



Factors Affecting Healthcare Utilization among Patients with Single and Multiple Chronic Diseases

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Abstract

Background: We aimed to investigate the factors affecting healthcare utilization among patients with single and multiple chronic diseases using the Andersen healthcare utilization model.

Methods: We used a combination of the data from the sixth and seventh Korea National Health and Nutrition Survey (2014–2016). The study population was 3,901 patients with single chronic disease and 1,829 patients with multiple chronic diseases as defined by the WHO. Participants were aged 19 yr or older. Multiple regression analysis was employed using the Andersen model to identify factors affecting healthcare utilization (inpatient and outpatient).

Results: According to the Andersen model (comprising predisposing, enabling, and need factors and health behaviors), the factors that increased outpatients with single chronic disease were female, being aged 65 yr or older, having basic livelihood security benefit, immobility, and poor subjective health status. Factors that increased inpatients with single chronic disease were being aged under 65, having private insurance, immobility, poor subjective health status, and nondrinking. Moreover, factors that increased outpatients and inpatients with multiple chronic diseases were female, being aged under 65, immobility, and poor subjective health status and immobility, poor subjective health status, nondrinking, and not engaging in physical activity, respectively.

Conclusion: We identified factors affecting outpatient and inpatient care utilization among patients with single and multiple chronic diseases, using the Andersen healthcare utilization model. The findings can be used as foundational data to develop preventive and management strategies in healthcare utilization among patients with single and multiple chronic diseases.

Keywords: Single chronic disease; Multiple chronic diseases; Andersen model; Healthcare utilization

Introduction

Chronic diseases are those sustained over a year or more and require continual medical care or restriction of physical activities in daily life or both (1). Chronic diseases such as cardiovascular disease, cancer, diabetes, and chronic lung diseases are the leading causes of death and disability worldwide, including countries such as the Unit-

ed States and Korea (1, 2). The increased prevalence of chronic diseases is a result of various factors: behavioral risk factors such as smoking, poor nutrition, lack of physical activity, and excessive drinking; biomedical risk factors including high blood pressure, high blood cholesterol, obesity, etc (3-5).

With the increasing older adult population and changing lifestyles, there is a persistent rise in the prevalence of multiple chronic diseases (presence of two or more chronic diseases) (6). Six in 10 adults have a chronic disease and four in 10 adults have multiple chronic diseases in the US (1). Increase in the prevalence of chronic diseases results in public health problems, medical challenges, and medical cost burden for the country as well as health and economic burden for the patients (7, 8). Healthcare utilization is associated with health outcomes (9, 10). Patients with multiple chronic diseases have reported slightly higher healthcare utilization than those with a single chronic disease (11). Thus, it is important to demonstrate the association between prevalence of chronic disease and healthcare utilization. However, few studies have analyzed the characteristics and affecting factors of healthcare utilization by classifying patients with single and multiple chronic diseases.

The Andersen healthcare utilization model is an authoritative and conceptual behavior model to analyze factors affecting health service utilization (12). According to the model, health service utilization including inpatient, outpatient, and dental care is demonstrated through predisposing, enabling, and need factors. Predisposing factors involve family composition, social structure, and health beliefs; enabling factors include family resources, access to health insurance, and community resources; and need factors involve illness and response. Several studies have applied the Andersen healthcare utilization model to analyze factors facilitating and impeding health service utilization (13, 14). An Ethiopian study on low antenatal care services examined factors to improve the antenatal care utilization using the Andersen-Newman model (13). The Andersen model was also applied in the analysis of health service utilization of migrants in Beijing (14).

Therefore, we aimed to investigate factors affecting healthcare utilization among patients with single and multiple chronic diseases using the Andersen healthcare utilization model.

Materials and Methods

Design

In this descriptive cross-sectional study, we compared the factors affected healthcare utilization by classifying patients into those with single and multiple chronic diseases. Data from the Korea National Health and Nutrition Examination study was used for secondary data analysis.

Study Population

We used the annual National Health and Nutrition Survey as for citizens aged one and over to identify the health standards, health status and nutrition of Korean citizens. The National Health and Nutrition survey is used to obtain basic data for health policies such as goals and assessment of the comprehensive plan on national health promotion and development of health promotion programs. It was conducted triennially since 1998, and then became an annual rolling sample survey since 2007 (15). We used data from 2015, the third year of the sixth survey, and 2016 and 2017, which were the first and second years of the seventh survey to analyze comprehensively the three most recent years.

