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Research Article

Effects of the Anger Management Program for Nurses

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A B S T R A C T

Purpose: The purpose of this study was to examine the effects of an anger management program on anger, job stress, psychological well-being, and heart rate variability in clinical nurses.
Methods: A quasi-experimental study was conducted using a nonequivalent control group, pre–post test design with repeated measures. The participants included 43 nurses assigned to the experimental and control groups. Anger, job stress, psychological well-being, and heart rate variability were evaluated before the intervention, immediately after the completion of the intervention, and four weeks after the end of the intervention. Chi-square test, t-test, Fisher's exact test, and GEE (Generalized Estimating Equations) were used to analyze the data.
Results: There were significant differences in the level of anger, state anger, job stress, and psychological well-being between the two groups. The rate of change in the total power (TP) and the high-frequency band (HF) of the experimental group increased immediately after the intervention completion, but that of the control group decreased at the same time.
Conclusion: The above results demonstrate that an anger management program for nurses effectively attenuated anger and job stress, improved psychological well-being, and regulated heart rate variability.
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Introduction

Anger refers to subjective feelings such as tension, irritation, and rage [1]. Anger is observed in unfair situations in which the needs or rights of individuals are ignored [2]. Anger can be divided into state anger, which can be experienced in momentary situations, and trait anger, which has temperamental tendencies [3]. Managing one's expression of anger can help prevent conflicts and improve organizational commitment [4]. However, uncontrolled expression and suppression of anger can cause an interpersonal problem and reducing job satisfaction and organizational performance [4,5].

Nurses experience anger when they are treated unfairly, face ethical dilemmas, and are blamed or not supported by coworkers or superiors [6]. However, Korean nurses often suppress or avoid anger [5], which can cause helplessness, frustration, stress, resentment,

and even destructive behavior [7]. Moreover, unresolved anger can provoke anger in others [7] while reducing care behavior quality [8].

Hospital nurses experience high stress owing to a heavy workload and emotional demands [9]. Failure to control anger during work or ruminating about an incident can also lead to increased job stress [8]. Nurses who experience prolonged exposure to job stress can be damaged physical and psychological health and reduced job satisfaction [10]. On the other hand, controlling negative emotions such as anxiety and anger becomes more challenging for nurses in a stressful environment, and it is difficult for nurses to maintain psychological well-being [11]. Therefore, it is important to help nurses effectively manage their anger and job stress.

Psychological well-being refers to individuals' overall life satisfaction [12]. It helps individuals control their behavior and induces a sense of purpose in their lives [13]. Compared to other professions, nursing is associated with lower psychological well-being [14,15] owing to emotional exhaustion and suppression of negative emotions [15]. In the past, suppressing negative emotions has been regarded as a virtue; however, continuous suppression of anger and excessive stress can lead to an imbalance in the autonomic nervous system, which can negatively affect health [16,17]. Therefore, it is necessary to promote nurses' psychological well-being by helping them resolve their anger and reduce job stress in appropriate ways.

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In the previous integrated literature review study, various stress programs have been proved to be effective in managing stress, depression, burnout, and increasing happiness among nurses [18]. The stress programs applied to nurses were mainly cognitive behavioral therapy, mindfulness therapy, and art therapy. In particular, cognitive behavioral therapy programs have been effective in the areas of occupational stress and mental health of nurses [18]. However, anger management should be approached differently from stress management.

To date, anger management programs have mostly been applied to groups expressing anger [19,20]. The anger management program mainly consists of understanding the causes and emotions of anger, rational thinking practice, and anger management skills training [19,20]. However, even groups that suppress anger need help in expressing and managing anger emotions in a desirable way. In previous studies [21,22], after applying the anger management program to nurses, an improvement has been noticed in psychological resilience and job satisfaction. This is because as nurses learn assertiveness and problem-solving skills, they become less frustrated with anger situations and improve their coping skills [21]. Therefore, it is necessary to apply a program that can reduce job stress and improve psychological well-being by acquiring positive anger expression and anger management skills for Korean nurses as well. In particular, this program focused on improving anger coping skills while on duty by combining education and practice.

Recently, anger was assessed using heart rate variability (HRV), which can be used to evaluate the activity and balance of the autonomic nervous system [23]. Consequently, we assessed the effects of an anger management program on nurses' anger, job stress, psychological well-being, and HRV.

Methods

Design

This was a quasi-experiment study with nonequivalent control group pre test−post test design to understand the effects of anger management programs on nurses' anger, job stress, psychological well-being, and heart rate variability.

Participants

Nurses who worked at Hospital S and Hospital Y in Seoul, Republic of Korea, for more than one year and consented to participate were included in this study. Participants were recruited as those wishing to participate in this study. Nurses were assigned to either the experimental or control group based on marital status, length of career [4], and level of anger through matching. Participants were not informed the group to which they were assigned. Compensation (100$) was provided to the participants.

The number of required participants was analyzed by a repeated-measures analysis of variance (ANOVA), following the formula by Cohen (1988) [24], with a significance level of .05, power of .80, and median effect size of .3. Therefore, the number of required participants in each group was 20. Considering a dropout rate of 20%, 24 participants were assigned to each group. However, four participants from the experimental group withdrew for personal reasons, health issues (dropout rate of 17%). In the control group, one participant (dropout rate of 4%) was excluded for not participating in the post-test. Therefore, the data from 20 participants in the experimental group and 23 participants in the control were analyzed (Figure 1).

There were no significant group differences in any key variables (Table 1).

Measures

Anger

Levels. The levels of anger experienced during and outside of work were assessed using a visual analog scale [25]. Respondents indicated the level of anger from 0 (*no anger*) to 10 (*extreme anger*) in a straight line. Higher scores indicated increased anger.

