Association of Grit and Body Composition with Fatigue and Burnout among Shift-work Nurses

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Purpose: This study aimed to investigate the effects of grit and body composition on fatigue and burnout in shift-working nurses. **Methods:** A descriptive cross-sectional design using self-report questionnaires was employed. Data were collected between February and April 2021 from 192 shift-working nurses in 22 units of C tertiary hospitals. Of the 192, 175 nurses returned their completed questionnaires (return rate: 91.1%). The participants objectively measured their body composition for three consecutive days using a home body composition measurement scale. **Results:** Nurses with higher consistency of interest were more likely to have lower chronic fatigue (B = -5.23, p = .013), lower emotional exhaustion (B = -2.75, p < .001), and decreased depersonalization (B = -1.08, p = .014). Perseverance of effort was not statistically significant for fatigue; however, it was statistically significant for higher personal accomplishment among the subdomains of burnout (B = 2.50, p < .001). Skeletal muscle mass and body mass index had no significant effect on fatigue and burnout. **Conclusion:** To reduce fatigue and burnout in shift-working nurses, comprehensive efforts at the organizational and individual levels should be implemented to increase their grit. Further research is needed to determine whether body composition affects fatigue and burnout in shift-working nurses.

Key Words: *Shift-work; Grit; Body composition; Fatigue; Burnout*

INTRODUCTION

Most hospital nurses (approximately 75%) are involved in shift-work schedules to provide 24-hour nursing care for patients [1]. Nurses who work in shifts (henceforth referred to as shift-work nurses), are exposed to physical and mental stress, such as a shortage of manpower, heavy workload, poor working environment, conflict with colleagues, maintaining professional roles, and irregular schedules [2,3]. Nurses are known to frequently experience physical and mental fatigue; therefore, they frequently experience "burnout syndrome" [4,5]. In particular, shift-work nurses have higher fatigue and burnout than nurses with fixed shifts be-

cause they are supposed to quickly deal with the changes in shift timings and handle high-intensity tasks, such as nursing care for patients and emergency nursing along with their regular work schedule [6]. Many studies on fatigue and burnout in nurses have found that the influencing factors for fatigue and burnout include gender, age, marital status, number of children, religion, education level, unit type, and the length of nurses' careers as individual characteristics, and job stress and work environment as organizational characteristics [1-5]. High job demands, which requires the nurses to quickly deal with and handle high-intensity tasks, are known to be an important factor in increasing fatigue and burnout in them [6]. Systemic changes at the organizational level, such as

securing manpower, flexible work schedules, and improving the working environment, are needed to alleviate fatigue and burnout among nurses. However, such systemic changes require considerable time and money. When striving to improve environmental systems, approaches to individual factors should also be considered.

Among the individual factors that reduce fatigue or burnout in nurses, grit as a psychological characteristic and body composition as a physical characteristic can be considered [7-12]. Grit refers to consistent passion, interest, and effort toward long-term goals and a disposition that constantly strives to maintain efforts and stands up to challenges despite failure, adversity, and plateaus in the process [7]. In view of the fact that individuals with grit are able to move toward long-term goals without giving up in challenging situations, it can be an important concept for shift-work nurses who perform high-intensity tasks in challenging work environments [8]. Studies that regard grit in clinical settings are needed in Korea as the existing body of literature has a dearth of relevant studies [8]. Nurses with high level of grit may strive to improve their tasks in active and positive directions in environmental and psychological situations [9]. Furthermore, grit allows individuals to overcome difficulties and stress from work, thereby reducing the negative effects associated with fatigue and burnout [8].

Body composition is defined as a quantitative or relative ratio of organs or tissues constituting the human body, and refers to indices that determine the amount of body fat, bone, and muscle in a human body [10]. Body composition includes body weight, body mass index (BMI), muscle mass, basal metabolic rate (BMR), skeletal muscle mass, and body fat percentage. Skeletal muscle mass, BMI, and body fat percentage are highly correlated with physical fitness; high skeletal muscle mass and low body fat percentage are important factors for predicting high physical fitness [11,12]. Nurses with high physical fitness are able to perform their work well, are satisfied with their jobs, and manage psychological stress well [13]. Additionally, nurses with strong physical fitness are more likely to have high emotional health and low stress responses, even in demanding work situations where their work intensity is high, and therefore experience less fatigue and burnout [14]. In other words, the degree to which nurses may feel fatigue and burnout and complain of related symptoms may differ according to their body composition. However, studies regarding differences in body composition according to the characteristics of shift-work nurses and the association between body composition and fatigue and burnout in shift-work nurses are scarce. Moreover, several prior studies have used self-report data, which have limitations in objectively interpreting the results [15,16]. To overcome these limitations, this study investigated the effects of grit and body composition on fatigue and burnout based on data collected using an easy-to-use body composition measurement scale.

