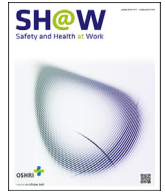




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Original article

## Compliance with Recommendations on Work Schedule for Shift Nurses in South Korea

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### ABSTRACT

**Background:** A well-designed shift schedule has been reported to have a positive effect on improving health problems associated with shift work. This study aimed to identify compliance with the 17 recommendations on work schedule (WSRs) for shift nurses and related factors.

**Methods:** The descriptive study was conducted with 182 nurses who worked in three shifts for more than 1 year at superior general and general hospitals in three regions. Data were collected with self-administered questionnaire and 13-week work schedule tables, and analyzed with both person- and cycle-based compliance.

**Results:** Person-based compliance was 11.77 among 17 items in total. However, no one completely complied with WSRs of “no work on weekends” and which showed the lowest cycle-based compliance (22.3%). Compliance with some WSRs was related to hospital type, proportion of nurses in school and having standards on work schedule at institutional level.

**Conclusion:** Compliance with WSRs of shift nurses in Korea is still unsatisfactory, and one day off after night shift and work on weekend are quite common. Hospitals should keep the standards on work schedule, monitor compliance with standards, and try to introduce modified shift systems to improve the current problems.

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### 1. Introduction

Shift work among nurses is common for continuous care. In South Korea, 74.7% of staff nurses work in shifts [1], average number of night shifts was 6.3–6.8 days per month [2]. Shift work can disrupt individual circadian rhythms, causing increase in poor sleep quality and fatigue [3,4], risk of gastrointestinal disorders [5], and neurocognitive decline [3] in the short term, and increase in likelihood of obesity due to increased caffeine consumption and total caloric intake [6] and risk of diabetes [7] in the long run. Furthermore, when a nurse fails to adapt to shift work properly, it may lead to an increase in job stress and turnover [8].

In numerous occupations, shift teams are organized, and work shifts are cycled at regular intervals, such as four group-two shifts or three group-three shifts. However, the shift schedule for nurses is very flexible depending on the workload. For example, fewer nurses may be working the night shift, weekends, or holidays when the workload or bed occupancy is reduced; However, more nurses

may be needed in an emergency. Such changes in the number of nurses may lead to a modification in the shift schedule of each nurse on a temporary basis, and may cause an irregular shift cycle [9,10]. In addition, unexpected internal fluctuations such as resignation, sick leave, schoolwork, pregnancy, and childbirth among nurses in the unit may increase the likelihood of violating the work schedule recommendations (WSRs) even after the work schedule approval process has been completed [9,11,12].

A well-designed shift schedule has been reported to have a positive effect on improving the various health problems associated with shift work [13,14]. Knauth and Hornberger [13] proposed a 20-item ergonomic recommendation, and the Korea Occupational Safety and Health Agency (KOSHA) [14] developed nine-item WSRs for night shift workers that is very similar to the ergonomic recommendation. Compliance with these WSRs have been shown to reduce problems related to circadian rhythm, sleep deprivation, accumulation of fatigue, and accident occurrence, while also

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demonstrating an increase in social contacts, leisure activities, and work-life balance among shift workers [13].

As the quality of nursing service affects the clinical outcome of patients [15], it is necessary to devise ways to reduce the problems caused by shift work for nurses to provide nursing care in the best health condition. However, as few studies have assessed compliance with ergonomic recommendations on work schedules for shift nurses in Korea, the present study aims to examine work schedules and compliance with WSRs among shift nurses in Korea. Therefore, this study was aimed to examine the work schedule, compliance with WSRs among shift nurses in Korea. Specifically, this study was (1) to identify the general characteristics of the shift nurses (population sociological characteristics, work characteristics, workplace characteristics), (2) to identify the status of compliance with the WSRs, and (3) to analyze compliance with WSRs according to the general characteristics.

## 2. Methods

### 2.1. Study participants

The participants of this descriptive study consisted of nurses who worked at the medical and surgical wards, intensive care units, and emergency departments of three general hospitals for at least 1 year. The participants voluntarily agreed to complete the questionnaire and provide a 3-month work schedule starting in June 2018. Owing to the lack of previous studies, the effect size was assumed to be Cohen's [16] median effect size ( $d = 0.5$ ) for average comparison between the two groups using nonparametric methodology. The minimum number of participants was estimated to be 185 nurses, considering a dropout rate of 20%.