Type. State anger and trait anger were evaluated using the STAXI-K IV, which was modified by Chon et al. [26] from the State−Trait Anger Expression Inventory (STAXI), developed by Spielberger [3]. This tool comprises 20 items (10 items each), which were measured on a Likert scale ranging from 1 (*not at all*) to 4 (*very much/always*). Higher scores indicated increased anger. Cronbach's α were .93 and .86 for state and trait anger, respectively, at the time of development; and .95 and .89, respectively, in this study.

Expression. Expression of anger was assessed using a tool developed by Chon [27,28]. This 20-item tool comprises four subdomains: suppression, expression, disguise, and anger control. Each question was evaluated with a four-point Likert scale ranging from 1 (*not at all*) to 4 (*almost always*), and expression of anger was evaluated using the mean score for each domain. In a preliminary survey of 20 nurses, Cronbach's α was .75; in this study, Cronbach's α was .70.

Job stress

Job stress was measured using the Korean version of the Expanded Nursing Stress Scale, developed by French et al. [29] and translated by Kim et al. [30], possessing good reliability and validity. This 48-item tool measures nine factors: death and dying, conflict with physicians, inadequate emotional preparation, problem relating to peers, problem relating to supervisors, heavy workload, uncertainty concerning treatment, patients and their families, and discrimination. Each item is rated on a scale of 0 (*never experienced*), 1 (*no stress at all*), to 4 (*always stressed*) points. Higher scores indicated higher job stress. Cronbach's α was .95 at the time of development and .91 in this study.

Psychological well-being

Psychological well-being was measured using the Korean version of the Psychological Wellbeing Scale, originally developed by Ryff [31] and modified by Kim et al. [13]. This 46-item tool measures six factors: self-acceptance, environmental mastery, positive relationship with others, autonomy, purpose in life, and personal growth with a five-point scale: 1 (*not at all*) to 5 (*very much*). Higher scores indicated greater psychological well-being.
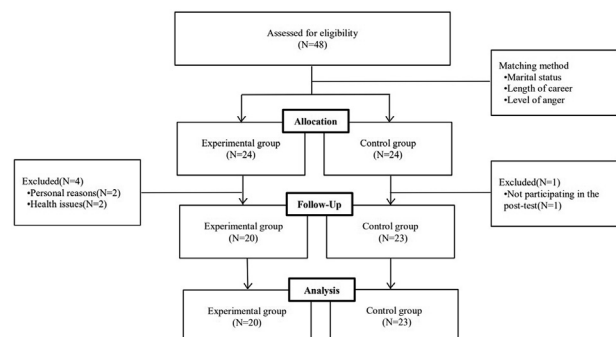

Figure 1. Flow chart of participants.

Table 1 Homogeneity test for Demographic Characteristics and Research Variables between the Groups.

Characteristics	Exp (n = 20)	Cont (n = 23)	χ^2/t	p
	n (%)/ Mean ± SD	n (%)/ Mean ± SD		
Age	32.10 ± 5.73	32.19 ± 5.97	0.45	.652
Religion				
Yes	14 (70.0)	10 (43.5)	3.05	.081
No	6 (30.0)	13 (56.5)		
Marital status				
Single	12 (60.0)	11 (47.8)	0.63	.425
Married	8 (40.0)	12 (52.2)		
Education				
<Bachelor	7 (35.0)	14 (60.9)	2.87	.129
≥Master	13 (65.0)	9 (39.1)		
Length of career				
1~4	4 (20.0)	4 (17.4)		>.999[a]
5~9	6 (30.0)	8 (34.8)		
≥10	10 (50.0)	11 (47.8)		
Duty type				
Day duty	7 (35.0)	10 (43.5)	0.32	.756
Shift duty	13 (65.0)	13 (56.5)		
Department				
General ward	14 (70.0)	10 (43.5)		.127[a]
Outpatient department	3 (15.0)	10 (43.5)		
Nurse specialist	3 (15.0)	3 (13.0)		
Anger				
Level of anger				
During of work	7.25 ± 2.02	7.17 ± 1.67	−0.14	.893
Outside of work	4.10 ± 3.16	3.43 ± 2.24	−0.80	.430
Type of anger				
State anger	16.85 ± 8.52	14.35 ± 5.02	−1.14	.262
Trait anger	21.15 ± 5.01	21.91 ± 6.18	0.44	.662
Expression of anger				
Anger-in	2.19 ± 0.63	2.22 ± 0.47	0.16	.872
Anger-out	1.68 ± 0.49	1.80 ± 0.51	0.78	.437
Anger-disguise	1.89 ± 0.57	1.83 ± 0.57	−0.37	.715
Anger-control	2.33 ± 0.45	2.23 ± 0.56	−0.67	.508
Job stress	3.47 ± 0.37	3.57 ± 0.44	0.82	.415
Psychological well-being	3.43 ± 0.44	3.40 ± 0.37	−0.25	.803
Heart rate variability (normal range)				
Total power (7.4~9.3 ms^2)	8.51 ± 0.92	8.49 ± 0.51	−0.08	.938
HF (4.2~7.4 ms^2)	6.35 ± 0.83	6.65 ± 0.80	1.22	.231
LF (6.1~8.1 ms^2)	7.00 ± 1.16	7.07 ± 0.66	0.24	.812
LF/HF (0.4~2.2)	1.09 ± 0.13	1.08 ± 0.15	−0.06	.955

Note. Cont = control group; Exp = experimental group; HF = high frequency band; LF = low frequency band; M = mean; SD = standard deviation.
[a] Fisher's exact test.

Cronbach's α was .91 at the time of development and .92 in this study.

