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## Research Article

## Turnover Rates and Factors Influencing Turnover of Korean Acute Care Hospital Nurses: A Retrospective Study Based on Survival Analysis

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## ABSTRACT

**Purpose:** This study aimed to explore turnover rates for Korean acute care hospital nurses and identify factors influencing their turnover.

**Methods:** The study was retrospective in nature. Nurse cohort data were obtained from hospital status data from Korea's Health Insurance Review Assessment Service. The observation period was from January 1, 2012 to December 31, 2016, and data for 96,158 nurses were analyzed. Independent variables included nurses' age and sex and hospital setting, type, ownership, and nurse staffing level. Kaplan–Meier analysis was performed to estimate survival curves, and factors influencing turnover were analyzed using Cox's proportional hazard regression.

**Results:** The cumulative turnover probability for all nurses was .17, .29, .38, .45, and .50 for the first, second, third, fourth, and fifth years, respectively. The results showed that the longer the career duration, the lower the turnover rates. According to the factors influencing nurse turnover, both nurses' (i.e., sex and career duration) and hospitals' (i.e., hospital setting, type, ownership, and nurse staffing level) characteristics were statistically significant.

**Conclusion:** It should be noted that the turnover rate of nurses with less than three year of career duration and of those with less than one year has been shown to be quite high. Therefore, target populations for acute care hospital nurse turnover should be expanded from new graduate nurses to experienced nurses with less than 3 years of career. Further studies are required to examine the causes of high turnover rates in hospitals that are small and/or have low nurse staffing levels.

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## Introduction

The shortage of hospital nurses is a global problem, and South Korea is no exception. This shortage refers to an imbalance between the demand for nursing skills (usually defined in terms of the number of nurses) and the availability of nurses [1]. Nurse turnover increases this imbalance, thereby exacerbating the nurse shortage. If a nurse shortage continues at a hospital, it becomes difficult to maintain an acceptable patient-to-nurse ratio, leading to increased nurse dissatisfaction, burnout, error, and turnover; higher patient mortality; and failure to rescue [2–4]. In addition, high nurse

turnover rates not only result in adverse patient outcomes but also reduce hospital productivity. The magnitude of the effects of nurse turnover on hospital financial status varies between hospitals [5]. However, increased nurse turnover is a factor affecting hospitals' financial burden because it requires hospitals to increase their resource input, which necessitates hospital expenditure for expansion [5]. Therefore, reducing nurse turnover is beneficial for hospital management and the reduction of patient safety issues caused by nurse shortages.

In Korea, the hospital nurse turnover rate is largely attributable to high turnover in new graduate nurses, and turnover rates vary between hospitals with certain characteristics. The Korean Hospital Nurse Association (KHNA) surveys around 200 hospitals annually to determine nurse turnover rates. According to the survey results, the average turnover rate for all hospital nurses decreased by 4.6%, from 18.5% in 2009 to 13.9% in 2018. However, the gap in turnover rates between large and small hospitals decreased by only 1.6%, from 29.8% in 2009 to 28.2% in 2018 [6,7]. In other words, the

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turnover rate of all nurses has been decreasing; however, the gap between the turnover rates of large hospitals and small- and medium-sized hospitals has not correspondingly decreased. Moreover, the average turnover rate for new graduate nurses increased from 16.7% in 2013 to 27.8% in 2018 [7,8].

For these reasons, nurse turnover is becoming a common focus in Korean research examining hospital nurse management. Studies exploring the factors influencing nurses' intention to leave hospital positions are numerous [9,10]. Despite the predominant research focus on nurses' intention to resign, a few studies have directly reported the actual turnover rates for hospital nurses. Moreover, the samples in previous studies were limited to approximately 300 new graduate nurses, and the studies did not include hospital-related characteristics in the data analysis or used a limited number of variables addressing hospital characteristics [11,12]. Consequently, it is questionable as to whether the results of these studies are representative of actual turnover rates for all hospital nurses in Korea, and it is difficult to determine how hospital characteristics influence turnover rates for hospital nurses based on the results of previous studies. Thus, examining representative data for the entire hospital nurse population is necessary to estimate the turnover rate for nurses working in Korean hospitals accurately.