Of the 27 types of chronic diseases listed in the National Health and Nutrition Survey, those with any of the 13 chronic diseases defined by WHO such as high blood pressure, strokes, myocardial infarction, angina, diabetes, stomach cancer, liver cancer, breast cancer, cervical cancer, lung cancer, thyroid cancer, and other cancers were considered to have chronic diseases. A total of 7,380 people responded in 2015, 8,150 responded in 2016, and 8,127 people responded in 2017. Out these, 1,748 were over the age of 19 with chronic diseases in 2015, and 1,982 and 2,000 in 2016 and 2017, respectively. The number of respondents considered for this study was 5,730, of which 3,901 had single chronic disease, 1,829 had two or more multiple diseases, of them 363 had three or more chronic diseases.

Ethical approval

This paper is based on secondary analysis of extant data. The study was exempt from ethics re-

view, and was confirmed by the university's Institutional Review Board (No. 1044396-201912-HR-210-01).

Measures

The dependent variable was healthcare utilization, which was categorized into inpatient and outpatient. Inpatient was defined as the number of hospitalizations over the past year without considering the duration of hospitalization, and outpatient was defined as the number of times treatment was received from hospitals including dental hospitals, health centers, or oriental clinics without being hospitalized over the past two weeks.

The factors affecting healthcare utilization were the independent variables, which were classified into predisposing, enabling, and need factors and health behaviors according to the Andersen model. Predisposing factors were gender, age (under 65, 65 yr or older), education level (below high school, above college), and marital status (has spouse, no spouse). Enabling factors were basic livelihood security, health insurance (National Health Insurance, Medicaid), private insurance, household income (in 10,000 KRW), living with family, and immobility. Need factors were subjective health status (good, poor), and unmet medical needs. Health behaviors were smoking (yes if there is a single case within the past year), drinking (yes if there is a single case within the past year), engaging in physical activity (middle level intensity in leisure activities), and undergoing health screenings.

Statistical Analysis

This statistical analysis was performed using SAS 9.4 software (SAS Institute, Inc., Cary, North Carolina). The study first defined general characteristics using frequency analysis and descriptive statistics of each factor and made comparisons between patients with single chronic disease and multiple chronic diseases. The Andersen model was applied using multiple regression analysis by adding factors that could affect the dependent variables of healthcare utilization (inpatient, outpatient) starting with predisposing factors, fol-

lowed by enabling factors, need factors, and health behaviors.

Results

General Characteristics of Patients with Single and Multiple Chronic Diseases

After identifying the predisposing factors of gender, age, education level, and marital status to compare patients with single and multiple chronic diseases, there were statistically significant differences with respect to age, education level, and marital status but not for gender, and the significance level was extremely close to 0.05.

For the enabling factors —basic livelihood security, health insurance, private insurance, household income, living with family, and immobility — there were statistically significant differences for all variables.

For the need factors, although there was a statistically significant difference in subjective health statuses, no statistically significant difference was found for unmet medical needs. For subjective health status, 26.8% of those with single chronic disease had poor and 73.2% had good subjective health status, whereas 45.7% of those with multiple chronic diseases had poor and 54.3% had good subjective health status; there were more instances of those with multiple chronic diseases having poor subjective health status compared to those with single chronic disease.

In terms of health behaviors — smoking, drinking, engaging in physical activity, and undergoing health screenings — there were statistically significant differences for drinking, physical activity, and health screening, but not for smoking.

In terms of healthcare utilization, the dependent variable, during the past two weeks, those with single chronic disease reported 0.8 outpatient cases whereas those with multiple chronic diseases reported 1.0 outpatient case, which showed more outpatient use from those with multiple chronic diseases compared to those with single chronic disease. Those with single chronic disease reported 0.2 inpatient case over the past year, whereas those with multiple chronic diseases reported 0.3 inpatient case, which showed

more inpatient use from those with multiple chronic diseases compared to those with single chronic disease (Table 1).

Comparison of Outpatient Influence Factors in Single and Multiple Chronic Diseases

The results from the investigation and comparison of factors that influence outpatient care utilization by the number of chronic diseases are summarized ahead. From Model 1 (predisposing factors), the factors that increased outpatients from those with single chronic disease were being female, aged 65 yr or older, below high school graduate, and having no spouses, whereas there were no factors that affected those with multiple chronic diseases.