Heart rate variability

HRV was measured using a pulse wavemeter (uBioClip v7, Biosense creative Ltd.; Seoul, South Korea) that analyzes pulse waves through an optical fiber sensor. Participants were asked to sit comfortably in a chair for about 10 minutes. Then, the machine was attached to the tip of a finger. For controlling factors that could affect the results, participants were asked to refrain from consuming alcohol and performing vigorous activities the day before. From three hours before the test, participants could not smoke, consume caffeine-containing beverages, or use drugs. We measured the following as per Kim and Min [16]: (1) Total power (TP), an index that reflects the overall regulatory ability of the autonomic nervous system, which decreases when stress is observed. (2) High frequency (HF), an index that reflects the activity of the parasympathetic nerve, decreases when stress, anxiety, and fear are experienced. (3) Low frequency (LF), mainly reflects the activity of the sympathetic nerve in long-term measurements, and

it reflects both the activity of the parasympathetic and sympathetic nerve in short-term measurements. LF increases in situations with acute stress but decreases with chronic stress. (4) LF/HF, which reflects the overall balance of the autonomic nervous system. Values closer to 1.5 indicate better balance.

Anger management program

Program development

The theoretical basis of this program was a cognitive behavior therapy model developed from Beck's cognitive theory [32]. Cognition, emotion, and behavior are closely related, and the behavior of anger occurs due to automatic thinking and distortion of cognition. Participants are able to manage anger by modifying their dysfunctional thoughts and actions that cause anger in a reasonable direction. In previous studies, it was proved that anger intervention based on cognitive behavior therapy was effective in adults [33].

A preliminary program was designed based on cognitive behavior therapy, an anger management program developed by Chon [27], literature review [33,34], focus-group interviews, and demand surveys. Focus-group interviews were conducted for 50 minutes with six nurses who had more than three years of work experience to assess their experiences and the need for an anger management program. The level of demand was evaluated in 13 nurses using nine items, which were evaluated on a 10-point scale. The demand survey examined the following contents: (1) the degree of anger at work; (2) negative emotions caused by anger; (3) the need for an anger management program; (4) the content and operation method of the anger management program; and (5) willingness to participate. Each session of the preliminary program was largely aimed at cognition, behavior change, and emotional regulation, following the cognitive behavior therapy approach.

The preliminary program was then reviewed by three nursing college professors, one psychiatrist, one clinician in emotional psychology, and three nurses with more than three years of clinical experience to obtain a content validity index ≥0.8. The final program was organized according to the four stages of the anger management model [34]. The model promotes participants' motivation and comprises a preparation stage to foster intimacy with the therapist, a strategic change stage to reduce anger by recognizing it and utilizing various management methods, an acceptance stage to accept and adapt to immutable situations, and a recurrence prevention stage to reinforce motivation and prevent the individual from returning to past patterns.

Consequently, the first session concerned an orientation and intimacy formation, followed by a second session about cognitive preparation for anger. Sessions three to six concerned the education for change and acceptance (physical, psychological, and social aspects). Last, sessions seven and eight focused on the prevention of recurrence. Each session comprised an introduction, activity, and conclusion. Anger-provoking cases used in the program were modified into situations and terms that were easy for nurses to understand, and anger management strategies that could be easily performed during work were selected.

In a meta-analysis on operating hours and sessions of the anger management group programs, it was recommended that more than nine sessions be performed for less than 60 minutes with less than seven participants [33]. However, based on a different study that decreased aggression in nurses after four two-hour sessions [21], advice from experts, and demand surveys that revealed that heavy workload limited nurses' ability to participate for more than two months, a small group (≤ eight) attended a one-hour session once a week for eight weeks (Table 2).

Application of the program

The first author obtained anger management instructor level two qualification by completing 16 hours of education at the Holistic Healing Academy and then further acquired level one qualification through eight weeks of anger management practice training. A manual was prepared to provide contents, methods, and time of the program in the same manner, and the first author conducted each session of the program. Additionally, the education materials developed by Chon [27] were modified and distributed to the nurses in each session.

Considering that nurses worked on a three-shift schedule, the desired times and dates were individually adjusted for each session, and 3—8 groups of 3—8 participants were created. The program was conducted in a classroom of C University, where lectures and group discussions were given.

In the first session, HRV was measured after a preliminary survey, and a lecture on program orientation and the necessity of anger management was given.

In the second session (cognition change), we lectured on "self-understanding" and "the definition and formula of anger." Nurses were informed that anger occurs when expectations do not match the given situation. After asking participants to consider their anger experiences as per the anger formula, they were asked to share their thoughts. Additionally, nurses were asked to record any experiences of anger during work in a diary for the next session.

The topic of the third session (cognition, behavior change) was "coping with anger by using attentional shift," and a lecture on self-developed anger was given to explain that anger is a temporary emotion that can be self-controlled. Attentional coping steps such as leaving the scene, counting numbers, viewing family photos, etc., that is, the routine method was introduced. Subsequently, nurses were asked to judge whether their experience recorded in the diary was self-developed anger and share their preferred ways of

attentional coping methods. Last, lavender, ylang-ylang, and chamomile German aroma oils, which are helpful in reducing anger, were introduced [35]. Necklaces were made using these oils. We recommended that nurses wear the necklace at work and manage anger by smelling the necklaces in anger-provoking situations. The task for next week (and the next three sessions) was to use one of the anger coping strategies and record the experience and effects in the diary.

In the fourth session (behavior change, emotional regulation), participants were given time to talk freely about the previous topic and share their experiences. They were informed that their anger management ability could be improved and were motivated to improve it. A lecture was given on "coping strategies that can be used in anger-provoking situations before, during, and after work." Music and tea meditation were recommended to relax the mind before work. Time-out and video techniques were suggested for anger-provoking situations during work. Participants were also informed to not take their work-related stressors "home with them." Then, participants practiced meditation techniques and shared their thoughts while drinking hot tea.

