



Original Article

## Predictors Affecting the Elderly's Use of Emergency Medical Services



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### ABSTRACT

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**Objectives:** Elderly adults are the demographic most likely to utilize emergency medical services (EMS). This study aimed to examine the difference in EMS utilization in subgroups of the elderly population by assessing the predictors for using EMS.

**Methods:** Using both descriptive and logistic regression analyses, this study analyses data from the 2014 Korean Health Panel Survey ( $n = 3,175$ ).

**Results:** It was observed that certain predisposing factors such as age, sex, and marital status were significant predictors of EMS utilization. However, differences in EMS need do not fully account for the original differences observed between subgroups of elderly Koreans. While health status and disability were important predictors of elderly Koreans using EMS, place of residence did not account for subgroup differences. Nonetheless, place of residence remained particularly important predictors of EMS utilization for the elderly.

**Conclusion:** Emergency needs and resource availability are 2 main determinants for elderly Koreans using EMS. In addition, it was observed that the demographic subgroup profile of unmarried/divorced/separated/widowed men who were aged 75 and older was least likely to utilize EMS. Improving their resource availability to meet their EMS needs should be a top priority for national policy making to narrow elderly population subgroup differences.

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## Introduction

Industrialized countries are seeing a rapid growth in their elderly populations as a percentage of their total populations. This issue is especially relevant in the Republic of Korea (Korea) where the elderly population group is fastest-growing. The national statistics office stated that the elderly population, as a proportion of the total population, increased from 7.2% in 2000 to 14.0% in 2017 and estimated it would reach an unprecedented 37.4% by 2050 [1,2]. Korea's rapid growth rate of the elderly population has surpassed Japan which in 2007 had

the highest percent of elderly in its population [3].

It has been reported that the elderly (aged 65 and older) are more likely to use emergency medical services (EMS) compared with younger adults [4-7]. When viewing this in conjunction with the rapid growth rate of the elderly population, there are obvious issues that must be addressed, such as health care needs for the elderly, which are likely to create an increased burden on government budgets and administrative staff. To allow for better management of elderly EMS needs in the future, there needs to be an understanding of how the various demographic subgroups utilize EMS. Prior

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studies examining EMS utilization by the elderly have primarily focused on the epidemiology of injuries in elderly patients [8,9], comparing young EMS users with elderly EMS users [10], assessing the factors contributing to the capacity of transport to an emergency medical department for elderly patients to receive EMS [11], and evaluating the appropriateness of EMS utilization [5]. However, detailed evaluation of the differences within elderly population subgroups and their EMS utilization have not been reported.

This study examined differences and predictors of EMS utilization within subgroups of the elderly population. The findings are based on data from the 2014 Korea Health Panel Survey (KHPS) conducted between February to September 2014 [12]. The findings of this study are expected to be valuable in identifying the subgroup differences that have been previously reported [13,14].

## Materials and Methods

### 1. Study sample

This study used data sourced from the 2014 KHPS [12]. The KHPS Review Board granted an exemption for this research. All participants provided written informed consent for their participation in the survey. The KHPS used face-to-face interviews and surveys to gather data on demographics, medical expenditure, service utilization, and the health behaviors of selected households. Focusing exclusively on EMS utilizations metrics, a total of 3,175 individuals were included in the study sample. The targeted sampling frame used by the KHPS was obtained from the National Population and Housing Census. To obtain a nationally-representative estimate from the sample size, weights were applied to logistic regression analyses. The KHPS sampling weights were adjusted to reflect survey nonresponse and national population totals from the current population survey.

### 2. Measures

The Aday-Andersen behavioral model is employed in this study to guide empirical and normative assessments of the differences. In this model, a series of predisposing, enabling, and need factors are hypothesized to be predictive of utilization of services. Aday and Andersen [14] also introduce “equitable distribution,” which may be a suitable model when performing exploratory research due to a lack of prior studies on EMS utilization.

The predisposing and enabling factors included variables such as age, gender, level of educational attainment, marital status, place of residence, and income. The EMS need and health-related factors included variables regarding health

status and the existence of a disability. The dependent variable was an original binary variable reflecting whether the sample person reported to have used EMS within the previous year (coded either “yes” or “no”). For the logistic regression analysis, the independent variables were re-coded to indicate dichotomies. The first category for a variable was coded 1 and the reference category for it (after “vs.”) was coded 0. Confronting a few survey data issues, a few individuals did not provide their health status ( $n = 146$ , or 4.6% of the sample).