The data on hospital nurses used in this study were drawn from hospital status data collected by the Health Insurance Review Assessment Service (HIRA). The HIRA is a public agency in charge of auditing hospital care costs and assessing the quality of hospital services in Korea [13]. This agency collects information on the facilities, personnel, and equipment in all Korean hospitals. Therefore, the data used in this study are highly representative of hospital nurses across the country.

The purposes of this study were to (1) estimate the turnover rate for hospital nurses in Korea, using cohort data collected from January 1, 2012 to December 31, 2016 and (2) identify factors influencing hospital nurse turnover.

## Methods

### Study design

This study used a retrospective observational study design and used nurse cohort data drawn from hospital status data of the HIRA in Korea.

### Data source

The study data were reported to the HIRA by acute care hospitals, including general and tertiary hospitals. The authors requested the hospital status data from the HIRA regarding nurses' working status from the fourth quarter of 2011 to December 31, 2016. Of the data received by email, hospital nurses represented by the HIRA's hospital status data for the fourth quarter of 2011 were identified as the members of the nurse cohort. Initially, the number of study subjects totaled 97,591 nurses. Of these, 1,433 nurses who resigned from their hospital jobs during the fourth quarter of 2011 were excluded from the study because the observation period of this study began on January 1, 2012. Therefore, data were ultimately analyzed for 96,158 nurses. The study's observation period lasted for a total of five years (January 1, 2012 to December 31, 2016).

### Study variables

An "event" was defined as a nurse's resignation from a hospital job. If a nurse's resignation date was present in the data within the observation period, from January 1, 2012 to December 31, 2016, the event was considered to have occurred and was assigned the value

"1." In contrast, if a nurse's resignation date did not occur in the data, it was assigned the value "0," representing censored data.

The independent variables consisted of sex, career duration, hospital region, hospital setting, hospital ownership, hospital type, and nurse staffing grade for general units. Sex was classified as female or male. Career duration was calculated as the period from the date of the nurse's license to January 1, 2012 (the start of the observation period) and was classified into one of four categories: <1 year, 1 to <3 years, 3 to <5 years, and  $\geq 5$  years. Hospital region was classified as one of the following eight areas: Seoul, Kyunggi/Incheon, Pusan/Ulsan/Kyeongnam, Daegu/Kyeongbuk, Gwangju/Julla, Daejeon/Choongchung, Kangwon, and Jeju. Hospital setting was categorized into metropolitan, medium/small city, and rural. Hospital ownership was classified into public, university, and private. Hospital type was categorized into tertiary, general, and medium/small. Finally, nurse staffing grades in general units were classified into seven grades based on the number of beds per nurse. The nursing care fee based on a differential system was introduced in 1999 to provide high-quality nursing services by securing appropriate nurse staffing levels. The hospital's nurse staffing is divided into seven grades based on the number of nurses per bed. The ratio of nurses in the hospital bed by nursing grade is as follows: Grade 1—less than 2.5:1 (less than 2.0:1 for tertiary hospital), Grade 2—2.5 to less than 3:1 (2.0 to less than 2.5 for tertiary hospital), Grade 3—3.0 to less than 3.5:1 (2.5 to less than 3.0 for tertiary hospital), Grade 4—3.5 to less than 4.0:1 (3.0 to less than 3.5 for tertiary hospital), Grade 5—4.0 to less than 4.5:1 (3.5 to less than 4.0 for tertiary hospital), Grade 6—4.5 to less than 6.0:1 (more than 4.0 for tertiary hospital), and Grade 7—more than 6.0. Ten to 70.0% of the basic nursing care fee (Grade 6) will be added for Grade 5 or higher while it would be reduced by 5.0% for Grade 7 [14]. For example, in the first grade, the number of beds per nurse was the lowest, while in the seventh grade, it is the highest. Thus, a Grade 1 hospital has better nurse staffing levels than the other grades. When hospitals lacked values for nurse staffing grades, the grade was classified as "unassigned." Since 2018, the patient-to-nurse ratio has been applied to the nursing grade system, but from 2012 to 2016, the number of beds-to-nurse ratio was applied to the nursing grade system.