From Model 2 (predisposing and enabling factors), the factors that influenced outpatients from those with single chronic disease were being aged 65 yr or older, having received basic livelihood security, and immobility, whereas the influencing factors for those with multiple chronic diseases were being female and immobility.

From Model 3 (predisposing, enabling, and need factors), the factors that influenced outpatients from those with single chronic disease were being aged 65 yr or older, having received basic livelihood security, immobility, and poor subjective health condition, whereas the factors for those with multiple chronic diseases were being female, aged 65 yr or older, immobility, and poor subjective health status.

Table 1: General characteristics of patients with single and multiple chronic diseases

Variable	Class	%, Mean±SD		χ ² , t (P)	
		Single chronic disease	Multiple chronic diseases		
Predisposing factors	Gender	Male	45.5	48.2	3.710 (0.054)
		Female	54.5	51.8	
	Age	Under 65	54.5	35.9	172.585 (<0.001)
		65 yr or older	45.5	64.1	
	Education level	Below high school	80.3	86.9	35.300 (<0.001)
Marital status	Above college	19.7	13.1	9.870 (0.002)	
	Has spouse	72.3	68.2		
Enabling factors	Basic livelihood security	No spouse	27.7	31.8	14.447 (<0.001)
		Yes	89.8	86.4	
	Health insurance	National health insurance	10.2	13.6	15.887 (<0.001)
		Medicaid	93.9	91.0	
	Private insurance	Yes	6.1	9.0	123.169 (<0.001)
		No	61.6	46.0	
	Household income *amount: 10,000 won	Low	38.4	54.0	86.867 (<0.001)
		Mid-low	31.0	42.1	
		Mid-high	26.9	26.5	
		High	20.9	17.4	
Living with family	High quantity	21.3	14.0	7.750 (<0.001)	
	Yes	321.1±304.4	258.0±277.6		
Immobility	Yes	82.6	80.4	4.146 (0.042)	
	No	17.4	19.6		
Need factors	Subjective health status	No	86.1	77.6	62.594 (<0.001)
		Yes	13.9	22.4	
	Unmet medical needs	Good	73.2	54.3	195.360 (<0.001)
Health behaviors	Smoking	Poor	26.8	45.7	0.380 (0.537)
		No	89.5	89.0	
	Drinking	Yes	10.5	11.0	0.497 (0.481)
		No	83.0	83.7	
Physical activity	Yes	17.0	16.3	21.829 (<0.001)	
	No	38.5	45.0		
	Yes	61.5	55.0		
Health screenings	Yes	18.5	14.1	16.342 (<0.001)	
	No	81.5	85.9		
Dependent variable	Yes	72.6	67.6	14.493 (<0.001)	
	No	27.4	32.4		
Outpatient	Outpatient	0.8±1.6	1.0±1.7	-3.744 (<0.001)	
	Inpatient	0.2±0.7	0.3±0.8	-3.638 (<0.001)	

From Model 4 (predisposing, enabling, and need factors and health behaviors), the factors that influenced outpatients from with single chronic disease were being aged 65 yr or older, having received basic livelihood security, immobility, poor subjective health status, and having undergone health screenings, whereas the factors for those with multiple chronic diseases were being aged 65 yr or older, immobility, and poor subjective health status. Comparing the single- and multiple-chronic-disease groups showed that basic livelihood security and health screenings only affected outpatients among those with single chronic disease, and gender, age, immobility and subjective health status affected both groups (Table 2).

Comparison of Inpatient Influence Factors in Single and Multiple Chronic Diseases

The results from the investigation and comparison of factors that influenced inpatient care utilization by the number of chronic diseases showed no statistically significant differences in Model 1 (predisposing factors) for both groups of single and multiple chronic diseases. Model 2 (predisposing and enabling factors) showed that immobility increased inpatients among patients with both single and multiple chronic diseases. Model 3 (predisposing, enabling, and need factors) showed that immobility and poor subjective health status increased inpatients among patients with both single and multiple chronic diseases.