Measures of health status were collected via face-to-face interviews and surveys, and ranged from highly subjective (e.g. self-evaluation) to the relatively objective (e.g. conditions checked by a nursing assistant) [14]. For the study, health status measures were categorized into self-perceived health [“poor/very poor” (1) or “fair/good/very good” (0)] and disable [“yes” (1) or “no” (0)].

In addition to health status of the elderly, there were additional demographic factors including age and sex included which were thought to be closely related to EMS utilization (marital status was also included). Therefore, as proxies for the need for EMS in the analysis, age, sex, and marital status were respectively represented as dichotomies: ages “65-74 years” (1) or ages “75 years and older” (0); “male” (1) or “female” (0), and “married” (1) or “unmarried, separated, divorced, or widowed” (0).

As a supplementary measure of socioeconomic status, the study used the sample person’s level of educational attainment, which was represented by the following dichotomy: “primary school or higher” (1) or “no formal schooling” (0).

Enabling factors included variables regarding place of residence and income. The relationship between income and care can be quite complicated, further examination of which is necessary [15]. That being said, for this study, income refers to the total amount for individuals if not married or the total for a couple if married with a spouse present in the same household [16]. These variables were represented by the following dichotomies: place of residence was represented by living in “capital areas” (Seoul, Incheon, Gyunggi) (1) or “non-capital areas” (0) and income was represented by salaries of “below 20 million won” (1) or salaries “above 20 million won” (0).

### 3. Statistical analysis

Firstly, descriptive statistics such as mean, standard deviation, percentages, and the  $\chi^2$  test were used to analyze the individual features of the sample. Then, using a logistic regression analysis, the relative importance of each of the factors in predicting EMS utilization was examined in more detail.

To better analyze the respective predisposing, enabling, and need-based factors as predictors of utilization, the analyses were conducted in a series of 3 stages. In Stage 1, the

predisposing variables were analyzed to examine differences between the demographic subgroups of the elderly Korean population. Stage 2 further analyzed the need for EMS variables to examine to what extent the subgroup differences were reduced when controlling for variations in the need for EMS factors. Finally, in Stage 3, the enabling factors were analyzed to examine whether the remaining subgroup differences were predominantly caused by the availability of EMS resources. From this 3-stage analysis, differences in the elderly population in terms of their engagement with EMS were more clearly defined. As a further explanation, the measurement of differences in EMS utilization was considered by using the relative importance of need-based factors compared with other factors (see previous studies [13,17-19] for further details).

The statistical significance of the odds ratios (the ratio of the likelihood that one age group (e.g., 65-74 years) had access compared with another age group (e.g., 75+ years), was tested to evaluate the impact of the predisposing, enabling, and need-based factors at each stage. Change in the magnitude or significance of the odds ratios in the successive stage was used to identify those factors which helped account for the subgroup differences in the probability of using EMS.

In addition, logistic regression analysis was used to control potentially confounding variables. Moreover, to avoid the problem of an over-fitting model, only variables significantly identified by descriptive analyses were included in the final regression model. All tests were conducted at the 5% level of significance.

## Results

### 1. Sample characteristics

The predisposing, enabling, and need-based characteristics along with emergency care utilization are presented in Table 1. Overall, survey respondents were most likely to have primary/middle schooling, to be married, aged 75 years or more, and female (Table 1). The average age of the respondents was 73.9 ( $\pm 6.7$ ) years, with 87.69% of the respondents being female. There were 54.87% of the respondents who were married. With regards to educational attainment, 23.28% of the respondents had no formal schooling, 60.22% had primary/middle schooling, 16.50% had a high school education or higher. The average family income of the respondents was 493.7( $\pm 159.8$ ) million won. More specifically, 47.97% of the respondents earned no annual family income, 31.15% earned 20 million won or less, 20.88% earned 20 million won or more. In terms of the area of residence, 65.13% of the respondents resided in non-capital areas while 34.87% resided in capital areas. In response to questions about self-perceived/reported and observed health, 47.21% of the respondents evaluated their health as poor or

very poor, and 52.79% evaluated their health as fair, good, or very good. There were 76.50% of the respondents who had no disability while 23.50% reported having a disability. There were 97.67% of the respondents who had chronic diseases while 2.33% had no chronic disease.

### 2. Bivariate analysis

Those who were most likely to have used EMS were primarily those individuals who were 75 years and older, were female, unmarried/divorced/separated/widowed, had primary/middle schooling, rated their health as fair, good, or very good, had no disability, lived in a non-capital area, and had no income (Table 2).