### Analysis

Descriptive statistics were used to analyze the distribution of participants' general characteristics according to event occurrence. Kaplan–Meier analysis was performed to estimate survival curves indicating the probability that nurses would retain their jobs in their hospitals. The log-rank test was used to test the differences between survival curves according to the variable categories. Turnover probability was calculated using the equation "1 – probability of retention." Factors influencing turnover were analyzed using Cox's proportional hazard regression, and the results were reported in terms of hazard ratios (HRs) and 95% confidence intervals. The SPSS 24.0 software package (IBM Corp., Armonk, NY, USA) was used to perform the analysis.

### Ethical considerations

The study was approved by the institutional review board at Changwon National University in Korea (Approval no. 1040271-201806-HR-020). In addition, the authors submitted the study proposal to the HIRA and received the agency's permission (via email) to use the data. The data contained hospital information regarding nurses' characteristics (including age, gender, license acquisition date, employment date, and resignation date) and hospital characteristics (including type, ownership, region, and

**Table 1** Resignation Status According to Individual and Hospital Characteristics of Nurses for 5 Years (from 2012 to 2016).

Variables	Categories	Not resignation		Resignation		Total	
		n	% <sup>a</sup>	n	% <sup>a</sup>	n	% <sup>b</sup>
Gender	Women	47,584	50.7	46,278	49.3	93,862	97.6
	Men	814	35.5	1,482	64.5	2,296	2.4
Career duration (year) <sup>c</sup>	<1	3,289	33.8	6,432	66.2	9,721	10.1
	1 - 2	6,506	38.5	10,390	61.5	16,896	17.6
	3 - 4	6,279	45.7	7,452	54.3	13,731	14.3
	≥5	32,324	57.9	23,485	42.1	55,809	58.0
Hospital region	SO	14,433	54.7	11,940	45.3	26,373	27.4
	KI	10,043	47.6	11,069	52.4	21,112	22.0
	DC	3,808	49.6	3,869	50.4	7,677	8.0
	DG	4,736	48.6	5,007	51.4	9,743	10.1
	PG	7,440	46.3	8,627	53.7	16,067	16.7
	GJ	5,671	50.5	5,563	49.5	11,234	11.6
	KW	1,674	59.0	1,163	41.0	2,837	3.0
	JJ	593	53.2	522	46.8	1,115	1.2
Hospital setting	Metropolitan	27,843	51.2	26,497	48.8	54,340	56.5
	Medium/small city	19,451	49.5	19,823	50.5	39,274	40.8
	Rural	1,104	43.4	1,440	56.6	2,544	2.6
Hospital ownership	Public	4,686	53.4	4,094	46.6	8,780	9.1
	University	20,163	64.0	11,331	36.0	31,494	32.8
	Private	23,549	42.1	32,335	57.9	55,884	58.1
Hospital type	Tertiary hospital	21,575	67.7	10,275	32.3	31,850	33.1
	General hospital	22,171	49.5	22,650	50.5	44,821	46.6
	Medium/small hospital	4,652	23.9	14,835	76.1	19,487	20.3
Nurse staffing level for general units	Grade 1	4,881	65.9	2,524	34.1	7,405	7.7
	Grade 2	12,820	56.9	9,698	43.1	22,518	23.4
	Grade 3	19,571	56.0	15,382	44.0	34,953	36.3
	Grade 4	3,160	41.8	4,397	58.2	7,557	7.9
	Grade 5	2,513	46.1	2,939	53.9	5,452	5.7
	Grade 6	1,972	33.0	4,010	67.0	5,982	6.2
	Grade 7	1,093	29.9	2,565	70.1	3,658	3.8
Total	Unassigned	2,388	27.7	6,245	72.3	8,633	9.0
		48,398	50.3	47,760	49.7	96,158	100.0