Participants were recruited by posting advertisement on bulletin boards of three web-communities ("Nurscape," "Nurse story," or "Everything about nurses") where nurses communicate, and of two nursing schools in a metropolitan city (Busan) and a province (Gyeongnam). Among 185 questionnaires distributed, 182 (response rate: 98.4%) were used for the analysis after excluding three incomplete questionnaires; 152 from web-communities and 30 from nursing schools.

### 2.2. Study instrument

A self-administered questionnaire was used to collect data on general characteristics such as the demographics, work-related factors, workplace factors, and a work schedule matrix for the last 3 months. Demographics included four items such as age, gender, education level, and marital status. Education level was categorized as "junior college," "college," as well as "master and above." Work-related factors included five items such as type of hospital, working unit, position, working years at hospitals, and working years at current department. Variables were categorized as "superior general" and "general" for type of hospital; "medical," "surgical," "intensive care", and "emergency room" for working unit; "staff nurse" and "charge nurse" for position. For workplace factors, proportion of nurses in school, proportion of nurses in pregnancy, chance to request their work schedule, chance to change their work schedule, change in work schedule without prior notice past 3 months and compensation for change, and presence of standards on work schedule at the institutional level. Proportion of nurses in school means the percentage of nurses attending graduate school among all nurses in each working unit and categorized into "less than 10%," "10–14%," as well as "15% and higher." Proportion of nurses in pregnancy means the percentage of pregnant nurses among all nurses in each working unit and categorized into "less than 5%," "5–9%," and "10% and higher." The matrix was designed

in a calendar format and participants were requested to fill in the shift for each date. Sick leave, maternity leave, and other leaves for family events were regarded as off-duty. Attending an on-the-job training program and split duty where day shift and evening shift overlapped (i.e., working from 9 AM to 5 PM) was considered a day shift.

### 2.3. Data collection

Data collection was conducted from September 21 to October 21, 2018. If nurses contacted one of the researchers by phone or e-mail of participating in the study, we explained the study and sent the consent form, questionnaire and the work schedule matrix, an anonymized return envelope, and a gift for their contribution through postal mail. After the questionnaire was completed, the participants returned the envelope enclosed with the consent form and the questionnaire directly to the researchers. The time required for data collection was 10 to 15 minutes per study subject.

The researchers reconstructed what was presented in each work schedule matrix into a structured survey sheet to check compliance with WSRs. In this study, we used 17 WSRs: 16 items from Knauth & Hornberger [13] except four items in domain 4 that were not considered in the design of shift system, and one item from KOSHA [14]. The final 17 items were as follows: (R1) maximum of three night shifts in succession, (R2) no permanent night work, (R3) maximum of 3 day shifts in succession, (R4) maximum of three evening shifts in succession, (R5) forward rotation (moving from day shift to evening shift to night shift), (R6) at least 1 day (24 h) off after last night shift, (R7) at least 2 days off after last night shift, (R8) no shift work such as "night shift-off-night shift," (R9) no single working day between days off (i.e., off-day shift-off), (R10) maximum of 5–7 working days in succession, (R11) extended shifts (>8 h) under limited situations, (R12) minimum 11 h of resting time between two shifts, (R13) not too early start of day shift, (R14) not too late end of evening shift, (R15) as early as possible end of night shift, (R16) no work on weekends, and (R17) free weekends with at least two consecutive days off, if there are works on weekends.

Each item was marked as O for compliance or X for noncompliance. For example, for WSR of "maximum of three night shifts in succession," we identified working cycles including night shift and calculated the number of night shift in each working cycle. When night shift in a cycle is greater than three times, we marked X on the sheet, and is less than or equal to three, we marked O. Therefore, if a subject had five cycles including at least one night shift during the last 3 months, and the number of consecutive night shifts was 3, 4, 3, 2, or 3 days, then we marked O, X, O, O, and O for "maximum of three night shifts in succession" for the subject.

### 2.4. Ethical consideration

This study was carried out after obtaining approval from the Pusan National University Institutional Review Board (IRB: 2018\_53\_HR). We explained participants on the purpose of the study, method and procedure of data collection, the guarantee of anonymity, and possibility of withdrawing at any time throughout the study.