Table 2: Comparison of outpatient influence factors for single and multiple chronic diseases

Variable	Single chronic disease				Multiple chronic diseases				
	Model 1 β (P)	Model 2 β (P)	Model 3 β (P)	Model 4 β (P)	Model 1 B (P)	Model 2 β (P)	Model 3 B (P)	Model 4 β (P)	
Pre-disposing factors	Gender (ref=Male)	0.035 (0.038)	0.033 (0.054)	0.024 (0.167)	0.017 (0.387)	0.053 (0.039)	0.062 (0.016)	0.054 (0.024)	0.054 (0.063)
	Age (ref=Under)	0.070 (<0.001)	0.053 (0.006)	0.057 (0.003)	0.048 (0.014)	0.046 (0.061)	0.047 (0.078)	0.056 (0.036)	0.054 (0.049)
	Education level (ref=Below)	-0.048 (0.005)	-0.034 (0.061)	-0.030 (0.096)	-0.030 (0.101)	-0.020 (0.412)	-0.011 (0.678)	-0.006 (0.815)	-0.010 (0.708)
	Marital status (ref=has)	0.036 (0.033)	-0.002 (0.940)	-0.005 (0.827)	-0.007 (0.748)	0.023 (0.371)	-0.003 (0.935)	-0.006 (0.861)	0.000 (0.989)
	Basic livelihood security (ref=No)		0.055 (0.015)	0.051 (0.023)	0.057 (0.013)		0.023 (0.506)	0.020 (0.568)	0.015 (0.665)
Enabling factors	Health insurance (ref=National)		0.001 (0.957)	-0.003 (0.905)	-0.001 (0.976)		0.048 (0.164)	0.043 (0.209)	0.052 (0.133)
	Private insurance (ref=Yes)		-0.019 (0.321)	-0.021 (0.280)	-0.011 (0.594)		-0.006 (0.840)	-0.007 (0.803)	-0.008 (0.781)
	Household income (Monthly average)		-0.025 (0.202)	-0.021 (0.291)	-0.023 (0.238)		0.006 (0.815)	0.011 (0.683)	0.013 (0.650)
	Living with family (ref=Yes)		0.020 (0.343)	0.020 (0.344)	0.020 (0.351)		-0.005 (0.882)	-0.003 (0.926)	-0.004 (0.910)
	Immobility (ref=No)		0.143 (<0.001)	0.121 (<0.001)	0.121 (<0.001)		0.095 (<0.001)	0.071 (0.005)	0.071 (0.006)
Need factors	Subjective health status (ref=Good)			0.076 (<0.001)	0.076 (<0.001)			0.103 (<0.001)	0.106 (<0.001)
	Unmet medical needs (ref=No)			0.016 (0.342)	0.018 (0.292)			-0.017 (0.483)	-0.019 (0.456)
Health behaviors	Smoking (ref=No)				-0.010 (0.584)				-0.007 (0.788)
	Drinking (ref=No)				-0.018 (0.303)				-0.019 (0.455)
	Physical activity (ref=Yes)				-0.004 (0.814)				0.000 (0.989)
	Health screenings (ref=Yes)				-0.048 (0.004)				-0.045 (0.063)
F (p)	13.664 (<0.001)	15.597 (<0.001)	14.834 (<0.001)	11.693 (<0.001)	3.721 (0.005)	4.057 (<0.001)	4.785 (<0.001)	3.959 (<0.001)	
R ²	0.015	0.042	0.047	0.05	0.008	0.023	0.033	0.036	
Adj. R ²	0.014	0.039	0.044	0.046	0.006	0.018	0.026	0.027	

Model 4 (predisposing, enabling, and need factors and health behaviors) showed that being aged 65 and under, holding private insurance, immobility, poor subjective health status, and nondrinking increased inpatients among those with single chronic disease, and immobility, poor subjective health status, nondrinking, and lack of physical activity increased inpatients among those

with multiple chronic diseases. Comparing the two groups (with single and multiple chronic diseases) showed that age and holding private health insurance affected inpatients with single chronic disease, physical activity affected inpatients with multiple chronic diseases, and immobility, subjective health status, and drinking affected both groups (Table 3).