Note. DC = Daejeon/Choongchug; DG = Daegu/Gyeongbuk; GJ = Gwangju/Julla; JJ = Jeju; KI = Kyunggi/Incheon; KW = Kangwon; PG = Pusan/Ulsan/Gyeongnam; SO = Seoul.

<sup>a</sup> % of row.

<sup>b</sup> % of column.

<sup>c</sup> Career duration was classified as of January 1, 2012.

nurse staffing grades for general units). The data included no information that would identify individual nurses or hospitals.

## Results

### Turnover rate according to nurse and hospital characteristics

During the 5-year observation period from 2012 to 2016, of 96,158 hospital nurses, 49.7% (47,760) experienced turnover events. These events occurred in 64.5% of male nurses and 49.3% of female nurses. Regarding career duration, the events were experienced by 66.2%, 61.5%, 54.3%, and 42.1% of nurses with career durations of <1 year, 1 to <3 years, 3 to <5 years, and ≥5 years, respectively (Table 1). Of the hospital characteristics, those with the highest turnover rates were as follows: 53.7% for the Pusan/Ulsan/Kyeongnam as the hospital region, 56.6% for the “rural area” hospital setting, 76.1% for the “medium/small” hospital type, 57.9% for “private” hospital ownership, and 72.3% for the “unassigned” nurse staffing grade for general units.

### Survival curve and cumulative probability of turnover

The survival curve for all nurses and survival curves according to career duration are presented in Figure 1. Survival curves, according to all other study variables, are included in the Appendix. During the overall observation period, the annual cumulative turnover probability, which was converted from cumulative retention probability, was .17, .29, .38, .45, and .50 for the first, second, third,

fourth, and fifth years, respectively. According to career duration, turnover rates were 0.22 for the first year, 0.51 for the third year, and 0.66 for the fifth year for durations of <1 year; 0.22 for the first year, 0.48 for the third year, and 0.62 for the fifth year for durations of 1 to <3 years; 0.193 for the first year, 0.42 for the third year, and 0.54 for the fifth year for durations of 3 to <5 years; and 0.14 for the first year, 0.32 for the third year, and 0.42 for the fifth year for durations of ≥5 years. The survival curves, according to career duration, were statistically significant (log-rank test  $p < .001$ ). In addition, the survival curves, according to all other variables, were statistically significant (log-rank test  $p < .001$ ).

### Factors influencing nurse turnover

Table 2 shows the results of the multivariate Cox's proportional hazard regression analysis. With respect to hospital jobs, male nurses (HR = 1.19) were significantly more likely to resign from their jobs relative to female nurses. In addition, nurses with career durations of <1 year (HR = 2.11) or 1 to <3 years (HR = 1.91) were significantly more likely to resign from their jobs relative to nurses with career durations of ≥5 years. Nurses working in metropolitan areas (HR = 1.24) or medium/small cities (HR = 1.11) were significantly more likely to resign from their jobs relative to nurses working in rural areas. Furthermore, nurses working for private hospitals (HR = 1.30) were significantly more likely to resign from their jobs relative to those working for public hospitals, and nurses working for medium/small (HR = 2.99) or general hospitals (HR = 1.63) were significantly more likely to resign from their jobs

**Table 2** Factors Influencing Turnover of Acute Care Hospital Nurses: Multivariate Cox's Proportional Hazard Regression.