### 2.5. Data analysis

The data collected were analyzed with the SPSS WIN 21.0 program. A two-tailed test was performed using a significance level ( $\alpha$ ) of 0.05. The general characteristics of the participants were analyzed using frequency and percentage or mean and standard deviation. The compliance with WSRs were calculated in person-based and cycle-based. The person-based compliance was

**Table 1**  
General characteristics of participants (N = 182)

Characteristics		n (%) or Mean ± SD
Age (y)	Mean ± SD	28.43 ± 3.28
Gender	Female	176 (96.7)
	Male	6 (3.3)
Education level	Junior college	29 (15.9)
	College	112 (61.6)
	Master & above	41 (22.5)
Marital status	Unmarried	141 (77.5)
	Married	41 (22.5)
Type of hospital	Superior general	102 (56.0)
	General	80 (44.0)
Working unit	Medical unit	60 (33.0)
	Surgical unit	48 (26.3)
	Intensive care unit	42 (23.1)
	Emergency room	32 (17.6)
Position	Staff nurse	172 (94.5)
	Charge nurse	10 (5.5)
Working years at hospitals	Mean ± SD	5.70 ± 3.33
Working years at current department	Mean ± SD	3.83 ± 2.67
Proportion of nurses in school (%) <sup>a</sup>	<10	96 (52.7)
	10–14	64 (35.2)
	≥15	22 (12.1)
Proportion of nurses in pregnancy (%) <sup>a</sup>	<5	119 (65.4)
	5–9	48 (26.4)
	≥10	15 (8.2)
Chance to request their WS		178 (97.8)
Chance to change their WS		113 (62.1)
Change in WS without prior notice past 3 mo		110 (60.4)
Presence of compensation for the unplanned WS change (n = 110)		17 (15.5)
Presence of standards on WS at the institutional level		152 (83.5)

SD, standard deviation; WS, work schedule.

<sup>a</sup> Proportion of nurses in school means the percentage of nurses attending graduate school among all nurses and proportion of nurses in pregnancy means the percentage of pregnant nurses among all nurses in each working unit.

calculated as a percentage of the number of participants who completely complied with a specific WSR. The cycle-based compliance was calculated as a percentage of the total number of working cycle (from off-duty to the next off-duty) to which a specific WSR was applied. The calculation formula is provided in Supplement 1. The cycle-based compliance according to the general characteristics of the participants was analyzed using the Mann–Whitney *U* test or Kruskal–Wallis test, followed by the Bonferroni post-hoc test.

### 3. Results

#### 3.1. General characteristics of the subjects

Table 1 presents the general characteristics of the participants: the mean age of the participants was  $28.43 \pm 3.28$  years, females accounted for 96.7%, 56.0% were working at superior general hospitals, and mean work experience was  $5.70 \pm 3.33$  years. Among them, those working in units with less than 10% of nurses in school was 52.7%, and 83.5% had work schedule standards at the institutional level.

#### 3.2. Compliance with recommendations

Table 2 shows compliance with WSRs. The mean person-based compliance was  $11.77 \pm 1.22$  of 17 in total,  $5.79 \pm 1.15$  of 9 for sequence of shift,  $2.96 \pm 0.19$  of 3 for duration and distribution of work time, and  $3.02 \pm 0.15$  of 5 for position of work time. Seven WSRs were completely adhered to by all participants, but no one had complied with the “no work on weekends” recommendation.

In Table 3, cycle-based compliance was calculated for nine WSRs showing less than 100% person-based compliance. The WSR that showed the lowest compliance was “no work on weekend” (22.3%), followed by “free weekends with at least two consecutive days off if weekend work was required” (28.7%).

#### 3.3. Compliance with recommendations according to general characteristics of the subjects

The compliance with WSRs according to general characteristics of the subjects for three WSRs that showed lower cycle-based compliance in Table 4 and the others in Supplement 2. The compliance with WSR of “at least 2 days off after last night shift” was related with “the proportion of nurses in school” ( $p = 0.013$ ), and “the presence of standards on work schedule at institutional level” ( $p = 0.011$ ).

### 4. Discussion

Compliance with WSRs for shift nurses was 69.2% in total. However, no one completely complied with WSRs of “no work on weekends” and which showed the lowest cycle-based compliance (22.3%). Compliance with some WSRs was related to hospital type, proportion of nurses in school and having standards on work schedule at institutional level.

Overall compliance with WSRs is lower compared with those found in a previous domestic study [17] where shift workers in large-sized manufacturing companies showed about 72% compliance with WSRs. The domain of “position of working time” showed about 60% compliance in this study, which is also lower than 74% compliance in the previous study [17]. That is, the compliance with WSRs was slightly lower than that of large-sized manufacturing shift workers, showing a large difference in “position of working time.” Though workers in the manufacturing companies have worked under various types of shifts (e.g., three groups-three shifts, four groups-three shifts, two groups-two shifts, four groups-two shifts), the duty cycle is rotating regularly at regular intervals [17]. However, nurses have adopted an atypical shift system showing irregular working cycles and intervals [9,10], which may cause lower compliance in nurses. The lowest compliance among WSRs were “no work on weekends” and “free weekends with at least two consecutive days off if weekend work is required,” which was 30% and 40% for large-sized manufacturing shift workers, respectively [17]. Although two groups under four-group two-shift system of the manufacturing companies could always have 1 or 2 days off on weekends [17], nurses found that weekend holidays were rarely guaranteed.