The theme of the fifth session (cognition change, emotional regulation) was "expanding one's tolerance," and strategies to accept uncontrollable situations, change controllable situations, and avoid inappropriate situations were introduced. Relevance of unreasonable expectation (i.e., its universally validity, whether it is useful after 10 years, whether communication is sufficient) was introduced.

In the sixth session (cognition, behavior change, and emotional regulation), participants were told that conflict or anger resulting from interpersonal relationships could be caused by over-interpretation of parts of the experience, and "expanding one's tolerance" was re-explained. Participants practiced having conversations from the perspectives of others and ignoring the situations in

Table 2 *The Anger Management Program.*

Session	Theme	Introduction	mins	Learning & Activities	mins	Closing	mins
1	• Orientation • Introduction	• Greeting	10	• Pre-test • Introduce program	20 10	• Share the anger experience • Homework	15 5
2	**Cognition change** • Self-understanding • Understanding of anger	• Review • Check-up homework	10	• Want profile test • Definition of anger • Formula of anger	10 10 10	• Discussion • Homework: anger diary	15 5
3	**Cognition and Behavior change** • Anger management I (The coping with anger)	• Review • Check-up homework	10	• Psychological aspect: transposition methods • Aroma necklace	15 15	• Discussion • Homework: anger diary	15 5
4	**Behavior change & Emotional regulation** • Anger management I (The coping with anger)	• Review • Check-up homework	10	• Physical aspect: the method of coping with anger • Anger management at work • Tea meditation	10 10 10	• Discussion • Homework: anger diary, cognitive distortion	10 10

5	**Cognition change & Emotional regulation**
	• Anger management II (Permissible range)
		• Review
		• Check-up homework
			10	• Psychological aspect
				  - Cognitive distortion, Understanding others
				  - Principle of AAA(accept, avoid, alter)
					30	• Discussion
						• Homework: anger diary
							15
							5

6	**Cognition and Behavior change & Emotional regulation** • Anger management II (Permissible range)	• Review • Check-up homework	10	• Social aspect - Personal relations, Anger and stress • Anger candle	15 15	• Discussion • Homework: anger diary	15 5
7	**Cognition and Behavior change & Emotional regulation** • Practice	• Review • Check-up homework	10	• Transcendental aspect: self-growth • Write a letter forgiveness & thank • Anger plan	10 10 10	• Discussion • Homework: anger diary	15 5
8	**Behavior change & Emotional regulation** • Review	• Review • Check-up homework	10	• Anger tree & Portfolio • Sharing feeling each other	20 10	• Completion ceremony • Post-test	5 15
9	• Continuous action			• Follow-up		• 4 weeks later-test	

which they cannot understand others. Then, so-called "anger candles" of various shapes were made using beeswax, and participants were encouraged to "burn the anger in their minds" with the candle.

In the seventh session (cognition, behavior change, and emotional regulation), a need for "transcendental thinking" was emphasized. Participants were told to think of a brighter future and see anger-provoking situations as opportunities for growth. Then, the group practiced assertive self-expression to express their feelings while being considerate of others. Participants were also asked to write their own anger management manual in addition to a letter of forgiveness or gratitude to themselves or others, which they could share with the group.

Last (behavior change, emotional regulation), participants were asked to write about the events or people that provoked the greatest anger in them on a note and post it on the board to relieve any feelings. After reflecting on past–present–future anger, participants shared their feelings and celebrated the end of the program. Participants' HRV and satisfaction with the program were measured.

Data collection and process

This study was approved by the Institutional Review Board of a Catholic university (Approval no. MC17FESE0019). After obtaining permission to collect data from the nursing department, a recruitment advertisement related to the program was posted on the bullet board of the nursing department, and the program was advertised to nurses. The experimental group (Hospital S) underwent the eight-week program, while the control group (Hospital Y) did not receive any treatment.

Both the experimental group (June–October 2017) and control group (November 2017–February 2018) were asked to complete a questionnaire on anger, job stress, and psychological well-being—in addition to HRV—before the program, immediately after program completion, and four weeks after the end of the program. The collected data were assigned a unique number for each individual according to the guidelines of personal information processing.

Data analysis

Data were analyzed using SPSS WIN 23.0 (IBM, Armonk, NY, USA). Participants' general characteristics were presented as frequencies and percentages or means and standard deviations. Homogeneity of general characteristics and pretest dependent variables between the two groups were tested with t-tests, χ^2tests, and Fisher's exact tests.

Anger, job stress, and psychological well-being of the two groups measured before the program, immediately after program completion, and four weeks after program completion were analyzed with GEE (Generalized Estimating Equations). The rate of change in HRV was analyzed using t-tests.

Results

Anger

In the experimental group, the level of anger during work decreased from 7.25 points before the program to 4.80 points immediately after program completion and four weeks after program completion. In contrast, in the control group, the difference in the level of anger during work was not significant from 7.17 to 6.78 and 6.30 measured before, immediately after, and four weeks after the program, respectively ($p = .001$). Moreover, the level of anger outside of work decreased from 4.10 points before the program to 3.65 points immediately after program completion and 2.25 point

four weeks after program completion in the experimental group. Among controls, the level of anger outside of work changed from 3.44 to 3.09 and 3.96 measured before, immediately after, and four weeks after the program, respectively ($p = .010$; Table 3).

For the type of anger, the score for state anger in the experimental group was 16.60 before the intervention, which decreased to 10.90 and 12.20 immediately after program completion and four weeks after program completion, respectively. Among controls, the score for state anger changed from 14.35 to 16.09 and 13.52 ($p = .002$). Trait anger in the experimental group decreased from 20.80 points before the program to 18.95 and 18.50 points immediately after program completion and at four weeks after program completion, respectively. Among controls, the score increased from 21.91 to 20.83 and 20.96 ($p = .449$; Table 3).

