficiaries within the *j*th region, α is the intercept, u_j is the level 2 random effect, and e_{ij} is the level 1 random error. Null model is the intercept only model, and only separates the variances of the dependent variable into two parts: the variance of groups (σ_u^2), and the variance of individuals (σ_e^2). The intraclass correlation (ICC) can be computed on the basis of these two variance components.

$$ICC = \sigma_u^2 / (\sigma_u^2 + \sigma_e^2)$$

The ICC refers to correlation among lower-level units (individual level) within higher level units (group level). ICC measures the degree to which individuals share common characteristics due to closeness in space or time, and is a proportion of variance in the outcome that is attributed to higher-level units (Lake, 2006).

Model 1

$$Y_{ij} = \beta_{0j} + \beta_1 AGE_{ij} + \beta_2 GENDER_{ij} + \beta_3 EDUCATION_{ij} + \beta_4 MARRIAGE_{ij} + \beta_5 DISABILITY_{ij} + \beta_6 BENEFICIARYTYPE_{ij} + u_j + e_{ij}$$

In model 1, β_{0j} is the intercept and could differ across groups, β is the effect of the covariate, and e_{ij} is the level 1 random error. Coefficients of model 1 ($\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$) were modeled as fixed slopes.

Model 2

$$Y_{ij} = \beta_{0j} + \beta_{1j\times} AGE_{ij} + \beta_{2j\times} GENDER_{ij} + \beta_{3j\times} EDUCATION_{ij} + \beta_{4j\times} MARRIAGE_{ij} + \beta_{5j\times} DISABILITY_{ij} + \beta_{6j\times} BENEFICIARY TYPE_{ij} + \beta_7 SDI_j + \beta_8 POPULATION_j + \beta_9 BENEFICIARIES_j + \beta_{10} CASEMANAGERS_j + u_j + e_{ij}$$

In model 2, group level variables were added. β_7, β_8, β_9, and β_{10} are the regression coefficients of the group level variables, e_{ij} is the level 1 random error, and u_j is the level 2 random effect.

RESULTS

1. General characteristics of the participants

The mean age was 66.93 years (SD = 12.51, range 11-100). Females constituted 64.5% (n = 10,281) of the beneficiaries, and 28% (n = 4,460) were married or cohabitating. Forty-two percent (n = 6,702) of participants had disabilities, and 35.5% (n = 5,660) had no school education. Seventy percent (n = 11,255) were beneficiaries of the type 1 medical aid program, while 10.9% (n = 1,737) were type 2 beneficiaries. The mean length of health care service utilization in 2009 during the six-month period was 1,235.99 days (SD = 585.99) (Table 1).

2. Attributes of group level characteristics

Group level characteristics of 229 regions were illustrated. The mean SDI was -0.10 (SD = 0.83), and the mean number of the population was 292,585.34 (SD = 212,291.33) persons. The mean number of beneficiaries was 10,214.73 (SD = 6,034.24) persons, while the mean number of case managers for each regional office was 3.40 (SD = 2.78) persons (Table 2).

3. Results of multilevel analysis

1) Null model

In the null model, statistical significance in the separate variances was observed at two levels ($p < .001$). ICC was estimated based on two variance components, 69,267.68/ (313,859.17 + 69,267.68) = 0.181, indicating that variance at the group level accounted for 18.1% of the total variance of health care service utilization. The results indicated that both individual and group variables could be considered in health care service utilization.

2) Model 1

The results indicated a significant association of health care service utilization with individual factors, including existence of disability and medical aid beneficiary type. The coefficient estimates of disability and beneficiary type were -35.98 and -97.17, respectively ($p < .05$), which implied decreased health care service utilization by an average of 35.98 days by those with disabilities and average of 97.17 days for beneficiaries with other than type 1. Existence of statistically significant variance at the group level (74,194.58, $p < .001$) implied that the intercept could differ significantly across regions.