Table 3: Comparison of inpatient influence factors for single and multiple chronic diseases

Variable	Single chronic disease				Multiple chronic diseases				
	Model 1 β (P)	Model 2 β (P)	Model 3 β (P)	Model 4 β (P)	Model 1 β (P)	Model 2 β (P)	Model 3 β (P)	Model 4 β (P)	
Pre-disposing factors	Gender (ref=Male)	0.020 (0.235)	0.015 (0.371)	0.013 (0.460)	-0.001 (0.959)	-0.023 (0.363)	-0.019 (0.473)	-0.022 (0.399)	-0.045 (0.119)
	Age (ref=Under)	-0.030 (0.085)	-0.033 (0.090)	-0.032 (0.101)	-0.042 (0.034)	-0.029 (0.236)	-0.042 (0.118)	-0.036 (0.175)	-0.051 (0.065)
	Education level (ref=Below)	-0.019 (0.285)	-0.010 (0.575)	-0.009 (0.608)	-0.009 (0.624)	0.014 (0.578)	0.017 (0.509)	0.020 (0.439)	0.029 (0.271)
	Marital status (ref=Has)	0.011 (0.514)	-0.005 (0.822)	-0.007 (0.760)	-0.015 (0.496)	0.054 (0.035)	0.009 (0.787)	0.006 (0.845)	0.011 (0.738)
Enabling factors	Basic livelihood security (ref=No)		0.046 (0.046)	0.046 (0.044)	0.047 (0.041)		-0.036 (0.292)	-0.038 (0.265)	-0.041 (0.232)
	Health insurance (ref=National)		-0.002 (0.932)	-0.006 (0.801)	-0.007 (0.773)		0.046 (0.180)	0.043 (0.207)	0.041 (0.232)
	Private insurance (ref=Yes)		-0.038 (0.057)	-0.038 (0.057)	-0.043 (0.034)		0.018 (0.497)	0.017 (0.528)	0.012 (0.657)
	Household income (Monthly average)		-0.004 (0.849)	-0.002 (0.925)	-0.005 (0.786)		0.035 (0.211)	0.038 (0.172)	0.047 (0.093)
	Living with family (ref=Yes)		-0.008 (0.703)	-0.007 (0.755)	-0.002 (0.930)		0.054 (0.088)	0.054 (0.083)	0.054 (0.086)
	Immobility (ref=No)		0.144 (<0.001)	0.136 (<0.001)	0.134 (<0.001)		0.132 (<0.001)	0.117 (<0.001)	0.113 (<0.001)
	Need factors	Subjective health status (ref=Good)			0.046 (0.010)	0.042 (0.020)			0.063 (0.013)
	Unmet medical needs (ref=No)			-0.028 (0.093)	-0.030 (0.078)			-0.001 (0.960)	0.004 (0.877)
Health behaviors	Smoking (ref=No)				0.000 (0.999)				0.006 (0.835)
	Drinking (ref=No)				-0.054 (0.003)				-0.066 (0.011)
	Physical activity (ref=Yes)				-0.004 (0.835)				0.057 (0.025)
	Health screenings (ref=Yes)				0.004 (0.803)				-0.035 (0.157)
F (p)	1.474 (0.207)	9.186 (<0.001)	8.385 (<0.001)	6.870 (<0.001)	1.478 (0.206)	4.289 (<0.001)	4.124 (<0.001)	3.939 (<0.001)	
R ²	0.002	0.025	0.027	0.030	0.003	0.024	0.028	0.036	
Adj. R ²	0.001	0.022	0.024	0.026	0.001	0.019	0.021	0.027	

Discussion

We demonstrated factors affecting the use of outpatient and inpatient care among patients with single and multiple chronic diseases using the Andersen healthcare utilization model. Chronic diseases are characterized by various

causes and risk factors and associated with healthcare utilization and cost (4, 7). Chronic diseases affect multiple parts of the body and are difficult to recover from quickly, and need continuous treatment and management, contrary to acute diseases that typically affect one part of the body and show faster response to treatment (16,

17). Furthermore, it is important to find and diagnose chronic diseases at an early stage because they have long latency periods from the onset of the disease to experiencing its effects (18).

In this study, it was considered important to classify patients with single and multiple chronic diseases. The difference between single and multiple chronic diseases is not simply the number of chronic diseases (11). In term of prevention and management of diseases, single chronic disease can be considered in terms of onset of chronic disease, and multiple chronic diseases can be considered in terms of maintenance of chronic diseases. With the increasing prevalence of chronic diseases, it is important to analyze factors affecting healthcare utilization among patients with both single and multiple chronic diseases (6). Analyzing factors affecting healthcare utilization among patients with single and multiple chronic diseases can help to improve accessibility to healthcare, manage chronic diseases persistently and effectively, and ensure stable use of healthcare services.