There was no difference in the change in the expression of anger between before the program, immediately after program completion, and four weeks after program completion ($p = .095~.537$; Table 3).

Job stress

Job stress in the experimental group decreased from 3.47 points before the program to 3.23 points and 3.11 points immediately after program completion and four weeks after program completion, respectively. In contrast, job stress scores among controls were 3.57, 3.54, and 3.56 points before the program, immediately after program completion, and four weeks after program completion, respectively ($p = .022$; Table 3).

Psychological well-being

Psychological well-being in the experimental group increased from 3.43 points before the program to 3.57 and 3.61 points immediately after program completion and four weeks after program completion, respectively. Among controls, the scores barely changed: from 3.40 to 3.40 and 3.38, respectively ($p = .016$; Table 3).

HRV

Among the indicators of HRV, the rate of change in TP before and immediately after program completion was increased by 3.09% in the experimental group and decreased by 1.79% among controls ($p = .028$). The rate of change in TP immediately after the program and four weeks after program completion was decreased by 2.14% in the experimental group and increased by 3.48% among controls ($p = .012$). The rate of change in HF before and immediately after program completion increased by 5.37% in the experimental group and decreased by 3.70% among controls ($p = .010$; Table 4).

Discussion

Compared to the control group, nurses experienced reduced anger during and outside of work after participating in the anger management program. This finding mirrors that of a previous study, which showed that an anger management program helped nurses control their negative emotions [22]. In the program, participants practiced understanding anger and modifying past thought patterns, and improve reasonable thinking skills. Modifying dysfunctional thought can help reduce anger [21,36]. Therefore, even if the working environment does not change, the level of anger seemingly decreases. An anger intervention approach based on cognitive behavior therapy helped Korean nurses manage their anger and negative emotions.

Table 3 *Effects of the Anger Management Program on Anger, Job Stress, Psychological Well–Being.*

Variables	Pre test	Post-test I	Post-test II	Source	χ^2	p
	M ± SE	M ± SE	M ± SE			
Level of anger						
During of work						
Exp	7.25 ± 0.44	4.80 ± 0.47	4.80 ± 0.40	Group	6.75	.009
Cont	7.17 ± 0.34	6.78 ± 0.43	6.30 ± 0.38	Time	35.98	<.001
				Group*Time	15.11	.001*
Outside of work						
Exp	4.10 ± 0.61	3.65 ± 0.60	2.25 ± 0.57	Group	0.17	.683
Cont	3.44 ± 0.57	3.09 ± 0.56	3.96 ± 0.53	Time	2.13	.344
				Group*Time	9.15	.010*
Types of anger						
State anger						
Exp	16.60 ± 1.90	10.90 ± 0.34	12.20 ± 1.00	Group	2.49	.114
Cont	14.35 ± 1.02	16.09 ± 1.59	13.52 ± 0.82	Time	5.04	.080
				Group*Time	12.37	.002*
Trait anger						
Exp	20.80 ± 1.10	18.95 ± 0.91	18.50 ± 0.92	Group	1.68	.194
Cont	21.91 ± 1.26	20.83 ± 1.23	20.96 ± 1.71	Time	10.75	.005
				Group*Time	1.60	.449
Expression of anger						
Anger-in						
Exp	2.22 ± 0.14	2.22 ± 0.10	2.16 ± 0.13	Group	0.03	.855
Cont	2.22 ± 0.10	2.18 ± 0.11	2.28 ± 0.10	Time	0.12	.944
				Group*Time	1.52	.469
Anger-out						
Exp	1.67 ± 0.11	1.58 ± 0.11	1.49 ± 0.11	Group	1.98	.159
Cont	1.80 ± 0.10	1.83 ± 0.12	1.69 ± 0.10	Time	6.55	.038
				Group*Time	1.24	.537
Anger-disguise						
Exp	1.92 ± 0.12	1.81 ± 0.09	1.73 ± 0.13	Group	0.10	.758
Cont	1.83 ± 0.12	1.73 ± 0.11	1.77 ± 0.12	Time	5.13	.077
				Group*Time	1.27	.530
Anger-control						
Exp	2.35 ± 0.10	2.54 ± 0.12	2.44 ± 0.10	Group	1.82	.177
Cont	2.23 ± 0.11	2.22 ± 0.10	2.36 ± 0.09	Time	3.31	.191
				Group*Time	4.70	.095
Job stress						
Exp	3.47 ± 0.09	3.23 ± 0.10	3.11 ± 0.11	Group	6.84	.009
Cont	3.57 ± 0.86	3.54 ± 0.92	3.56 ± 0.10	Time	8.35	.015
				Group*Time	7.63	.022*
Psychological well–being						
Exp	3.43 ± 0.10	3.57 ± 0.08	3.61 ± 0.09	Group	1.81	.178
Cont	3.40 ± 0.08	3.40 ± 0.07	3.38 ± 0.07	Time	5.14	.076
				Group*Time	8.28	.016*

Note. Cont = control group (n = 23); Exp = experimental group (n = 20); M = estimated mean; SE = standard error. *p < .05
Pre- test = before the program, Post-test I = immediately after program completion; Post-test II = 4 weeks later after the end of program.