Weekends off work can prevent family conflict through more time on family activities and prevent disruption of leisure time while increasing social activities compared with weekday holidays [18]. Moreover, a study in Israel found that the emotional exhaustion of nurses who spent 2 days on weekends was significantly reduced and their vitality increased rather than spending 2 days on weekdays [19]. Nonetheless, because of the nature of shift work, it is often difficult to avoid work on weekends. However, the challenge of the current domestic shift work system is that weekend work is taken for granted [17]. Working on weekends was quite common among shift nurses in Korea. This study showed that 64% of the nurses worked on weekends during 9–12 weeks in succession of a total of 13 weeks. In addition, work on weekends is often not evenly distributed and tends to focus on specific nurses (considering that the compliance with “no work on weekends” ranges from 0.0% to 61.5%), with less than 10% of compliance observed in approximately 20% of nurses in this study. Therefore, it is recommended that managers ensure that weekend work is

**Table 2**  
Compliance with recommendations on work schedule for nurses: Person-based ( $N = 182$ )

Domain (no.)	Criteria	Recommendation	Compliance $n$ (%) or Mean $\pm$ SD
Total (16)			11.77 $\pm$ 1.22
Sequence of shifts (9)			5.79 $\pm$ 1.15
	Consecutive shifts	1. Maximum of 3N in succession	182 (100.0)
		2. No permanent night work	182 (100.0)
		3. Maximum of 3D in succession	63 (34.6)
		4. Maximum of 3E in succession	62 (34.1)
	Direction of rotation Particular sequence of shifts	5. Forward rotation (i.e., D–E, D–N, D–N, D–E–N)	175 (96.2)
		6. At least 1 d (24 h) off after last night shift	145 (79.7)
		7. At least 2 d off after last night shift	38 (20.9)
		8. No shift work such as “N-off-N”	140 (76.9)
		9. No single working day between days off (i.e., off-D–off)	67 (36.8)
Duration & distribution of working time (3)			2.96 $\pm$ 0.19
Working days Duration of shift Time off	10. Maximum of 5–7 working days in succession	182 (100.0)	
	11. Extended shifts (>8 h) under limited situations	182 (100.0)	
	12. Minimum 11 h of resting time between two shifts	175 (96.2)	
Position of working time (5)			3.02 $\pm$ 0.15
Start of D shift End of E shift End of N shift Work on weekends	13. Not too early	182 (100.0)	
	14. Not too late	182 (100.0)	
	15. As early as possible	182 (100.0)	
	16. No work on weekends <sup>a</sup>	0 (0.0)	
	17. Free weekends with at least 2 consecutive days off <sup>b</sup>	4 (2.2)	

D, day shift; E, evening shift; N, night shift; SD, standard deviation.

<sup>a</sup> Weekend total 13 times during the study period. Weekend off is defined as not working on Saturday and Sunday. A night shift starting on Friday is considered as working on Saturday, a night shift starting on Sunday is considered as working on Monday.

<sup>b</sup> If recommendation No. 15 cannot be fulfilled.