Variables	HR	95% CI	p
Nurse characteristic			
Gender			
Women	1.00		
Men	1.19	1.13–1.26	<.001
Career duration <sup>a</sup>			
<1	2.11	2.05–2.17	<.001
1 - 2	1.91	1.86–1.95	<.001
3 - 4	1.56	1.52–1.60	<.001
≥5	1.00		
Hospital characteristic			
Hospital setting			
Metropolitan	1.24	1.17–1.31	<.001
Medium/small city	1.11	1.06–1.18	<.001
Rural	1.00		
Hospital ownership			
Public	1.00		
University	1.02	0.98–1.06	.38
Private	1.30	1.26–1.34	<.001
Hospital type			
Tertiary hospital	1.00		
General hospital	1.63	1.59–1.68	<.001
Medium/small hospital	2.99	2.88–3.09	<.001
Nurse staffing level for general units			
Grade 1	1.00		
Grade 2	1.25	1.19–1.31	<.001
Grade 3	1.22	1.17–1.28	<.001
Grade 4	1.45	1.38–1.53	<.001
Grade 5	1.19	1.12–1.26	<.001
Grade 6	1.51	1.43–1.59	<.001
Grade 7 or unassigned	1.57	1.49–1.66	<.001

Note. CI = confidence interval; HR = hazard ratio

<sup>a</sup> Career duration was classified as of January 1, 2012.

relative to those working for tertiary hospitals. Furthermore, nurses working in general units with the seventh or unassigned nurse staffing grade (HR = 1.57) were significantly more likely to resign from their jobs relative to nurses working in general units with the first-grade nurse staffing levels; therefore, lower nurse staffing levels were associated with higher HRs for nurse turnover (Table 2).

## Discussion

Using representative cohort data for Korean hospital nurses, this study was performed to identify trends in hospital nurse turnover rates and factors influencing turnover. The cumulative turnover probability for all nurses was .17, .38, and .50 for the first, third, and fifth years, respectively. The cumulative probability for the first year represents the cumulative incidence rate from January 1 to December 31, 2012, which can be considered the nurse turnover prevalence rate (17.2%) for 2012. According to the KHNA report, the overall turnover rate for hospital nurses in 2012 was 16.9% [12]. Therefore, the rate observed in the present study was similar to that reported by the KHNA.

The cumulative turnover probability for nurses with career durations of <1 year was .22 for the first year, .51 for the 3rd year, and .62 for the 5th year. According to the 2013 KHNA report [15], the turnover rate for new graduates in 2012 was 31.2%, which included those who had been hired by a hospital but decided to resign from the position before starting work. In general, they are not included in turnover rate calculations; therefore, when these nurses were excluded from the calculation, the rate decreased to 19.6%, which was 2.4% lower than the rate observed in the present study. The turnover probability observed in the present study was somewhat higher relative to that derived from the results of previous studies using pre-2010 data and similar to that observed in

previous research based on data collected since 2010. For example, Cho et al. [16] analyzed 3 years of data (2005–2007) for 533 new graduate nurses from the Graduate Occupational Mobility Survey (GOMS), and the cumulative turnover probability was .09 for the 1st year, .17 for the 2nd year, and .23 for the 3rd year. Further, Cho et al. [11] analyzed GOMS data for 2006–2008 and reported a probability of .18, .33, and .46 for the first, second, and third years, respectively. In contrast, Kim and Lee [12] used GOMS data for 2010–2013 and reported nurse turnover rates of 24.5%, 39.0%, 47.4%, and 51.7% for the first, second, third, and fourth years, respectively. The present study results showed a trend similar to that identified by Kim and Lee's study [12], the most recent of the previous studies. Lee [17] reported that about 25% of new graduate nurses left their job in the first year, and the annual turnover rate of new graduate nurses was gradually increased from 2008 to 2010. In summary, the results of the present and previous studies indicate that the turnover rate of new graduate nurses increased during the periods examined.

