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Longitudinal changes in comorbidity patterns over time in relation to mortality in older Korean adults

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ABSTRACT

This study investigates the different pattern of change in comorbidity over time and its effect on mortality in older adults in South Korea. Data are from the National Health Insurance Service–Korean Senior (NHIS-Korean Senior) claim database, consisting of a random sample of 10% of adults aged 60 years and older. At baseline in 2002 121,733 subjects, who were admitted to the hospital at least once a year between 2002 and 2008, were analyzed. We used the Cox proportional hazards models after growth mixture modeling (GMM) to estimate trajectories in the combined comorbidity Index scores which is the Gagne's method between 2002 and 2008, and their 1-, 3-, and 5-year mortality rates. Five comorbidity trajectory groups were generated: consistently low, increased, decreased/low, decreased/high, and consistently high. After adjusting for all confounders, compared with decreased/low, the consistently high group presented the highest mortality risk ($p < 0.001$; $P_{trend} < 0.001$), with hazard ratios (HR) of 3.48 at 1-year, 2.53 at 3-year, and 1.92 at 5-year follow-up, followed by the increased and decreased/high groups. Five distinct comorbidity trajectories were identified that predicted increased risk of mortality. The group with the consistently high comorbidity scores over time exhibited the highest mortality risk.

1. Introduction

It is common that older adults have more than one illness, defined as comorbidity, with its prevalence increasing with age (Nunes, Flores, Mielke, Thume, & Facchini, 2016). In observational studies evaluating health outcomes (Chu, Ng, & Wu, 2010; Farley, Harley, & Devine, 2006; Schneeweiss et al., 2001), by summarizing various medical conditions into single numeric indices based on administrative database (Charlson, Charlson, & Peterson, 2008; Elixhauser, Steiner, Harris, & Coffey, 1998; Quan, Sundararajan, & Halfon, 2005; Uemura, Imataki, & Kawachi, 2016; Von Korff, Wagner, & Saunders, 1992), that includes diagnosis codes, a variety of summary comorbidity measures or scores (Charlson et al., 2008; Elixhauser et al., 1998; Quan et al., 2005; Uemura et al., 2016; Von Korff et al., 1992), have been developed. These comorbidity indices provide a standardized summary of the burden of comorbidity and can be used as a potentially important independent predictor or confounder of health outcomes.

Previous studies have shown that the comorbidity among older adults is associated with poorer health outcomes, such as increased mortality (Charlson et al., 2008; Schneeweiss, Wang, Avorn, & Glynn, 2003), higher rates of hospital admissions (Clark, Von Korff, Saunders, Baluch, & Simon, 1995; Von Korff et al., 1992), worse physical function status, and greater utilization of health services (Fortin et al., 2004; Kriegsman, Deeg, & Stalman, 2004). These studies, however, are limited in that comorbidity at one time or for a one-year period has been assessed, incorporating diagnosis as a simple count or using different weights by health conditions (Charlson et al., 2008; Elixhauser et al., 1998). This approach may help clinicians understand reasons for poorer health among certain profiled patients in a setting. Yet, it cannot give a good perspective on how changes in comorbidities over time affect health outcomes.

Recent longitudinal studies have measured comorbidity scores at several points to predict important health outcomes (Morris, Sanders, Kennedy, & Rogers, 2011; Zimmer, Martin, Nagin, & Jones, 2012).

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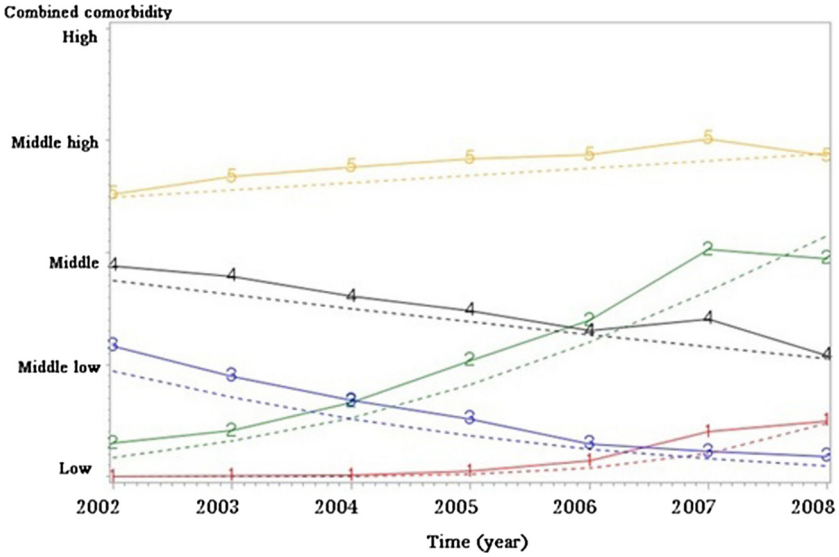

Fig. 1. Trajectories of Combined comorbidities between 2002 and 2008.