Objectives

This study aims to investigate the difference in grit and body composition in shift-work nurses as per their general characteristics, and the effects of grit and body composition on fatigue and burnout.

METHODS

1. Study design

This study used a descriptive cross sectional design to investigate the effects of grit and body composition on fatigue and burnout among shift-work nurses.

2. Participants

The participants in this study were shift-work nurses in general wards and special departments (ICU, emergency department, etc.) at C tertiary hospital located in Seoul, South Korea. Those who understood the purpose of this study and agreed to participate in it were included in the study.

Of the 192 recruited participants, 17 with incomplete information (four who lost contact, six who stopped participating in this study, and seven with missing values for body composition measurements and questionnaire items) were excluded, thereby resulting in a total of 175 participants that were finally included in the analysis. Thirty participants were simultaneously measured with a home body composition measurement scale (as a gold standard) to verify the validity of the body composition measurement scale used in this study. When the number of participants required for this study was calculated using the G*Power 3.1.9 program (significance level (α) = .05, effect size = .015, power (1-β) = 0.95, and the number of predictive factors = 19 for linear regression analysis), the minimum required number of participants was calculated to be 90. To increase the accuracy and reliability of the statistical analysis results, the sample size finalized for this study was sufficient.

3. Instruments

1) Grit

Grit was measured using the Korean version [17] of the short version of the Grit Scale originally developed by Duckworth et al. [7]. This scale comprises 12 items (ranging from 1-5), including two subdomains: persistence of interest (six items) and perseverance of effort (six items). Grit was calculated as the mean value of the items, with a higher score indicating higher level of grit. The Cronbach's α at the time of its development was .73-.83 [7], and in this study was .71.

2) Body composition

Body composition was measured using a scale that objectively measures skeletal muscle mass, BMI, and body fat percentage. A body composition measurement scale (Fit-Coach Scale WFSC20, Fusionfnc, China), whose validity was studied in 2017 by the Korea Consumer Agency, was used in the current study. This scale operates based on the principle of bioelectrical impedance, in which the resistance changes according to the biological characteristics of the tissue during electrical conduction. The participants measured their body composition for three consecutive days in the morning of the day or evening shifts (i.e., not night shifts) after fasting for at least eight hours and after getting sleep for at least six hours [18]. The mean values measured over three consecutive days were used for data analysis [19]. To confirm the validity of the scale used to measure body composition in this study, 30 participants were simultaneously assessed using the home body composition measurement scale (Inbody H20N, Inbody, Korea), and the values obtained from both scales were examined using Pearson's correlation analysis. The correlation coefficients were r = .86 for skeletal muscle mass, and r = .93 for BMI, confirming their validity. However, that of body fat percentage was r = .22, suggesting poor validity; thus, body fat percentage was excluded from the further analysis. In terms of skeletal muscle mass, a skeletal muscle mass of ≤ 22 kg, 22.1-27.0 kg, and ≥ 27.1 kg indicated below the standard, standard, and above the standard, respectively [20]. In terms of BMI, a BMI of ≤ 18.4 kg/m², 18.5-22.9 kg/m², 23-24.9 kg/m², and 25 kg/m² indicated underweight, normal, overweight, and obese, respectively [21].

3) Fatigue

Fatigue was measured using the Korean version of Occupational Fatigue Exhaustion Recovery Scale (OFER) [22]. This tool comprises three subdomains with a total of 15 items (range 0-6), including five items related to chronic fatigue, five to acute fatigue, and five to inter-shift recovery. For attaining each subdomain score, the sum of the scores for each item was converted into 100. For chronic and acute fatigue, a higher score indicates higher fatigue, and a higher score for inter-shift recovery indicates a higher level of recovery. The Cronbach's α at the time of the development of the tool was .86 for chronic fatigue, .84 for acute fatigue, and .84 for inter-shift recovery [22]. In this study, Cronbach's α was .76 for chronic fatigue, .80 for acute fatigue, and .80 for inter-shift recovery.