**Table 3**  
Compliance with recommendations on work schedule for nurses: cycle-based

Recommendations	%	Type of non-compliance
Sequence of shifts		
3. Maximum of 3D in succession ( $N = 1716$ )	89.7	4D: 8.2% (141), 5D: 1.9% (32) 6D: 0.2% (3)
4. Maximum of 3E in succession ( $N = 1705$ )	88.7	4E: 8.0% (136), 5E: 3.2% (55) 6E: 0.1% (1)
5. Forward rotation ( $N = 1158$ )	99.4 D–E: 37.1%, D–N: 29.0% E–N: 26.3%, D–E–N: 7.0%	E–D: 0.5% (6), N–E: 0.1% (1)
6. At least 1 d (24 h) off after last night shift ( $N = 1338$ )	95.9	1off-D <sup>c</sup> : 4.0% (54), No off: 0.07% (1)
7. At least 2 d off after last night shift ( $N = 1338$ )	74.4	1off-D: 4.0% (54), No off: 0.07% (1) 1off-N: 0.5% (7), 1off-E: 21.0% (281)
8. No shift work such as “N-off-N” ( $N = 1334$ )	95.8	N-1off-N: 0.5% (7), N-2off-N: 1.9% (25) N-3off-N: 1.8% (24)
9. No single working day between days off ( $N = 3304$ )	92.3	Off-D-off: 3.2% (105), off-E-off: 3.7% (121) off-N-off: 0.8% (29)
Duration & distribution of working time		
12. Minimum 11 h of resting time between two shifts ( $N = 3549$ )	99.8	E–D: 0.2% (6), N–E: 0.03% (1)
Position of working time		
16. No work on weekends <sup>a</sup> ( $N = 2366$ )	22.3	Work on either Sat or Sun: 40.3% (953) Work on both Sat & Sun: 37.4% (886) Work on weekend for 5–8 wk: 9.5% (30/182), 9–12 wk: 64.4% (145/182), 13 wk: 3.8% (7/182)
17. Free weekends with at least 2 consecutive days off <sup>b</sup> ( $N = 1839$ )	28.7	

D, day shift; E, evening shift; N, night shift; SD, standard deviation.

Parentheses indicate the number of cases.

<sup>a</sup> Weekend total 13 times during the study period. Weekend off is defined as not working on Saturday and Sunday. A night shift starting on Friday is considered as working on Saturday, a night shift starting on Sunday is considered as working on Monday.

<sup>b</sup> If recommendation No. 15 cannot be fulfilled.

<sup>c</sup> It was regarded as noncompliance because off time is less than 24 h.

**Table 4**

Compliance with recommendations on work schedule for nurses according to general characteristics of participants: cycle-based

Characteristics		R7	Z or $\chi^2$ (p)	R16	Z or $\chi^2$ (p)	R17	Z or $\chi^2$ (p)
		M $\pm$ SD (%)		M $\pm$ SD (%)		M $\pm$ SD (%)	
Total		74.69 $\pm$ 19.53		22.27 $\pm$ 12.46		32.61 $\pm$ 25.84	
Age (y)	<30	74.47 $\pm$ 18.44	-0.41	22.95 $\pm$ 12.55	-0.99	33.97 $\pm$ 27.16	-0.99
	$\geq$ 30	75.12 $\pm$ 21.58	(0.686)	21.00 $\pm$ 12.30	(0.322)	30.05 $\pm$ 23.12	(0.322)
Type of hospital	Superior general	76.21 $\pm$ 17.44	-0.90	23.23 $\pm$ 12.76	-1.09	34.49 $\pm$ 26.72	-1.09
	General	72.75 $\pm$ 21.86	(0.368)	21.06 $\pm$ 12.04	(0.277)	30.22 $\pm$ 24.62	(0.277)
Working years at hospitals	1-2	74.45 $\pm$ 16.15	0.53	24.04 $\pm$ 13.85	1.76	37.33 $\pm$ 33.00	1.76
	3-4	75.83 $\pm$ 18.34	(0.912)	21.95 $\pm$ 9.91	(0.624)	30.18 $\pm$ 16.64	(0.624)
	5-6	73.44 $\pm$ 18.93		20.08 $\pm$ 13.42		29.70 $\pm$ 29.57	
	$\geq$ 7	74.69 $\pm$ 23.08		22.68 $\pm$ 12.84		33.19 $\pm$ 24.15	
Working years at current department	<1	68.97 $\pm$ 23.58	3.70	22.12 $\pm$ 11.88	0.28	31.42 $\pm$ 21.62	0.28
	1-2	72.85 $\pm$ 18.78	(0.296)	22.17 $\pm$ 13.85	(0.964)	33.44 $\pm$ 29.36	(0.964)
	3-4	75.51 $\pm$ 18.07		21.47 $\pm$ 9.43		29.20 $\pm$ 16.00	
	$\geq$ 5	78.01 $\pm$ 20.15		23.08 $\pm$ 13.16		34.61 $\pm$ 28.71	
Proportion of nurses in school (%) <sup>a</sup>	<10 (a)	77.43 $\pm$ 20.12	8.65	21.87 $\pm$ 13.17	0.27	32.47 $\pm$ 28.13	0.27
	10-14 (b)	74.46 $\pm$ 17.37	(0.013)	22.84 $\pm$ 12.33	(0.876)	33.39 $\pm$ 24.79	(0.876)
	$\geq$ 15 (c)	63.43 $\pm$ 19.54	(a $\neq$ c)	22.38 $\pm$ 9.76		30.98 $\pm$ 18.04	
Proportion of nurses in pregnancy (%) <sup>a</sup>	<5 (a)	74.45 $\pm$ 19.91	1.18	22.24 $\pm$ 13.24	0.75	33.12 $\pm$ 28.00	0.75
	5-9 (b)	76.52 $\pm$ 18.93	(0.553)	23.08 $\pm$ 11.55	(0.689)	33.27 $\pm$ 22.88	(0.689)
	$\geq$ 10 (c)	70.76 $\pm$ 18.88		20.00 $\pm$ 8.63		26.47 $\pm$ 14.79	
Chance to request their WS	Yes	75.67 $\pm$ 19.82	-0.94	21.99 $\pm$ 11.72	-0.32	31.46 $\pm$ 22.49	-0.32
	No	73.09 $\pm$ 19.06	(0.349)	22.74 $\pm$ 13.67	(0.746)	34.51 $\pm$ 30.62	(0.746)
Presence of standards on WS at the institutional level	Yes	76.51 $\pm$ 18.54	-2.55	22.42 $\pm$ 12.52	-0.28	32.98 $\pm$ 26.59	-0.28
	No	65.48 $\pm$ 22.02	(0.011)	21.54 $\pm$ 12.35	(0.778)	30.75 $\pm$ 21.92	(0.778)