3) Model 2

The significant random intercept indicated that even after controlling for individual factors, health care service utilization differs significantly across regions. Among group level variables, SDI and number of case managers showed a negative association with health care service utilization, while the number of beneficiaries showed a positive association

Table 1. General Characteristics of Medical Aid Beneficiaries (*N*=15,948)

Individual variable	Distribution	n (%)	M ± SD	Range
Age (year)			66.93 ± 12.51	11-100
Gender	Male	5,667 (35.5)		
	Female	10,281 (64.5)		
Marital status	Married/cohabitating	4,460 (28.0)		
	Single	977 (6.1)		
	Widowed/divorced/separated	6,171 (38.7)		
	No response	4,340 (27.2)		
Education (n=19,946)	None	5,660 (35.5)		
	≤ 9 years	6,171 (38.7)		
	≥ 10 years	2,243 (14.1)		
	No response	1,874 (11.7)		
Disability	Yes	6,702 (42.0)		
	No	9,246 (58.0)		
Beneficiary type	Type 1	11,255 (70.6)		
	Type 2	1,737 (10.9)		
	Person of national merit	1,358 (8.5)		
	Other[a]	1,598 (10.0)		
Health care service utilization (days/6 months)			1,235.99 ± 585.99	1–15,872

[a]Included refugees, servicemen, victims of natural disasters etc.

Table 2. Attributes of Group Level Characteristics according to the 229 Regions (*N*=15,948)

Group variables	Range	M ± SD
SDI	-1.42-1.69	-0.10 ± 0.83
Population	18,221-1,073,149	292,585.34 ± 212,291.33
Number of beneficiaries	468-27,773	10,214.73 ± 6,034.24
Number of case managers	1-10	3.40 ± 2.78

SDI=Social deprivation index.

with health care service utilization ($p<.05$). Results of the chi-squared test for difference of variance between Model 1 and Model 2 indicated that Model 2 showed a better fit ($\chi^2 = 40{,}813.04$, $p<.001$), which suggests that both individual and group level variables are good predictors for explaining variations in health care service utilization among medical aid beneficiaries across regions (Cho, 2003) (Table 3).

DISCUSSION

Using multilevel analysis, findings of the current study demonstrated an association of both individual and group level variables with health care service utilization among medical aid beneficiaries in Korea. Using the null model, the estimated ICC was 0.181 (18.1% of the variance was explained with statistical significance by the group-level variables). ICC greater than .05 (5%) and .10 (10%) demonstrated meaningful and substantial differences across groups, respectively (Lee, 2009); thus, the ICC=0.181 (18.1%) of the current study also indicated substantial differences in health care service utilization across regions. Data collected from medical aid beneficiaries have a hierarchical structure, and can be correlated with one another (Park & Lake, 2005). Using clustered data, estimated standard errors in a conventional regression are smaller than actual standard errors due to failure to account for the correlated structure of observations, which increases a Type I error (Park & Lake). Thus, for the current study, application of multilevel analysis was appropriate. At the individual level, existence of disability and types of medical aid beneficiaries showed a significant association, while SDI, the number of beneficiaries and case managers at the group level, showed a significant association with health care service utilization. The results indicated significant variation in health care service utilization by region. These differences could be explained by group level variables.

Findings from a previous study illustrated that beneficiaries with disability were more likely to be in poor health, and to have more health care service needs (Park et al., 2006). However, barriers to health care service utilization, such as transportation, communication, financial problems, and lack of expert providers, prohibit them from utilization of needed health care services (Eun et al., 2006), which is consistent with results of the current study. In the current study, due to barriers indicated above (transportation, communication etc.), beneficiaries with disabilities may have utilized health care services less often than those without disabilities, even though their health care service needs were greater. The beneficiaries included in the current study were heavy users

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Table 3. Multilevel Analysis of Health Care Service Utilization according to the 229 Regions (N=15,948)