This study indicated that high turnover does not only occur in the new graduate nurse group. Notably, during the first 2 years of observation, hospital nurses with career durations of <1 year and 1 to <3 years showed virtually the same trends in turnover probability. However, from the third observation year onward, the two groups' turnover probability trends showed considerable and increasing differences. These findings indicate that even nurses who were not new graduates showed the same turnover probability as that of new graduates until their career durations reached 3–4 years. Thus far, new graduate nurses have been the target population in most studies examining hospital nurse turnover. However, the present study revealed that turnover rates for nurses with career durations of ≤3 years were as high as those of new graduates. Consequently, future studies should expand their target populations to include all nurses with career durations of ≤3 years.

Regarding factors influencing nurse turnover, all variables entered into the Cox regression model were statistically significant. However, unlike other variables, the directional effects for hospital setting differed between the survival and Cox regression analyses. The survival curves according to hospital setting showed that the cumulative turnover probability for rural areas was higher relative to that for metropolitan and medium/small cities <Appendix>; however, according to the Cox regression results, the HRs for nurse turnover in metropolitan and medium/small cities were significantly higher relative to those in rural areas. We assumed that these differences were related to the concentration of nurses and large hospitals in urban areas based on relevant literature and secondary data. According to statistics in the 2018 Health and Welfare Statistics Yearbook [18], the number of practicing nurses per 100 beds was 30 in metropolitan areas, which is considerably higher relative to the 19 recorded in nonmetropolitan areas. Park et al. [19] analyzed the numbers of unemployed experienced and new graduate nurses in each region of Korea and showed that the number of unemployed experienced nurses in urban areas was higher relative to that observed in rural areas, while the opposite was observed for new graduate nurses. In addition, Cho et al. [20] found that 61.7% of new graduate nurses were employed by hospitals located in metropolitan areas. Furthermore, of all the 42 tertiary hospitals in Korea, which typically have more than 500 beds and large purchasing power for nurses, 27 (64.3%) and 15 (35.7%) are located in metropolitan and medium/small cities, respectively [21]. Therefore, we concluded that the supply of large hospitals and nurses is concentrated in urban areas, leading to high nurse turnover.

Concerning hospital types, the HR for nurse turnover was 2.99 in medium/small hospitals and 1.63 in general hospitals compared with tertiary hospitals. Previous studies involving Korean nurses reported that nurse turnover rates in small hospitals were higher