In the initial stage of the analyses, variables such as age, sex, education, marital status, income, residence, self-perceived health status, and disability remained significant predictors of EMS utilization. All tests were conducted at the 5% level of significance.

Table 1. Descriptive characteristics of the sample (N = 3,175).

Variables	N (%)	Mean ( $\pm$ SD)
<b>Predisposing</b>		
Age group (y)		73.9 ( $\pm 6.7$ )
65-74	1,457 (45.89)	
75+	1,718 (54.11)	
Sex		
Male	391 (12.31)	
Female	2,784 (87.69)	
Education		
No schooling	739 (23.28)	
Primary/middle schooling	1,912 (60.22)	
High schooling +	524 (16.50)	
Marital status		
Married	1,742 (54.87)	
Others	1,433 (45.13)	
<b>Need</b>		
Health status		
Poor	1,430 (47.21)	
Fair +	1,599 (52.79)	
Disability		
Yes	746 (23.50)	
No	2,429 (76.50)	
<b>Enabling</b>		
Income (10,000 won)		493.7 ( $\pm 159.8$ )
0	2,513 (47.97)	
1-2,000	989 (31.15)	
2,000 +	663 (20.88)	
Residence		
Capital area	1,107 (34.87)	
Non-capital area	2,068 (65.13)	

### 3. Multivariate Analysis

The odds ratios for EMS utilization (simultaneously adjusted for multiple independent variables) are presented in Table 3. After adjusting for predisposing factors (Stage 1), older adults who were most likely to have utilized EMS were female, aged 65-74, who had no schooling. Among all the predisposing variables, 3 variables, namely age, sex, and education, were significantly associated with EMS use.

These relationships were reexamined, adjusting for need (Stage 2). Those who had a poor health status or disability were more likely to have used EMS than their counterparts. The need variables had little impact on the subgroup differences in EMS utilization (see Table 3). The differences between demographic subgroups, those aged 65-74 versus adults over 75 years widened, or those subgroups male versus female, and those

who had primary schooling or higher versus no schooling, narrowed in Stage 2. The predisposing factor education which was significant in Stage 1 became non-significant in Stage 2. The predisposing factor marital status, which was insignificant in Stage 1, became significant in Stage 2. These findings suggest health status and disability remain important predictors of EMS utilization.

The impact of the enabling factors including income and residence were examined in Stage 3. Those who lived in non-capital areas were more likely to use EMS than those who lived in a capital area. Adjusting for the resource variables such as residence had little impact on the odds ratios of EMS utilization for the predisposing and need-based factors. The remaining subgroup differences remained about the same once the resource variables had been considered.

Table 2. Percentage of those who used emergency services by each variable.

Study variables	Emergency care utilization	
	%	$\chi^2$
Predisposing		
Age (y)		8.75*
65-74	28.28	
75+	37.51	
Sex		164.73*
Male	11.65	
Female	54.14	
Education		16.38*
No schooling	13.92	
Primary/middle schooling	40.47	
High schooling <sup>†</sup>	11.40	
Marital status		217.45*
Married	29.92	
Others	35.87	
Need		
Self-perceived health status		149.27*
Poor	25.49	
Fair <sup>†</sup>	39.68	
Disability		21.18*
Yes	17.10	
No	48.69	
Enabling		
Income (10,000 won)		122.43*
0	36.09	
1-2,000	18.96	
2,000 <sup>†</sup>	10.74	
Residence		9.68*
Capital area	24.19	
Non-capital area	41.61	

\*  $p < 0.01$ .

<sup>†</sup> The number of cases on which the estimates are based is 3,175 except for the following variables (for which the number of cases are noted in parentheses): self-perceived health status (3,029).

In summary, the place of residence did not account for the remaining subgroup differences in EMS utilization among older Koreans, as observed in Stage 3. Nonetheless, it remains a significant independent determinant of EMS utilization. The chi-square-based test for assessing how well the models fit the data resulted in a level of significance (Table 3).

**Discussion**

This study was the first of its kind to examine the differences

in EMS utilization among the elderly population in Korea. Observations of the study do not fully support the preconceived expectations regarding the equity of the elderly's use of EMS. However, the results still yielded useful information. The multivariate analysis revealed that health status and needs were accurate predictors of EMS utilization by elderly Koreans. Additionally, it was observed that differences in EMS needs do not fully explain the differences observed between subgroups of the elderly population. The subgroup differences (Table 3) remained relatively unchanged even after considering the resource variables. Nonetheless, place of residence remains an

Table 3. Multivariate logistic regression analysis of predictors of emergency care utilization for Korean elders.