The state anger among nurses in the experimental group decreased compared to the control group. With respect to trait anger with temperamental tendencies, while the experimental group showed a decreasing trend, an increasing trend was noticed in the control group; however, there was no significant interaction. In the program, nurses learned an integrated (physical, social, and psychological) anger management method aimed at facilitating immediate responses to anger situations. The nurses continued to practice and self-reflect through an anger diary in each session. Through this, it is estimated that the state anger decreased as the ability to cope with momentary anger improved. However, the trait anger with temperamental tendencies is difficult to change with increased age. Since it is more effective to apply anger management programs to adolescents [33] and college students [37], it is necessary to develop and apply a program to help nursing students manage anger.

In this study, a tool that included the concept of anger disguise was used to reflect the anger expression patterns of Korean nurses. Korean nurses disguised their anger by sulking or cursing inwardly. Korean nurses tend to suppress their emotions or express their anger passively, as they fear expressing anger will worsen the

situation [38]. However, it causes the provoker's wrong behavior to be overlooked, resulting in repetitive anger situations. This not only makes the situation worse but also causes stress to the nurse; therefore, it is important to actively help nurses manage anger [38].

In this study, there was no significant Group × Time interaction concerning the expression of anger. Although direct comparisons are difficult, as different measurement tools were used, this finding contrasts those from other studies [36] where expression of anger changed positively after an anger management program was implemented with college students. The sessions and contents of programs in previous studies [36] were similar to those of our study. However, participants' experiences and environments differed. From this study, nurses may have been more exposed to anger situations while on duty. The method of coping with anger may has already been fixed. Therefore, we posited that because college students' behavioral habits related to anger were less fixed [33], they responded in a more flexible way. Therefore education for anger management should be more emphasized in the curriculum of nursing students. In addition, when applying an anger management program to nurses, it is necessary to evaluate changes in the expression of anger by implementing an in-depth approach

Table 4 *Effects of the Anger Management Program on Heart Rate Variability.*

Variables	Between pre test and post-test I percentage change	t (p)	Between Post-test I and post-test II percentage change	t (p)
Heart rate variability (normal range)				
Total power (7.4~9.3 ms^2)				
Exp	3.09 ± 7.89	−2.28 (.028)*	−2.14 ± 6.60	2.64 (.012) *
Cont	−1.79 ± 6.16		3.48 ± 7.28	
High-frequency band (4.2~7.4 ms^2)				
Exp	5.37 ± 9.94	−2.69 (.010)*	−1.86 ± 9.55	1.28 (.209)
Cont	−3.70 ± 11.87		2.28 ± 11.39	
Low-frequency band (6.1~8.1 ms^2)				
Exp	7.82 ± 13.96	−2.16 (.037)*	−2.62 ± 10.84	2.42 (.020) *
Cont	−0.57 ± 11.47		5.23 ± 10.41	
Low-frequency band/High-frequency band (0.4~2.2)				
Exp	4.77 ± 12.67	−0.35 (.725)	0.07 ± 9.02	1.24 (.224)
Cont	3.22 ± 15.66		4.26 ± 12.60	

Note. Cont = control group (n = 23); Exp = experimental group (n = 20). *p < .05
Pre -test = before the program, Post-test I = immediately after program completion; Post-test II = 4 weeks later after the end of program.

through individual counseling or customized anger management programs according to individuals' expressions of anger.

Job stress decreased among the experimental group; however, no significant change was observed among the controls. This was similar to Lee et al.'s (2016) findings, which showed that anger and stress decreased after programs that implemented a cognitive-behavioral approach and provided relaxation therapy to emotional labor workers [39]. Another study that applied cognitive emotional behavior therapy with nurses observed similar findings [40]. Distorted and repetitive anger-provoking situations at work lead to increased job stress [8]. Moreover, conflicts between patients, guardians, and healthcare professionals are a major cause of job stress in nurses [41]. Instead of suppressing feelings of anger, nurses learned desirable communication skills and were trained in interpersonal skills. It is thought that job stress decreases as the ability to flexibly respond to anger and conflict and problem-based coping skills improve.

Psychological well-being increased in those in the experimental group; however, no change was observed among the controls. In previous studies, positive internal resources such as gratitude and social support could increase psychological well-being [14,42]. As a result, in the current program, participants were taught tolerance to better understand anger-provoking situations and others' reactions. Moreover, writing a letter of gratitude and embracing forgiveness may have promoted feelings of social support through emotional exchanges and encouragement with colleagues, thereby increasing psychological well-being.

HRV was measured as an objective indicator of psychological state. In anger-provoking and stressful situations, TP and HF decrease while LF increases [16]. However, in situations with chronic stress, HF and LF decreased [43]. Additionally, in short-term measurements, the reliability of LF was low [16]. Therefore, the rate of change of TP and HF was confirmed in this study. The rate of change in HRV was analyzed based on the advice of a psychiatrist.

The rates of change in TP and HF immediately after the program in the experimental group increased, while they decreased among controls, suggesting that the program was effective in helping nurses manage anger and stress. This result was similar to the finding of another study [44], in which stress and anger decreased while HF increased after a four-week distress management program was conducted with patients with cancer. However, various factors such as lifestyle and environments affect HRV as well [16,45]. Therefore, it is possible that the aroma necklaces and other factors could have affected the nurses in the experimental group. We recommend studies that control for variables that can affect HRV to confirm the effects of the anger management program.

Participants in the experimental group reported that it was possible to talk more comfortably and empathize with others because the group was small. Moreover, they reported feeling social support by being able to discuss the anger and stress experienced at work. Anger negatively affects the quality of care and job satisfaction [4,8]. Therefore, rather than dismissing these as individual problems, measures at the hospital or departmental level, such as forming a dedicated counseling team to support freedom of expression and helping nurses control their emotions, are necessary. Moreover, as regular follow-up training is essential for anger management education [33], supportive policies to monitor and conduct anger management programs regularly would be important. Additionally, participants suggested that it would be desirable if the sessions are conducted online, especially considering that nurses worked on a three-shift schedule. Thus, in the future, it will be necessary to operate an anger management program with online access.