In this study, immobility as an enabling factor and poor subjective health status as a need factor increased healthcare utilization among outpatients and inpatients for both single and multiple chronic diseases. Furthermore, lack of physical activity increased inpatient care utilization for multiple chronic diseases. Immobility itself can imply poor health condition and increase healthcare utilization. However, this study showed that decreased physical activity did not simply increase healthcare utilization, and increased only inpatient utilization in multiple chronic diseases. Rather, multiple chronic diseases have been shown to disturb physical activity. Health behaviors such as physical activity is controversial in healthcare utilization depending on patient condition and the type of physical activity (19-22). Nonetheless, physical activity is an expected but important influencing factor in healthcare utilization among patients with single and multiple chronic diseases.

With increase in age, prevalence of chronic diseases and demand for healthcare utilization increases, but economic independence decreases

(23-25). Being aged 65 or older is a factor that can facilitate or impede healthcare utilization. In this study, being aged 65 or older increased outpatient care utilization for both single and multiple chronic diseases. Korea has high healthcare accessibility owing to the national health insurance. However, as inpatient care involves burden, being aged 65 or older was a factor that decreased healthcare utilization. Furthermore, absence of private insurance decreased inpatient utilization for single chronic disease. This may suggest the importance of economic burden in healthcare utilization.

Moreover, drinking as a health behavior decreased inpatient utilization for both single and multiple chronic diseases. It has been reported that alcohol use decreases healthcare utilization regardless of drinking patterns (26). Drinkers have known to be less likely to engage in preventive behavior. Thus, nondrinking is a key health behavior in the management of chronic diseases and healthcare utilization.

This study showed that having received basic livelihood security benefit and having undergone health screenings increased outpatient care utilization for single chronic disease. A study reported that severe disability and low income without national basic livelihood security decreased outpatient and inpatient care utilization among older adults (27). Basic livelihood security benefit has increased accessibility to outpatient care. Furthermore, health screening increasing outpatient care utilization for single chronic disease is consistent with previous reports that health screening is associated with higher outpatient utilization in cardiovascular diseases (28). Health screening was also a significant factor in single chronic disease, which indicates onset of chronic disease. In outpatient care, which involves less cost burden, basic livelihood security benefit and national health screening were the affecting factors in the onset and diagnosis of chronic disease. In inpatient utilization, which involves more cost burden, private insurance was the affecting factor for single chronic disease.

In this study, there were differences in the factors affecting outpatient and inpatient care utilization

among patients with single and multiple chronic diseases. Thus, it is important to manage the affecting factors depending on whether a patient has single or multiple chronic diseases. Furthermore, it is essential to improve the accessibility to healthcare services for appropriate disease management and to reduce excessive and unnecessary healthcare utilization for single and multiple chronic diseases.

However, this study has some limitations. Chronic diseases were analyzed only by number, regardless of type and severity. Furthermore, in inpatient care utilization, the duration of hospitalization was not considered because only the number of hospitalizations was taken into account regardless of hospitalization period.

Conclusion

Comparing the single- and multiple-chronic-disease groups showed that basic livelihood security and health screenings only affected outpatients among those with single chronic disease, and gender, age, immobility and subjective health status affected both groups, and that age and holding private health insurance affected inpatients with single chronic disease, physical activity affected inpatients with multiple chronic diseases, and immobility, subjective health status, and drinking affected both groups. The findings can be used as foundational data to develop preventive and management strategies for healthcare utilization among patients with single and multiple chronic diseases.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