Determinants	Emergency care utilization					
	Stage 1		Stage 2		Stage 3	
	Odds ratio (95% CI)	<i>P</i>	Odds ratio (95% CI)	<i>P</i>	Odds ratio (95% CI)	<i>P</i>
<b>Predisposing</b>						
Age group (y)						
65-74	1.49 (1.37-1.61)	< 0.01	1.59 (1.46-1.73)	< 0.01	1.58 (1.46-1.72)	< 0.01
75+	ref.		ref.		ref.	
Sex						
Male	0.76 (0.70-0.83)	< 0.01	0.78 (0.71-0.85)	< 0.01	0.77 (0.70-0.84)	< 0.01
Female	ref.		ref.		ref.	
Education						
Primary schooling *	0.31 (0.28-0.35)	< 0.01	0.90 (0.80-1.00)	0.057	0.91 (0.81-1.02)	0.116
No schooling	ref.		ref.		ref.	
Marital status						
Married	0.98 (0.89-1.07)	0.604	1.20 (1.09-1.31)	< 0.01	1.21 (1.10-1.32)	< 0.05
Others	ref.		ref.		ref.	
<b>Need</b>						
Self-perceived health status						
Poor			2.45 (2.26-2.65)	< 0.01	2.46 (2.26-2.66)	< 0.01
Fair *			ref.		ref.	
Disability						
Yes			1.39 (1.27-1.54)	< 0.01	1.39 (1.26-1.53)	< 0.01
No			ref.		ref.	
<b>Enabling</b>						
Income (10,000 won) †						
0-20					0.98 (0.88-1.08)	0.611
20 +					ref.	
Residence						
Capital area					0.87 (0.80-0.94)	< 0.01
Non-capital area					ref.	
Model chi-square	770.43		805.33		816.71	
Degrees of freedom	4		6		8	
Significance	< 0.0001		< 0.0001		< 0.0001	

\* The coefficient in logistic regression,  $b_k$ , implies that every one-unit increase in the variable increases the odds of contact with a doctor by a factor of  $EXP(b_i)$ .

† Korean monetary unit (\$ US 1=KRW 1,150)

important independent predictor of access to EMS. Likewise, predisposing factors such as age, sex, and marital status were also observed to be significant predictors of the EMS utilization of elderly Koreans.

The study also observed that in Korea, those fitting the demographic profile of being married women who were aged 65-74 years were most likely to utilize EMS. This result is consistent with those of previous studies [14,17]. This current study is based on the research of Rucker et al [11], which examined predictors of EMS utilization among all adults in the population and observed that age and physical functional capability were not necessarily associated with an increased likelihood of using EMS. This study further examines the population separately assessing the elderly population and those admitted to a hospital emergency department as an important and vulnerable subgroup in the general population, which requires further evaluation.

This study also shows that health-related needs (health status and disability) and resource availability (residence) determine EMS utilization. Health status and needs predicted the use of EMS. The observations, similar to previous studies [17,20], suggest that income was not a significant predictor of EMS utilization. However, it was observed that resource availability such as place of residence are positively associated with EMS utilization, a finding similar to previous studies [19,21].

This study further contributes to the understanding of equity in EMS utilization and is the first study to examine national equitability of EMS for elderly Koreans. Various predisposing, enabling, and need-based variables associated with EMS utilization were built into the model to evaluate EMS utilization of elderly Koreans based on the relative importance of need, compared with other defined factors.

This study was limited by the analysis model which used data collected by the 2014 Korea Health Panel Study [12]. Therefore, there are natural difficulties that arise with using secondary data in an analytical model. In terms of the study design, none of the established observations in the panel data can be inferred as having a cause-effect relationship. The majority of the data were self-reported, however, the surveyors did allow for proxy responses in situations where the family member was not home or if the respondent was a child or unable to provide their own responses due to either physical or mental handicap. Irrespective of the efforts to promote accurate reporting, the responses still face a risk of being inaccurate due to the respondent (being unaware of relevant information or choosing to not respond in a certain way due to privacy concerns).

## Conclusion

These results do not fully support the preconceived expectations regarding the equity of elderly Koreans' use of EMS. The main challenges were linked to equity between EMS needs and resource availability. Resource availability and needs are the 2 main determinants for elderly Koreans utilizing EMS. In addition, it was observed that the demographic subgroup profile of unmarried/divorced/separated/widowed men aged 75 and older was least likely to utilize EMS. Improving their resource availability and needs should be a top priority for national policy to narrow the population subgroup differences.

## Conflicts of Interest

The authors have no conflicts of interest to declare.

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