The anger management program was effective in reducing nurses' anger and job stress and improving their psychological well-being. Nonetheless, this study had some limitations. The expression of anger was defined as yelling or direct aggression toward others; passive aggression was not included. Future research should confirm the effectiveness of the anger management program by developing a new tool that includes passive aggression. Also, the sample size was small, and individual lifestyle factors were not controlled. In addition, our follow-up period was brief. Despite these setbacks, we implemented a novel anger management program for nurses in South Korea, and anger was assessed using various concepts: expression, suppression, control, and disguise. Moreover, the effects of the program were assessed using HRV—an objective indicator. We propose that future studies develop a tool that can assess anger experienced by nurses in clinical practice and further modify the anger management program to assess its long-term effects.

Conclusion

The novel anger management program effectively reduced anger and job stress and improved psychological well-being among clinical nurses in South Korea. Additionally, the program also showed stable effects concerning HRV. Participants reported that the program was helpful in maintaining emotional stability and harmonious relationships with others through effective management strategies to control anger and react in healthy cognitive ways in anger-provoking situations. We suggest that future researchers assess whether anger management programs improve nurses'

organizational commitment and care quality and prevent burnout. Additionally, we suggest an intervention study combining the anger management program with meditation and exercise therapies. Furthermore, education for anger management should be more emphasized in the curriculum of nursing students.

Conflict of interest

No potential or any existing conflict of interest relevant to this article was reported.

References

1. Spielberger CD, Johnson EH, Russel SF, Crane RJ, Jacobs GA, Worden TJ. The experience and expression of anger: construction and validation of an anger expression scale. Anger and hostility in cardiovascular and behavioral disorders. Washington DC: Hemisphere; 1985. p. 5—30.
2. kim DG. Ethics counseling for program for the improvement of the anger control ability. J Ethics Educ Stud. 2017;43:27—48. https://doi.org/10.18850/jees.2017.43.02. Korean.
3. Spielberger C. Manual for the state-trait anger expression scale (STAXI). Odessa, FL: Psychological Assessment Resources; 1988.
4. Lee WH, Song JE, Kim JH, Kim HJ, Lee JM, Kim UY. The relationships among trait anger, anger expression, jab satisfaction, job commitment, and organizational performance in clinical nurses. J Nurses Acad Soc. 2009;15(4):539—49.
5. Han AK, Won JS, Kim OS, Lee SE. Anger expression types and interpersonal problems in nurses. Asian Nurs Res. 2015;9(2):146—51. https://doi.org/10.1016/j.anr.2015.04.001
6. Thomas SP. Transforming nurses' stress and anger: steps toward healing. 3rd ed. Berlin: Springer Publishing Company; 2008. p. 3—21.
7. Shrand J, Devine L. Outsmarting anger: 7 Strategies for defusing our most dangerous emotion. Seo YJ, translator. Seoul: Gilbut; 2013. p. 26—97.
8. Han JA, Kim MJ. The convergence study of interpersonal caring behaviors on anger, job stress and social support in nurses. J Korea Converg Soc. 2016;7(3):87—98. https://doi.org/10.15207/JKCS.2016.7.3.087. Korean.
9. Kim JH, Lee YM, Joung HY, Choo HS, Won SJ, Kwon SY, et al. Effects of emotional labor, emotional intelligence and social support on job stress in clinical nurses. Kor J Fund Nurs. 2013;20(2):157—67. https://doi.org/10.7739/jkafn.2013.20.2.157. Korean.
10. Oh E, Kang K, Kim K, Min H. Research trend analysis on job stress of hospital nurses. Kor J Hosp Manag. 2018;23(1):16—27. Korean.
11. Sohn SK, Kim MS, Lee YS, Park HK, Roh MY. The mediating effect of social support and stress on optimism and psychological well-being in clinical nurses. J East W Nurs Res. 2014;20(1):63—71. https://doi.org/10.14370/jewnr.2014.20.1.63. Korean.
12. Diener E. Subjective well-being. Psychol Bull. 1984;95(3):542—75.
13. Kim MS, Kim HW, Cha KH. Analyses on the construct of psychological well-being of Korean male and female adults. Kor J Soc Pers Psychol. 2001;15(2):19—39. Korean.
14. Jun WH, Lee ES, Lee KL. Relationships among gratitude, depression, and psychological well-being in clinical nurses. J Kor Acad Psychiatr Ment Health Nurs. 2015;24(2):136—44. https://doi.org/10.12934/jkpmhn.2015.24.2.136. Korean.
15. Kang SM, Bae SH. The mediating effect of emotional intelligence on the relationship between emotional labor and psychological well-being of clinical nurses. Kor Soc Muscle Joint Health. 2015;22(3):185—94. https://doi.org/10.5953/JMJH.2015.22.3.185. Korean.
16. Kim BS, Min JA. Application and analysis of heart rate degree in stress clinic. Seoul: Beommun Education; 2015. p. 21—45.
17. Kwon HN. Humanistic consideration on anger. J Hum Stud. 2010;19:77—105.
18. Lee J, Kim H, Lim S. An integrative review of job stress and mental health intervention programs for experienced nurses. J Kor Acad Psychiatr Ment Health Nurs. 2019;28(2):190—204. https://doi.org/10.12934/jkpmhn.2019.28.2.190. Korean.
19. Avci D, Kelleci M. Effects of the anger coping programme based on cognitive behavioural techniques on adolescents' anger, aggression and psychological symptoms. Int J Nurs Pract. 2016;22(2):189—96. https://doi.org/10.1111/ijn.12410
20. Willner P, Rose J, Jahoda A, Kroese BS, Felce D, Cohen D, et al. Group based cognitive behavioural anger management for people with mild to moderate intellectual disabilities: cluster randomised controlled trial. Br J Psychiatry. 2013;203(4):288—96. https://doi.org/10.1192/bjp.bp.112.124529