4) Burnout

Burnout was measured using the Korean version of the Maslach Burnout Inventory-Human Services Survey (MBI-HSS) [23]. This tool comprises three subdomains with a total of 22 items (range 0-4) including nine items regarding emotional exhaustion, five regarding depersonalization, and eight regarding personal accomplishment. Higher scores for emotional exhaustion and depersonalization, and lower scores for personal accomplishment, indicate higher burnout. The Cronbach's α at the time of the development of the tool was .89, .80, and .76 for emotional exhaustion, depersonalization, and personal accomplishment, respectively [23].

5) Job demands

To adjust the statistical models for estimating the effects of grit and body composition on fatigue and burnout, job demands were included as a controlling variable. Job demands were measured using the four items regarding "quantitative job demands" among "job demands" from the Korean version of the second version of the Copenhagen Psychosocial Questionnaire [24,25]. Each item was rated from 1 to 5, which were then converted to 0, 25, 50, 75, and 100. Higher scores indicate higher work demands.

6) General characteristics

The participants' general characteristics included gender, age, marital status, educational degree, unit, and years of experience as a registered nurse.

4. Data collection

Data were collected from February 19 to April 17, 2021. Recruitment notices were distributed to each unit; those interested in participating in this study were asked to contact the researchers directly. To ensure ano-

nymity, each completed questionnaire was sealed in an envelope and collected directly by the researchers. To confirm the validity of the body composition measurement scale utilized in the study, 30 of 175 participants agreed to measure body composition simultaneously with a home body composition measurement scale along with the scale used in this study. The researchers met each of the 30 participants individually and measured their body composition using two measurement scales.

5. Data analysis

Data were analyzed using SPSS/WIN program 26.0 (IBM Corp., Armonk, NY, USA). The general characteristics of the participants, grit, and body composition were analyzed using descriptive statistics such as frequency and percentage, and mean and standard deviation. Differences in grit and body composition according to the participants' general characteristics were analyzed using t-tests and ANOVA. Post hoc tests were performed using the Scheffé test. The effects of grit and body composition on fatigue and burnout were analyzed using multiple linear regression models. The statistical models were adjusted for general characteristics and job demands, which are well-known factors affecting fatigue and burnout [1-6].

6. Ethical considerations

This study was conducted after obtaining permission from the Department of Nursing at C Hospital and the approval from the institu-

tional review board (IRB) of C Hospital (IRB No.: 2073-004-432). For personal information protection, all data were anonymized, and the clause of anonymity and confidentiality of individual participants was mentioned in the consent form. The participants were told that if they wish to withdraw from the study, they could refuse to participate in the questionnaire survey or stop participating at any time. The collected questionnaires were then stored in a locker to secure personal information and survey responses.

RESULTS

1. General characteristics of the participants

Most of the participants were female (97.7%) and unmarried (77.7%), with a bachelor's degree (83.4%). Approximately half of the participants were aged 20-29 years old (48.0%) (Table 1). In terms of working units, the proportion of those working in wards (64.0%) was the highest, followed by the ICU (27.4%) and emergency department (8.6%). In terms of nursing careers, the proportion of nurses with <1 year, 1-4 years, 3-9 years, and ≥10 years of work experience were 10.9%, 36.6%, 31.4%, and 21.1%, respectively. The mean score for job demands was 48.85 (standard deviation: 11.73).