M, mean; R7, at least 2 days off after last night shift; R16, no work on weekends; R17, free weekends with at least 2 consecutive days off; SD, standard deviation; WS, work schedule.

<sup>a</sup> Proportion of nurses in school means the percentage of nurses attending graduate school among all nurses and proportion of nurses in pregnancy means the percentage of pregnant nurses among all nurses in each working unit.

evenly distributed to all nurses rather than being concentrated on specific nurses. If this is not possible, it is advised that other WSRs with similar outcomes (e.g., "maximum three evening shifts in succession") [13] be complied with when working on weekends.

Compliance with WSRs of "at least two days off after last night shift" was also relatively low. When individuals failed to comply with this particular WSR, it is usually organized as "one day off-evening shift" to follow the amendment of the Labor Standards Act [20]. A failure to ensure adequate rest time after a night shift may result in sleep deprivation before the following day shift [13], which may ultimately lead to unintentional accidents. In 2018, the Korea Labor Standards Act was revised to provide employees with at least 11 h of uninterrupted recess starting from the end of a working day until the beginning of the next working day. In a study by Chang et al. [21], cognitive function, anxiety, and objectively measured sleep were compared between nurses in a Taiwanese mental hospital who experienced "two night shifts-off (2N-off)" and those who experienced "three day shifts-off (3D-off)." The findings showed that fewer repetitive and total errors were made for "3D-off" nurses compared with "2N-off nurses."

As to "extended shifts (>8 h) under limited situations," we regarded as compliant if the official working hours were 8 h even if the working hours. In other words, actually nurses always take over their patients so their work hours extend to <8 h, so compliance of this was evaluated as 100% but most nurses' working hours of night shift exceed 8 h. However, the ward nurses should take over their patients before and after work, it should consider this as an official job. If take over time is 30 minutes, the official work hours should be 9 h (8 h + 30 mins before and 30 mins after job). Therefore, this finding has a limitation to reflect real shift extension related to frequent overtime in excessive workload settings. Further observational studies are recommended to investigate how often this situation occurs and whether there are appropriate measures to provide sufficient breaks and to minimize the accumulation of fatigue when shift is expectedly or unexpectedly extended.

Compliance with WSRs was related to the following factors: "type of hospital," "proportion of nurses in school," and "presence of work schedule standards at the institutional level." For the most part, the superior general hospitals were more compliant than the general hospitals. Superior general hospitals need a greater labor force, facilities, and equipment to provide highly skilled medical services compared with general hospitals. Therefore, these hospitals have more nurses and find it easier to follow WSRs than general hospitals. The proportion of nurses in school affects compliance with "sequence of shifts." As day shifts are usually assigned to nurses in school and work schedules are adjusted in consideration of their study time, it is difficult to comply with items related to sequence of shifts. For "the presence of work schedule standards at the institutional level," nurses working in hospitals with work schedule standards tend to comply better with WSRs. In turn, 83.5% of the participants responded that their hospital had work schedule standards. However, the compliance with some WSRs is still unsatisfactory as standards are not compulsory. Therefore, hospitals need to not only keep standards for work schedules, but also monitor compliance to standards and obtain measurements for improvement. According to National Institute for Occupational Safety and Health training program, the standards are required to address topics including a backup staffing plan, restriction on shift length, ensuring recovery days, exploring flexible scheduling options and shorter shifts [22]. Hospitals also need to monitor whether work schedule standards include those topics to reduce risks and fatigue and increase recovery among nurses on shift work.