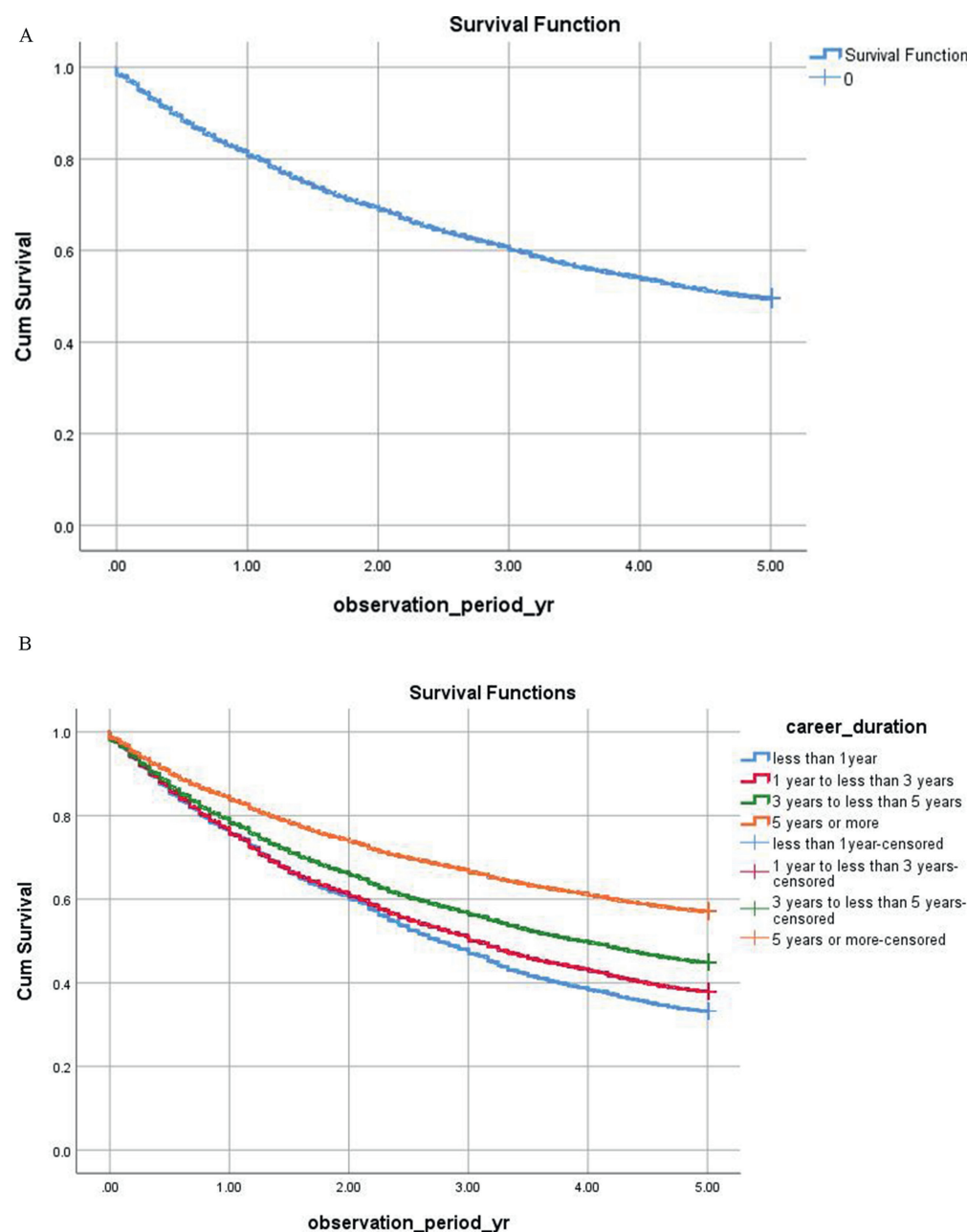


Figure 1. Survival curves. (A) Survival curves of total hospital nurses. (B) Comparison of survival curves among career durations of hospital nurses.

relative to those in medium or large hospitals [7,22], consistent with the current results. However, previous studies involving American nurses did not show a significant relationship between hospital size and nurse turnover rates [23,24]. The researchers in the Korean studies posited that high nurse turnover rates in small hospitals were the consequence of poorer working conditions (e.g., low wages and numerous patients per nurse) relative to those in large hospitals [22]. Therefore, to reduce nurse turnover in small- and medium-sized hospitals, future research should focus on identifying the causes of undesirable working conditions in such hospitals and developing policy interventions to improve those conditions.

Regarding hospital ownership, the HR for nurse turnover was 1.30 in private hospitals compared with that in public hospitals. Staggs and Dunton [23] studied the association's hospital

organizational characteristics and nurse turnover in 306 acute hospitals in the US, and they found that governmental ownership had a significant relationship with low nurse turnover. Based on the survey on nurses working for hospitals with various ownerships in Swiss, nonprofit organization's workplaces were associated with the highest degree of autonomy, flexibility, participation, recognition, organizational commitment, and job satisfaction, and the authors argued that these characteristics of nonprofit hospitals attract nurses to their hospitals [25]. Therefore, improving the nursing working environment of private hospitals is necessary, and measures should be devised to expand and apply the benefits system provided by public hospitals to private hospitals.