Fixed effect	Null model		Model 1		Model 2	
	Estimates	*p*	Estimates	*p*	Estimates	*p*
Individual level						
Intercept	1,209.39	<.001	1,325.70	<.001	1,254.37	<.001
Age			0.77	.121	0.61	.258
Gender			-1.73	.890	-11.42	.395
Education			-27.06	.099	-19.12	.287
Marital status			19.21	.114	15.62	.232
Disability			-28.67	.014	-35.98	.005
Beneficiary type			-111.49	<.001	-97.17	<.001
Group level						
SDI					-73.17	.044
Population					0.00	.678
Number of beneficiaries					0.02	.005
Number of case managers					-47.02	.007
Random effect	**Variance component**	***p***	**Variance component**	***p***	**Variance component**	***p***
Residual	313,859.17	<.001	320,318.59	<.001	285,288.65	<.001
Intercept (variance)	69,267.68	<.001	74,194.58	<.001	62,038.82	<.001
Deviance	247,649.77		165,740.62		124,927.58	
χ^2			81,909.15	<.001	40,813.04	<.001

SDI=Social deprivation index.
Variables: Gender 1=male, 2=female; education 1=less than or equal to 9 years, 2=more than 9 years; marriage1=without spouse (single, divorces, widowed, or separated), 2=with spouse; disability 0=not disabled, 1=disabled; beneficiary type 1=type 1, 2=other (type 2, those for persons of national merit, refugees, servicemen, and victims of natural disasters).

of health care services who were in the top 1% of 1.84 million beneficiaries (Korea Ministry of Health & Welfare, 2010); thus, they may have different attributes with regard to use of health care services, compared with those not included in this category. However, negative association between disability and health care service utilization may imply that case managers need to ensure that health care needs of the beneficiaries with disabilities are met and/or that quality and continuity of health care services are assured.

Findings of the current study also revealed an association of beneficiary type with health care service utilization, and those who were type 1 medical aid beneficiaries (those who have no copayments) were more likely to overuse health care services, regardless of health conditions; therefore, it is obvious that due to insensitivity to health care costs, removal of financial barriers with type 1 medical aid may promote increased use of health care services. Thus, for the sake of public interest, in education of medical aid beneficiaries, responsibility for use of common goods (free health care services) should be fostered.

A previous study contended that those living in deprived regions were less likely to utilize preventive health care services (Chang, 2012), which is consistent with the current study that SDI was negatively associated with health care service utilization. SDI showed strong positive association with standardized mortality (Shin et al., 2009), and others argued for an association of deprivation with unhealthy lifestyles (Hanlon et al., 1998), thus beneficiaries living in deprived areas could be priority target of case management services to enhance health and quality of life, and to promote optimal use of health care services.

The ecological model posits that multiple level factors such as intrapersonal, interpersonal, and community level factors were associated with behavior (Sallis et al., 2008). Applying ecological model, Bae et al. (2008) demonstrated that intrapersonal (age) and community factors (community health education, and social norm) were associated with use of preventive health care services in Korea, while Medlensky, Esplen, Gallinger, McLaughlin, and Goel (2003) investigated that individual (age, and perceived benefits and barriers), family (encourage from family), physician (advice from physician), and societal level (screening advertisement) factors were associated with colorectal screening behavior in Canada. This could be applied to the results of the current study demonstrating that individual or intrapersonal level (existence of disabilities and type of

medical aid) and group or community level factors (SDI, and number of case managers and beneficiaries) may have had an influence on behaviors of individual beneficiaries in health care service utilization. Influence of group level factors outside beneficiaries in health care service utilization may imply that education targeting beneficiaries is insufficient for promotion of appropriate health care service utilization. Future interventions should include use of multi-level approaches applying Ecological Model (Sallis et al.), such as enhancing awareness of health care providers and communities, and/or change in public health policy.