The Korea Ministry of Health and Welfare has discussed how to improve the working conditions for nurses [23], and currently two modified shift systems have been proposed; a three-group two-shift under dedicated night shift [9] and a five-group three-shift [17]. The former shift system is good for increasing days off and reducing the number of night shifts. However, it may be difficult to recruit dedicated night shift nurses and their circadian rhythm may be disturbed [9,24,25]. When the latter shift system is adopted,



most WSRs may be complied with –except for the “no work on weekends,” “avoid work on weekends on a regular basis,” and “reduce number of consecutive shifts less than 3 days” [17].

To the best of our knowledge, this is the first study to identify the compliance with WSRs and related factors for shift nurses to suggest areas and measurements that require improvement in the field of nursing. However, careful interpretation of the results is required because of the following limitations. First, we did not collect hospital names, thus we cannot rule out the possibility of over-representation for some hospitals. Considering that the work schedule for nurses is influenced by the work schedule standards of each hospital (as confirmed in this study), the work schedules of nurses from the same hospitals may show a similar pattern making analysis on the distribution of hospitals where the participants belong to necessary. Although attempts were made to identify the hospital names associated with the participants, most nurses refused to provide such information during the pilot study. Therefore, data on hospital names for this study were not collected. Second, with regard to WSRs on “start of day shift” and “end of evening shift,” Knauth and Hornberger [13] did not specify the detailed time but described “not too early” as 06:30 h better than 06:00 h, 06:00 h better than 05:00 h, and “not too late” as 22:00 h better than 23:00 h, 23:00 h better than 24:00 h. So, we collected subjective data whether they have perceived too early start of day shift or too late end of evening shift. Therefore, if specific time is given, the results on these WSRs may be changed. Third, although participants were selected in various ways in several nursing schools (including online or bulletin boards), this study has a limitation in generalizability of its results because all participants were working at general or superior general hospitals in a metropolitan city within a single province. Therefore, further studies using nurses who work within other regions or other types (e.g., small and medium sized hospitals) of hospitals are recommended.

In conclusion, compliance with WSRs of shift nurses in Korea is still unsatisfactory as one day off after a night shift and work on the weekends remains quite common. In particular, work on weekends is not evenly distributed and the task tends to focus on specific nurses. As WSRs are one of the solutions that can minimize the negative effects of shift work, nurse managers should monitor compliance with these WSRs, and should distribute appropriately rather than focused on a small number of nurses. Considering the compliance with WSRs was related to having standards on work schedules at the institutional level, hospitals should keep the standards of work schedules, have a system to monitor compliance with these standards, and to introduce modified shift systems to improve the current problems. Additional studies assessing different regions or types of hospitals are recommended to increase the generalizability of this study.

### Conflicts of interest

The authors declared no conflict of interest.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.shaw.2021.01.006>.