The descriptive statistics for grit, body composition, fatigue, and burnout are presented in Table 2. The mean grit was 3.03±0.44. By subdomain, the average scores for the consistency of interest and perseverance of effort were 2.93±0.55 and 3.11±0.62, respectively. With regard to body composition, the mean skeletal muscle mass was 21.72±5.14 kg, and the

Table 1. General Characteristics of the Participants   (N=175)

Variables	Categories	n (%)	Mean (standard deviation)
Gender	Female	171 (97.7)	
	Male	4 (2.3)	
Age (yr)	20-29	84 (48.0)	
	30-39	80 (45.7)	
	≥40	11 (6.3)	
Marital status	Not married	136 (77.7)	
	Married	39 (22.3)	
Educational degree	Associate	15 (8.6)	
	Bachelor's	146 (83.4)	
	Master's/Doctoral	14 (8.0)	
Unit	General ward	112 (64.0)	
	Intensive care unit	489 (27.4)	
	Emergency room	15 (8.6)	
Years of experience as a registered nurse	<1	19 (10.9)	
	1-4	64 (36.6)	
	5-9	55 (31.4)	
	≥10	37 (21.1)	
Job demands			48.85 (11.73)

Table 2. Descriptive findings of Grit, Body composition, Fatigue, and Burnout   (N=175)

Variables	Min	Max	Mean	SD
Grit	1.90	4.00	3.03	0.44
Consistency of interest (range 1-5)	1.30	4.20	2.93	0.55
Perseverance of effort (range 1-5)	1.50	4.80	3.11	0.62
Physical fitness				
Skeletal muscle mass (kg)	12.40	52.50	21.72	5.14
Body mass index (kg/m²)	12.70	35.60	21.09	2.92
Fatigue				
Chronic fatigue (range 0-100)	3.33	96.67	64.95	16.78
Acute fatigue (range 0-100)	20.00	93.33	59.07	13.35
Inter-shift recovery (range 0-100)	6.67	100.00	44.99	16.98
Burnout				
Emotional exhaustion (range 0-36)	3.00	36.00	21.52	5.47
Depersonalization (range 0-20)	0.00	16.00	8.49	3.38
Personal accomplishment (range 0-32)	9.00	30.00	19.38	4.14

SD=Standard deviation.

mean BMI was 21.09 ± 2.92 kg/m². In terms of skeletal muscle mass, the numbers of those whose skeletal muscle mass was below standard, standard, and above standard were 111 (62.7%), 42 (23.7%), and 22 (12.4%), respectively. In terms of BMI, 26 (14.7 %), 113 (63.8 %), 24 (13.6 %), and 12 (6.8 %) participants were classified as underweight, normal weight, over-weight, and obese, respectively. In terms of the subdomains of fatigue, the scores for chronic fatigue, acute fatigue, and inter-shift recovery were 64.95 ± 16.78, 59.07 ± 13.35, and 44.99 ± 16.98, respectively. In terms of the subdomains of burnout, the scores for emotional exhaustion, deper-sonalization, and personal accomplishment were 21.52 ± 5.47, 8.49 ± 3.38,

Table 3. Differences in Grit by the General Characteristics (N = 175)

Variables	Categories	n	Consistency of interest					Perseverance of effort				
			Mean	SD	t/F	p	Scheffé	Mean	SD	t/F	p	Scheffé
Gender	Female	171	2.93	0.55	-0.26	.814		3.11	0.62	0.28	.799	
	Male	4	2.88	0.43				3.20	0.62			
Age (yr)	20-29	84	2.84	0.52	2.94	.055		3.04	0.56	2.30	.103	
	30-39	80	3.00	0.56				3.15	0.66			
	≥ 40	11	3.17	0.54				3.44	0.73			
Marital status	Not married	136	2.90	0.55	-1.37	.171		3.10	0.62	-0.76	.447	
	Married	39	3.04	0.53				3.18	0.62			
Educational degree	Associate[a]	15	2.83	0.77	1.69	.188		3.05	0.61	7.98[†]	< .001	a,b < c
	Bachelor's[b]	146	2.92	0.52				3.06	0.59			
	Master's/Doctoral[c]	14	3.17	0.54				3.73	0.69			
Unit	General ward	112	2.95	0.57	0.39	.681		3.08	0.60	0.67	.515	
	Intensive care unit	48	2.93	0.53				3.20	0.59			
	Emergency room	15	2.81	0.47				3.11	0.88			
Years of experience as a registered nurse	< 1[a]	19	2.92	0.41	4.08[†]	.008	a < c,d	2.93	0.56	2.80[†]	.041	(-)
	1-4[b]	64	2.75	0.44				3.12	0.55			
	5-9[c]	55	3.04	0.66				3.02	0.65			
	≥ 10[d]	37	3.08	0.51				3.35	0.68			
Job demands					r = -.04	.623				r = -.12	.123	

[†]$p < .05$.
SD = Standard deviation.