References

1. Centers for Disease Control and Prevention (2019). About chronic diseases. Available from: <https://www.cdc.gov/chronicdisease/about/index.htm> (accessed 27 October 2019).
2. Raghupathi W, Raghupathi V (2018). An empirical study of chronic diseases in the United States: A visual analytics approach. *Int J Environ Res Public Health*, 15(3):431.
3. Australian Government Department of Health. Chronic conditions. Available from: <https://www1.health.gov.au/internet/main/publishing.nsf/Content/chronic-disease#footnote> (accessed 8 Nov 2019).
4. Vainieri M, Quercioli C, Maccari M, Barsanti S, Murante AM (2018). Reported experience of patients with single or multiple chronic diseases: Empirical evidence from Italy. *BMC Health Serv Res*, 18(1):659.
5. World Health Organization (2019). Chronic diseases and health promotion. Available from: https://www.who.int/chp/chronic_disease_report/part2_ch1/en/index12.html (accessed 8 Nov 2019).
6. Hajat C, Stein E (2018). The global burden of multiple chronic conditions: A narrative review. *Prev Med Rep*, 12:284–293.
7. Atella V, Piano Mortari A, Kopinska J, et al (2019). Trends in age-related disease burden and healthcare utilization. *Aging Cell*, 18(1): e12861.
8. Ko D, Bratzke LC, Roberts T (2018). Self-management assessment in multiple chronic conditions: A narrative review of literature. *Int J Nurs Stud*, 83:83–90.
9. Wang SY, Chen LK, Hsu SH, Wang SC (2012). Health care utilization and health outcomes: a population study of Taiwan. *Health Policy Plan*, 27(7):590-599.
10. Jiang M, Yang G, Fang L, et al (2018). Factors associated with healthcare utilization among community-dwelling elderly in shanghai, China. *PLoS One*, 13(12):e0207646.

11. Hopman P, Heins MJ, Korevaar JC, Rijken M, Schellevis FG (2016). Health care utilization of patients with multiple chronic diseases in the Netherlands: Differences and underlying factors. *Eur J Intern Med*, 35:44–50.
12. Andersen RM (1995). Revisiting the behavioral model and access to medical care: Does it matter? *J Health Soc Behav*, 36(1):1–10.
13. Tesfaye G, Chojenta C, Smith R, Loxton D (2018). Application of the Andersen-Newman model of health care utilization to understand antenatal care use in Kersa District, Eastern Ethiopia. *PLoS One*, 13:e0208729.
14. Shao S, Wang M, Jin G, Zhao Y, Lu X, Du J (2018). Analysis of health service utilization of migrants in Beijing using Anderson health service utilization model. *BMC Health Serv Res*, 18:462.
15. Korea Centers for Disease Control and Prevention (2016). The Seventh Korea National Health and Nutrition Examination Survey. Seoul: KCDC.
16. Bernell S, Howard SW (2016). Use your words carefully: What is a chronic disease? *Front Public Health*, 4:159.
17. Graziadei IW (2011). The clinical challenges of acute on chronic liver failure. *Liver Int*, 3:24–6.
18. Lee s, Huang H, Zelen M (2004). Early detection of disease and scheduling of screening examinations. *Stat Methods Med Res*, 13(6):443–456.
19. Fonseca VR, Nobre MR, Pronk NP, Santos LA (2010). The association between physical activity, productivity, and health care utilization among employees in Brazil. *J Occup Environ Med*, 52(7):706–712.
20. Jacobs JM, Rottenberg Y, Cohen A, Stessman J (2013). Physical activity and health service utilization among older people. *J Am Med Dir Assoc*, 14(2):125–129.
21. Kang SW, Xiang X (2017). Physical activity and health services utilization and costs among U.S. adults. *Prev Med*, 96:101–105.
22. Vozoris NT, O'Donnell DE (2012). Prevalence, risk factors, activity limitation and health care utilization of an obese, population-based sample with chronic obstructive pulmonary disease. *Can Respir J*, 19(3):e18–e24.
23. Bähler C, Huber CA, Brüngger B, Reich O (2015). Multimorbidity, health care utilization and costs in an elderly community-dwelling population: a claims data based observational study. *BMC Health Serv Res*, 15:23.
24. Decker SL, Doshi JA, Knaup AE, Polsky D (2012). Health service use among the previously uninsured: is subsidized health insurance enough? *Health Econ*, 21(10):1155–1168.
25. Zayas CE, He Z, Yuan J, et al (2016). Examining healthcare utilization patterns of elderly middle-aged adults in the United States. *Proc Int Fla AI Res Soc Conf*, 361–366.
26. Zarkin GA, Bray JW, Babor TF, Higgins-Biddle JC (2004). Alcohol drinking patterns and health care utilization in a managed care organization. *Health Serv Res*, 39(3):553–570.
27. Jeon B, Noguchi H, Kwon S, Ito T, Tamiya N (2017). Disability, poverty, and role of the basic livelihood security system on health services utilization among the elderly in South Korea. *Soc Sci Med*, 178:175–183.
28. Kim MJ, Lee H, Kim EH, et al (2017). Disparity in health screening and health utilization according to economic status. *Korean J Fam Med*, 38(4): 220–225.