### References

- [1] Park SK, Cho KM, Jwa YG, Kang DW, Lee YJ. Fact-finding surveys on status of nurses activity. Cheongju: Korea Health Industry Development Institute; 2014. Report No.: 11-1352000-001476-0.
- [2] Hospital Nurses Association. Fact-finding surveys on hospital nurses labor conditions in 2017. Seoul: Hospital Nurses Association; 2018.
- [3] Jung YJ, Kang SW. Differences in sleep, fatigue, and neurocognitive function between shift nurses and non-shift nurses. *J Kor Acad Soc Adult Nurs* 2017;29(2):190–9. <https://doi.org/10.7475/kjan.2017.29.2.190>.
- [4] Flo E, Pallesen S, Grønli J, Nordhus IH, Bjorvatn B, Åkerstedt T, et al. Shift-related sleep problems vary according to work schedule. *Occup Environ Med* 2013;70(4):238–45. <https://doi.org/10.1136/oemed-2012-101091>.
- [5] Kim EJ, Jung HS, Choi EH. Relationship of shift work to gastrointestinal disorders in hospital nurses. *Kor J Health Promot* 2014;14(4):172–9. <https://doi.org/10.15384/kjhp.2014.14.4.172>.
- [6] Ramin C, Devore EE, Schernhammer ES, Wang W, Wegrzyn LR, Pierre-Paul J. Night shift work at specific age ranges and chronic disease risk factors. *Occup Environ Med* 2015;72(2):100–7. <https://doi.org/10.1136/oemed-2014-102292>.
- [7] Hansen AB, Andersen ZJ, Stayner L, Hansen J. Night shift work and incidence of diabetes in the Danish nurse cohort. *Occup Environ Med* 2016;73(4):262–8. <https://doi.org/10.1136/oemed-2015-103342>.
- [8] Yang EO, Choi IR, Kim SM. The impact of sleep disorder and job stress on turnover intention of shift-working nurses. *Kor J Stress Res* 2017;25(4):255–64. <https://doi.org/10.17547/kjsr.2017.25.4.255>.
- [9] Park YC, Kwak SS. Policies for manpower and working condition for health-care industry workers. Seoul: Economic, Social & Labor Council; 2015.
- [10] Jeon WR, Ko YW, Kim J. A study of nurse scheduling problem using efficient approximation algorithms. *J Kor Inst Inform Technol* 2016;14(2):159–66. <https://doi.org/10.14801/jkiit.2016.14.2.159>.
- [11] Drake RG. The nurse rostering problem: from operational research to organizational reality? *J Adv Nurs* 2014;70(4):800–10. <https://doi.org/10.1111/jan.12238>.
- [12] Drake RG. The ‘robust’ roster: exploring the nurse rostering process. *J Adv Nurs* 2014;70(9):2095–106. <https://doi.org/10.1111/jan.12367>.
- [13] Knauth P, Hornberger S. Preventive and compensatory measures for shift workers. *Occup Med* 2003;53(2):109–16. <https://doi.org/10.1093/occmed/kgg049>.
- [14] Korea Occupational Safety and Health Agency (KOSHA). Health care guidelines for shift workers (KOSHA guide No. H-22-2019). Ulsan: Korea Occupational Safety and Health Agency; 2019.
- [15] Liang YW, Lee JL, Chen WY, Huang LC. Nurse staffing, direct nursing care hours and patient mortality in Taiwan: the longitudinal analysis of hospital nurse staffing and patient outcome study. *BMC Health Serv Res* 2012;12(1):44–52. <https://doi.org/10.1186/1472-6963-12-44>.
- [16] Cohen J. *Statistical power analysis for the behavioral sciences*. 2nd ed. Hillsdale (NJ): Lawrence Erlbaum Associates; 1988.
- [17] Kee DH, Kim HJ. Ergonomic evaluation and improvement measures for shiftwork systems of large scale manufacturing enterprises in Korea. *J Ergon Soc Korea* 2017;36(6):795–803. <https://doi.org/10.5143/JESK.2017.36.6.795>.
- [18] Gassman-Pines A. Low-income mothers’ nighttime and weekend work: daily associations with child behavior, mother-child interactions, and mood. *Fam Relat* 2011;60(1):15–29. <https://doi.org/10.1111/j.1741-3729.2010.00630.x>.
- [19] Drach-Zahavy A, Marzuq N. The weekend matters: exploring when and how nurses best recover from work stress. *J Adv Nurs* 2013;69(3):578–89. <https://doi.org/10.1111/j.1365-2648.2012.06033.x>.
- [20] Ministry of Government Legislation. Enforcement decree of the labor standards act [Internet]. Sejong: Ministry of Employment and Labor; 2019.
- [21] Chang YS, Wu YH, Chen HL, Hsu CY. Is one day off sufficient for re-adaptation to a daytime routine after two consecutive nights of work? *Ergon* 2018;61(1):162–8. <https://doi.org/10.1080/00140139.2017.1330492>.
- [22] Centers for Disease Control and Prevention. NIOSH training for nurses on shift work and long work hours-Module 5. Work organization strategies to promote alertness and health in nurses [Internet]; 2020 [cited 2020 Nov 24]. Available from: <https://www.cdc.gov/niosh/work-hour-training-for-nurses/default.html>.
- [23] Korea Health Industry Development Institute. Nurse’s work environment and treatment improvement plan [Internet]. Sejong: Korea Health Industry Development Institute; 2018.
- [24] Van Amelsvoort LGPM, Jansen NWH, Swaen GMH, Van den Brandt PA, Kant I. Direction of shift rotation among three-shift workers in relation to psychological health and work-family conflict. *Scand J Work Environ Health* 2004;20(2):149–56. <https://doi.org/10.5271/sjweh.772>.
- [25] Son DM, Ham OK. The relationship between work-life conflict and turnover intention among hospital nurses based on shift work. *Kor J Occup Health Nurs* 2018;27(4):191–202. <https://doi.org/10.5807/kjohn.2018.27.4.191>.