Table 4. Differences in Body Composition by the General Characteristics (N = 175)

Variables	Categories	n	Skeletal muscle mass (kg)					Body mass index (kg/m²)				
			Mean	SD	t/F	p	Scheffé	Mean	SD	t/F	p	Scheffé
Gender	Female	171	21.50	4.98	3.81[†]	< .001		21.07	2.93	0.61	.543	
	Male	4	31.05	3.50				21.98	2.75			
Age (yr)	20-29	84	21.30	4.36	2.08	.128		20.90	3.14	1.07	.343	
	30-39	80	21.76	4.97				21.14	2.68			
	≥ 40	11	24.64	9.81				22.25	2.86			
Marital status	Not married	136	21.73	5.31	0.04	.966		21.01	2.93	-0.74	.460	
	Married	39	21.68	4.58				21.40	2.91			
Educational degree	Associate	15	19.67	3.20	2.95	.055		20.03	1.54	2.61	.076	
	Bachelor's	146	21.68	4.77				21.07	3.01			
	Master's/Doctoral	14	24.24	8.82				22.47	2.66			
Unit	General ward	112	21.46	4.70	0.97	.381		21.01	2.98	0.74	.479	
	Intensive care unit	48	22.56	6.40				21.47	2.89			
	Emergency room	15	20.93	3.51				20.51	2.60			
Years of experience as a registered nurse	< 1	19	22.71	6.83	2.44	.066		20.77	4.25	2.18	.092	
	1-4	64	21.42	4.02				21.18	2.88			
	5-9	55	20.62	3.93				20.48	2.23			
	≥ 10	37	23.35	6.91				22.02	2.94			
Job demands					r = -.10	.187				r = .03	.738	

[†]$p < .05$.
SD = Standard deviation.

Table 5. Association of Grit and Body Composition with Fatigue and Burnout among Shift-work nurses   (N = 175)

Variables	Category	Chronic fatigue		Acute fatigue		Intershift recovery		Emotional exhaustion		Depersonalization		Personal accomplishment	
		B	p	B	p	B	p	B	p	B	p	B	p
Grit	Consistency of interest	-5.23†	.013	-2.09	.225	3.49	.149	-2.75†	<.001	-1.08†	.014	-0.10	.855
	Perseverance of effort	-1.04	.576	-2.40	.145	1.42	.508	-0.01	.989	-0.58	.134	2.50†	<.001
Skeletal muscle mass	Below standard	0.88	.754	-3.45	.166	-1.66	.609	-1.17	.196	-0.13	.822	-0.22	.755
	Above standard	1.16	.792	0.97	.803	4.12	.419	-0.56	.694	-0.20	.826	-0.19	.867
Body mass index	Underweight	2.06	.517	6.06	.176	-2.15	.558	1.27	.213	0.42	.524	-0.67	.401
	Overweight	1.42	.684	-2.05	.505	-3.43	.394	-0.51	.649	0.66	.366	-0.78	.373
	Obesity	4.71	.401	0.52	.917	-8.05	.215	1.47	.413	1.46	.216	-2.21	.119
Control variable													
Marital status	Married	2.13	.550	2.23	.480	0.26	.949	-0.63	.578	0.02	.984	0.74	.412
Educational degree	Master's/Doctoral	8.57	.130	-1.86	.709	-4.18	.522	-0.10	.957	-1.58	.182	0.90	.525
	Bachelor's	12.50†	.003	2.29	.533	-4.55	.345	1.46	.275	0.61	.486	-0.82	.434
Unit	Emergency room	-4.14	.300	-5.42	.124	8.12	.079	-0.23	.858	2.42†	.004	-2.17†	.032
	Intensive care unit	-0.77	.763	-2.80	.214	0.04	.990	-0.62	.449	0.11	.838	-0.59	.363
Years of experience as a registered nurse	≥ 10	-12.96†	.011	0.89	.840	-2.12	.715	-2.28	.158	0.22	.834	2.32	.069
	5-9	-1.55	.695	-3.26	.350	-0.95	.835	-0.26	.838	1.74†	.037	1.98	.048
	1-4	-3.32	.390	-3.27	.337	2.26	.611	-1.49	.226	1.32	.104	1.50	.123
Job demands		0.61†	<.001	0.38†	<.001	-0.52†	<.001	0.22†	<.001	0.07†	<.001	-0.04	.078

†$p < .05$.
Reference group: skeletal muscle mass (standard); body mass index (average weight); marital status (not married); educational attainment (associate); units (general ward); and years of RN experience (< 1).

and 19.38 ± 4.14, respectively.