Andersen's Behavioral Model, which is the most frequently used theoretical model for explaining use of health care services, could also be applied to the current study. The model consists of three determinant factors: predisposing, enabling, and need factors (Kim, Nam, Chae, & Lee, 2008). Findings of the current study revealed a significant association of enabling (beneficiary type and case managers) and need factors (existence of disability) with health care service utilization, and indicated that community resources (case managers) may influence health care service utilization by medical aid beneficiaries.

The significant negative association observed between the number of case managers and health care service utilization may indicate effectiveness of case management programs in promotion of appropriate use of health care services. A previous study reported on the effectiveness of administration of a case management program in decreasing health care service utilization among medical aid beneficiaries with less severe conditions (Lim, 2010), which is consistent with results of the current study. On the part of beneficiaries, those with less severe conditions may have overused unnecessary health care services with minimum or no copayments. On the part of the providers, a fee-for-service payment system reimbursed by the government may result in increased frequency of use of nonessential health care services. It is assumed that administration of case management programs could result in effective curtailment of unnecessary or nonessential use of health care services that were previously overused by beneficiaries with less severe conditions. Kim (2012) investigated that case management services targeting medical aid beneficiaries were effective in promoting self-care abilities and quality of life of the beneficiaries, while decreasing health care service utilization such as clinic visits, drug prescription duration, and health care costs. The study results may indicate that strengthening of systematic medical aid case management services will help to meet the ever increasing needs of the beneficiaries in line with increased elderly population and chronic diseases, while to safeguard health care resources (Kim).

Policy implications of the current study may include in order to assure quality and continuity of health care services, assignment of additional case managers in regions with an insufficient number of case managers are needed, since results of the current study revealed reverse relationship between the number of case managers and health care service utilization, moreover, average 3.40 (SD = 2.78) case managers were assigned within the region, with an average of 10,215 (SD = 6,034) beneficiaries. In assigning case managers, level of deprivation and number of beneficiaries with disabilities within the region should be considered, rather than assigning case managers proportional to the number of beneficiaries.

Limitation of the current study includes due to difficulties in obtaining regional data, most of the regional data were restricted to those related to the case management services such as number of beneficiaries and number of case managers. The current study entered total number of days of health care service utilization (combining clinic visits, hospitalization, and drug prescription days) into the equation as an outcome variable, instead of analyzing factors of these three services, separately. Total number of days of health care service utilization is an important indicator in the management of beneficiary qualifications, however, future studies are recommended to separately examine factors of three different types of services (clinic visits, hospitalization, and drug prescription days) to verify whether factors of service utilization differ by the types of services. The current study only considered the existence of disability as a health related variable in analysis of factors of health care service utilization. Future studies are recommended to consider other health related variables such as pain, depression, and disease characteristics in understanding factors of health care service utilization. Another limitation includes 229 administrative districts were employed in the classification of regions, which might not have well represented true contextual effects in health care service utilization of medical aid beneficiaries. Lastly, applying ecological model, the current study only considered individual and community level variables as predictors of health care service utilization, while interpersonal and public policy level variables were not included, thus future studies are recommended to include social network, social norm, and/or local public health policy in the analysis of factors of health care service utilization.

CONCLUSION

By application of multilevel modeling, this study sought to identify individual-and group-level factors associated with health care service

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utilization among Korean medical aid beneficiaries. At the individual level, existence of disability and types of medical aid beneficiaries showed a significant association, while at the group level, SDI, and number of beneficiaries and case managers within the region showed a significant association with health care service utilization. Results of the current study illustrated that variance at the group level accounted for 18.1% of the total variance in health care service utilization. Influence of group level factors outside beneficiaries in health care service utilization may imply a necessity for use of group level approaches. Thus, case management should include promotion of appropriate use of health care services targeting beneficiaries, while assuring quality and continuity of health care services on the part of case managers and health care providers, as well as to include public health policy change and enhancing community awareness. Further investigations are needed in order to determine whether interpersonal and public policy level factors (social network, social norm, and local public health policy etc.) are associated with health care service utilization.

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