Furthermore, lower nurse staffing levels were associated with higher HRs for nurse turnover. Nurses working in general units with the seventh or unassigned nurse staffing grades were 57.0%

more likely to resign from their hospital jobs relative to nurses working in general units with the first nurse staffing grade. Vahey et al. [26] reported that lower nurse staffing levels led to greater dissatisfaction with working conditions, which resulted in higher nurse turnover rates. Moreover, Cho and Kim [27] reported that nurses working in large hospitals were assigned fewer patients relative to those working in small hospitals. Therefore, we concluded that working conditions in most medium/small hospitals with low nurse staffing levels were poor, which led to high turnover rates.

Since a plan for providing financial incentives to hospitals based on nurse staffing levels was introduced in the Ministry of Health and Welfare of Korea in 1999, many hospital managers have recognized that hiring more nurses contributes to the improvement of hospital profits and the quality of hospital care [12]. According to the current results, approximately 10.0% of all nurses were working in hospitals with the “unassigned” nurse staffing grade, in that they did not provide their nurse staffing data to the HIRA, and their turnover rates were the highest of all grades. Consequently, we expect nurse staffing levels in hospitals with the “unassigned” grade to be lower relative to those of hospitals with the seventh grade. Therefore, to remove “loopholes” related to reporting of nurse staffing levels, the nurse staffing-level management system for Korean hospitals should be supplemented by collecting staffing-level data from noncompliant hospitals. In addition, the government should strengthen its policy by establishing a mandatory reporting system to secure nursing staff levels.

This study has limitations that should be acknowledged. The data used in this study were administrative hospital status data from the HIRA, which contained information regarding nurses' demographic characteristics (e.g., age, gender, license acquisition date, hired or retired date) and the structural characteristics of hospitals (e.g., hospital type, location ownership, and nurse staffing levels). Therefore, the study did not consider nurses' working conditions (e.g., salary, workload [28], and low job satisfaction [29]) or organizational characteristics (e.g., organizational commitment [30] and the leadership of supervisors [31]), which were identified as factors influencing nurse turnover in many previous studies. Despite this limitation, the results derived from the representative large cohort data were very reliable.

In 2018, the HIRA issued a revised standard for assessing “the number of nurses per inpatient” to be included in hospital quality assessment criteria. Under this revised standard, which took effect in 2019, the percentage of nurses with career duration of >3 years was given greater weight in the calculation of this ratio [32]. The revision is generally considered to be a positive change because it recognized that employing experienced nurses is an important factor in maintaining the quality of hospital care. However, if the turnover rates of nurses with lower career duration (e.g., 3 years or less) were directly addressed in a quality assessment standard—for example, if a high turnover rate was penalized with a lower quality score—this would help to reduce the turnover rates among such nurses.

Therefore, the current findings will provide useful evidence for developing policies to expand hospital nurse staffing levels and to eliminate unbalanced nurse distribution, which may, in turn, reduce nurse turnover.

## Conclusion

This study was conducted to determine hospital nurse turnover rates from 2012 to 2016 and identify factors influencing those rates, using representative cohort data for nurses working in Korean hospitals. During the observation period, the annual cumulative turnover probability was .17, .29, .38, .45, and .50 for the first,

second, third, fourth, and fifth years, respectively. The nurses with career durations of less than 3 years were approximately twice as likely to resign from their jobs as nurses with career durations of 5 years or more. Therefore, research target populations should be expanded to include experienced nurses with career durations of less than 3 years and new graduate nurses. Among the hospital characteristics, location in a metropolitan area, private ownership, medium/small size, and low nurse staffing levels in hospitals were identified as factors influencing nurse turnover. It is necessary to comprehensively examine organizational characteristics to identify the causes of high turnover rates in hospitals that are small and/or have low nurse staffing levels.

## Author contributions

B.P. designed the study and prepared the manuscript; collected the data; and analyzed the data and prepared the manuscript. Y.K. revised the manuscript critically for important intellectual content. All authors approved the final version for submission and are in agreement with the contents of the manuscript.

## Conflicts of interest

The authors have declared that no competing interests exist.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.anr.2020.09.001>.

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