2. Grit and body composition according to general characteristics

Table 3 shows the differences in grit according to the general characteristics of the participants. In terms of grit, the consistency of interest was significantly lower in nurses with 1–4 years of work experience (2.75) than in those with 5–9 years of work experience (3.04) or those with ≥10 years of work experience (3.08) (F = 4.08, p = .008). The perseverance of effort in 3-year college graduates (3.05) or 4-year college graduates (3.06) was significantly lower than that for graduate school graduates or higher (3.73) (F = 7.98, p < .001). The perseverance of effort varied significantly according to the length of work experience (F = 2.80, p = .041); however, the post-hoc test results were not significant.

The differences in body composition according to general characteristics are presented in Table 4. Skeletal muscle mass was significantly higher in men (31.05 kg) than in women (21.50 kg) (t = 3.81, p < .001).

3. Associations of grit and body composition with fatigue and burnout

In terms of grit, the consistency of interest was a statistically significant factor for chronic fatigue; those with a higher consistency of interest were more likely to report lower chronic fatigue (B = -5.23, p = .013) (Table 5). Further, higher consistency of interest was significantly associated with lower emotional exhaustion (B = -2.75, p < .001) and depersonalization (B = -1.08, p = .014). Perseverance of effort was not statistically significant for fatigue; however, it was statistically significant for higher personal accomplishment among the subdomains of burnout (B = 2.50, p < .001). Body composition was not statistically significant for fatigue or burnout.

DISCUSSION

This study aimed to investigate the effects of grit and body composition on fatigue and burnout in shift-work nurses. The results are discussed as follows.

The mean score for grit was 3.03 out of 5, which was lower than the scores found in prior studies for nurses at university hospitals with more than 500 beds (3.12) [8] and for nurses working at general hospitals with less than 300 beds per hospital (3.11) [26]. The grit score found in this study was lower than that of nursing students (3.01-3.31) [27,28]. During data collection, the study hospital was planning to open another branch, thus causing frequent unit transfers and a shortage of nursing staff. These changes might cause nurses to suffer from heavy workloads and

mental stress, resulting in a decrease in consistent interest and effort in work. In addition, the score for perseverance of effort (3.11) was higher than that for consistency of interest (2.93). This result is similar to those of a study involving university hospital nurses [8] and that involving medical specialists [29]. For nurses who are physically and mentally fatigued and exhausted due to the heavy workload, emergency situations, shift-work schedules, and interpersonal relationship stress, it can be difficult to maintain a single job for a prolonged duration [8]. Moreover, there was a difference in grit according to the length of work experience, which is consistent with the results of a previous study on grit in university hospital nurses [30]. As nurses' work experience increases, they may be promoted in their careers, which in turn helps them create a sense of responsibility and leadership. Consequently, nurses may take a consistent interest in their work and make steady efforts to increase their grit [7].

With regard to body composition, the mean skeletal muscle mass was 21.72 kg, and the mean BMI, 21.09 kg/m². The participants in this study had a higher BMI than those in a previous study involving female college students (21.05 kg/m²) [20]. However, the participants in this study had a lower BMI compared to the data collected from the Korea National Physical Fitness Survey, which reported that the mean BMI of women aged 25-40 years to be 22.31 kg/m² [31]. In comparison with the general female population, the participants in this study had lower skeletal muscle mass and higher BMI maybe due to irregular sleep patterns and eating habits associated with shift work and lack of physical activity. Those with high physical fitness would increase their work performance, which in turn would be satisfied with their job and manage psychological stress well [13]. Therefore, to encourage the development of body composition and physical fitness for shift-work nurses, hospitals should create campaigns that promote nurses' health awareness, such as using stairs instead of elevators, using public transportation when commuting to and from the hospital, and doing physical training at home [32].