Table 1
Descriptive Characteristics of Older Adults.

			1-year survival					3-year survival					5-year survival				
	Total		No		Yes		P-value	No		Yes		P-value	No		Yes		P-value
	N	%	N	%	N	%		N	%	N	%		N	%	N	%	
Combined comorbidity							< .0001					< .0001					< .0001
Group 1 (Consistently low)	22,028	18.1	21,171	96.1	857	3.9		19,955	90.6	2,073	9.4		18,462	83.8	3,566	16.2	
Group 2 Increased	29,691	24.4	27,326	92	2,365	8		25,178	84.8	4,513	15.2		22,872	77	6,819	23	
Group 3 (Decreased [low])	16,750	13.8	16,203	96.7	547	3.3		15,293	91.3	1,457	8.7		14,149	84.5	2,601	15.5	
Group 4 (Decreased [high])	19,488	16	18,437	94.6	1,051	5.4		17,087	87.7	2,401	12.3		15,543	79.8	3,945	20.2	
Group 5 (Consistently high)	33,776	27.8	29,964	88.7	3,812	11.3		26,746	79.2	7,030	20.8		23,574	69.8	10,202	30.2	
Age							< .0001					< .0001					< .0001
60-69	78,679	64.6	75,368	95.8	3,311	4.2		71,777	91.2	6,902	8.8		67,593	85.9	11,086	14.1	
70-79	36,904	30.3	32,956	89.3	3,948	10.7		28,897	78.3	8,007	21.7		24,556	66.5	12,348	33.5	
≥80	6,150	5.1	4,777	77.7	1,373	22.3		3,585	58.3	2,565	41.7		2,451	39.9	3,699	60.2	
Sex							< .0001					< .0001					< .0001
Male	44,091	36.2	40,058	90.9	4,033	9.2		36,080	81.8	8,011	18.2		32,007	72.6	12,084	27.4	
Female	77,642	63.8	73,043	94.1	4,599	5.9		68,179	87.8	9,463	12.2		62,593	80.6	15,049	19.4	
Income							0.012					0.001					< .0001
Low	25,637	21.1	23,729	92.6	1,908	7.4		21,827	85.1	3,810	14.9		19,666	76.7	5,971	23.3	
Middle	37,881	31.1	35,296	93.2	2,585	6.8		32,642	86.2	5,239	13.8		29,679	78.4	8,202	21.7	
High	58,215	47.8	54,076	92.9	4,139	7.1		49,790	85.5	8,425	14.5		45,255	77.7	12,960	22.3	
Type of insurance							0.01					< .0001					< .0001
Community insurance	53,460	43.9	49,537	92.7	3,923	7.3		45,508	85.1	7,952	14.9		41,155	77	12,305	23	
Workplace insurance	68,218	56	63,514	93.1	4,704	6.9		58,708	86.1	9,510	13.9		53,405	78.3	14,813	21.7	
Medical Aid	55	0.1	50	90.9	5	9.1		43	78.2	12	21.8		40	72.7	15	27.3	
Region							< .0001					< .0001					< .0001
Metropolitan	26,074	21.4	24,493	93.9	1,581	6.1		22,803	87.5	3,271	12.6		20,919	80.2	5,155	19.8	
Urban	27,210	22.4	25,214	92.7	1,996	7.3		23,164	85.1	4,046	14.9		20,982	77.1	6,228	22.9	
Rural	68,449	56.2	63,394	92.6	5,055	7.4		58,292	85.2	10,157	14.8		52,699	77	15,750	23	
Total	121,733	100	113,101	92.9	8,632	7.1		104,259	85.7	17,474	14.4		94,600	77.7	27,133	22.3	

Lappenschaar, Hommersom, and Lucas (2013) identified nine chronic cardiovascular morbidities over time, another study followed increasing comorbidity over 5–6 years (Quiñones, Liang, Bennett, Xu, & Ye, 2011), and a Dutch study found that increasing comorbidity over time was associated with poorer physical function. (Aarts, den Akker, & Bosma, 2012). However, little is known about the effects of trends in comorbidity changes on several time points on mortality among the older population after controlling for confounders.

This study aims to develop statistical models to estimate trends in comorbidity score changes over time from 2002 to 2008 before an index event, and investigate the effect of trends in comorbidity changes on mortality at 1-year, 3-year, and 5-year.

2. Methods

2.1. Data source

We used the National Health Insurance Service–Korean Senior (NHIS-Korean Senior) claim database from 2002 to 2013 provided by the Korean National Health Insurance Service (KNHIS) (Lee, Lee, Park, Shin, & Kim, 2016). The National Health Insurance Service–Korean Senior (NHIS-Korean Senior) claim database contained personal information, demographics and medical treatment data for Korean elderly citizens (65 years or more). The NHIS-Korean Senior was generated using participants' medical bill expenses claimed by medical