High consistency of interest as a grit subdomain was associated with lower chronic fatigue, and lower emotional exhaustion and depersonalization as burnout subdomains. It was also found that the perseverance of effort in nurses had no effect on fatigue but an increased personal accomplishment as a burnout subdomain. Consistency of interest refers to maintaining attention and interest towards one's goals. Nurses with high consistency of interest continuously and positively strive towards their goals in particular work environments, such as shift work. Consequent-

ly, nurses with high consistency of interest may feel lower sensitivities for fatigue and burnout than those with low consistency of interest, which is thought to reduce chronic fatigue, emotional exhaustion, and depersonalization. Nurses who make steady efforts would not give up in the face of challenging situations and difficult tasks, and thus strive to improve themselves in an active and positive direction in a given working environment and psychological situation, which can ultimately increase their sense of personal accomplishment [9]. Interventions to improve grit should be implemented to reduce nurses' fatigue and burnout. Regular unit rotations could enable nurses to have opportunities to explore a department suitable for their interests and aptitudes and maintain the consistency of their interests. Workplace education programs such as one-on-one coaching programs or continuing education programs must be developed to help increase nurses' constant effort [8,26-28].

Body composition, especially skeletal muscle mass, is an important factor in predicting physical fitness [12]. With strong physical fitness, workers perform their tasks well and manage their psychological stress adequately [13,33]. The study revealed that skeletal muscle mass and BMI had no effect on fatigue or burnout. In this study, over half of the participants were within the standard BMI range; however, their skeletal muscle mass was lower than the standard range. In older adults, body composition has been reported to have a significant effect on physical fitness and health outcomes [34]. Nevertheless, body composition values did not sensitively affect health outcomes in healthy adults aged 20-30 years-old [35], who were of similar age to the participants in this study. It would take time for skeletal muscle or BMI to contribute to preventing or developing symptoms such as fatigue and burnout, and the association between body composition, fatigue, and burnout may thus not be observed sensitively in young adults. Body fat percentage was not included in this study because of the low validity of the measured values; however, it is an important indicator used for physical fitness evaluation [11]. When the body fat percentage is low, muscle mass and physiological function are reduced, and finally, BMR and physical fitness decrease [33]. Nurses with low body fat percentage may have lower physical fitness than those with normal body fat percentage. Thus, they have lower work productivity and ability, and an increased sensitivity to burnout. However, because body composition in shift-work nurses has not been sufficiently measured, a definite conclusion could not be drawn from our findings. Future research should repeatedly measure the body composition of nurses with various characteristics, using devices with a minute margin of error.

This study has the following limitations. First, because the participants were recruited from a single hospital, it cannot represent all shift-work nurses in South Korea, thereby limiting the generalizability. In particular, in terms of body composition, the study participants were mostly healthy young women, causing limitations in the data. Multicenter studies involving nurses with various shift patterns (e.g., 8-hour, 12-hour, and flexible work shifts) are needed. Second, errors might have occurred in the process of participants' self-measurement of their own body composition. Nonetheless, nurses are known to be highly knowledgeable regarding health, and provide accurate research data [36]. Furthermore, a previous study reported that waist-hip circumference measured and reported by nurses was highly accurate [37]. Therefore, a minimal error can be inferred in the process of nurses' self-measurement of their body composition. Third, there may have been social desirability, recall, denial, and deception in our self-reported data. Fourth, because this was a cross-sectional study, a causal relationship could not be determined.

CONCLUSION

To reduce fatigue and burnout among nurses, hospitals must implement programs to help increase grit for shift-work nurses, such as mentor programs, self-leadership strengthening programs, and autonomous decision-making ability improvement programs at the organizational level. Future studies should recruit nurses from various healthcare settings such as general hospitals, public health centers, and schools to include nurses from various practice backgrounds. Furthermore, it is necessary to develop research devices that can easily and accurately measure body composition and can be utilized in clinical settings. Longitudinal prospective studies should be conducted to determine the causal relationship between grit and body composition and fatigue and burnout.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

BMJ and HK contributed to the conception and design of this study. They performed the statistical analysis and interpretation. BMJ and HK drafted the manuscript and critically revised the manuscript. They both supervised the entire study process. All authors have read and approved the final manuscript.

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