21. Farahani M, Zare SE. Effectiveness of cognitive-behavioral anger management training on aggression and job satisfaction on nurses working in psychiatric hospital. Zahedan J Res Med Sci. 2018;20(2):e55348. https://doi.org/10.5812/zjrms.55348
22. Turan N. An investigation of the effects of an anger management psycho-education programme on psychological resilience and affect of intensive care nurses. Intensive Crit Care Nurs. 2021;62:102915. https://doi.org/10.1016/j.iccn.2020.102915
23. Schwartz JA, Portnoy J. Lower catecholamine activity is associated with greater levels of anger in adults. Int J Psychophysiol. 2017;120:33—41. https://doi.org/10.1016/j.ijpsycho.2017.07.005
24. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale, NJ: Erlbaum; 1988. p. 1—552.
25. Stern R, Arruda J, Hooper C, Wolfner G, Morey C. Visual analogue mood scales to measure internal mood state in neurologically impaired patients: description and initial validity evidence. Aphasiology. 1997;11(1):59—71. https://doi.org/10.1080/02687039708248455
26. Chon KK, Kim DY, Yi JS. Development of the the state trait anger expression scale Korea: IV. Kor J Art Ther. 2000;7:33—50. Korean.
27. Chon KK. Anger management habit. Paju: Book21 Publishing Group; 2012. p. 1—399.
28. Healing Holistic. Emotion plus academy[internet]. Gangneung; 2020 [cited 2021 Feb 01]. Available from: http://www.handh.co.kr/
29. French SE, Lenton R, Walters V, Eyles J. An empirical evaluation of an expanded nursing stress scale. J Nurs Meas. 2000;8(2):161—78. https://doi.org/10.1891/1061-3749.8.2.161
30. Kim KM, Nam KA, Lee EH, Jung GH. Validity and reliability of the Korean version of the expanded nursing stress scale. J Kor Acad Nurs Adm. 2015;21(5):542—51. https://doi.org/10.11111/jkana.2015.21.5.542. Korean.
31. Ryff CD. Happiness is everything, or is it? Explorations on the meaning of psychological well-being. J Pers Soc Psychol. 1989;57(6):1069.
32. Wright Jesse H, Brown Gregory K, Thase Michael E, Basco MR. Learning cognitive behavior therapy. Seoul: Hakjisa; 2019. p. 15—25.
33. Gu SE, Kim JS. A meta-analysis on the effects of anger management group programs. Kor J Counsel Psychother. 2017;29(1):55—77. https://doi.org/10.23844/kjcp.2017.02.29.1.55. Korean.
34. Kassinove H, Tafrate RC. Anger management. Seoul: Hakjisa; 2011. p. 389—94.
35. Cho SJ, Lee IS. Aromatherapy. Seoul: Hakjisa; 2006. p. 121—212.
36. Üzar Özçetin YS, Hiçdurmaz D. Effects of structured group counseling on anger management skills of nursing students. J Nurs Educ. 2017;56(3):174—81. https://doi.org/10.3928/01484834-20170222-10
37. Oshima Y, Araki H, Iida D, Watanabe M, Tanaka K. The effectiveness of an anger management program based on cognitive-behavioral approaches among undergraduate students: a randomized controlled trial. Kitasato Med J. 2020;50(1):27.
38. Kim MA, Ko SH, Park EA, Park JE, Jung BH, Kim SH. Types of anger expression in clinical nurses: Q methodology. J Kor Clin Nurs Res. 2010;16(1):107—17. Korean.
39. Lee JE, Shin J, Kim MS, Jo MH, Lee IJ. Development and evaluation of cognitive behavioral group treatment to reduce psychological stress of emotion labor workers : a preliminary study. Kor J Stress Res. 2016;24(1):35—45. https://doi.org/10.17547/kjsr.2016.24.1.35. Korean.
40. Kim HL, Yoon SH. Effects of group rational emotive behavior therapy on the nurses job stress, burnout, job satisfaction, organizational commitment and turnover intention. J Kor Acad Nurs. 2018;48(4):432—42. https://doi.org/10.4040/jkan.2018.48.4.432. Korean.
41. Yoon SH. Occupational stress and depression in clinical nurses-using Korean occupational stress scales. J Kor Acad Nurs Adm. 2009;15(3):463—70. Korean.
42. Xie J, Liu M, Zhong Z, Zhang Q, Zhou J, Wang L, et al. Relationships among character strengths, self-efficacy, social support, depression, and psychological well-being of hospital nurses. Asian Nurs Res. 2020;14(3):150—7. https://doi.org/10.1016/j.anr.2020.06.002
43. Borchini R, Veronesi G, Bonzini M, Gianfagna F, Dashi O, MMJIjoer Ferrario, et al. Heart rate variability frequency domain alterations among healthy nurses exposed to prolonged work stress. Int J Environ Res Publ Health. 2018;15(1):113. https://doi.org/10.3390/ijerph15010113
44. Park HY, Oh SH, Noh YM, Kim JY, Kim JH. Heart rate variability as a marker of distress and recovery: the effect of brief supportive expressive group therapy with mindfulness in cancer patients. Integr Canc Ther. 2018;17(3):825—31. https://doi.org/10.1177/1534735418756192
45. Kim CG, Cho MK, Kim JI. Effects of phytoncide aromatherapy on stress, symptoms of stress and heart rate variability among nursing students. J Kor Biol Nurs Sci. 2012;14(4):249—57. https://doi.org/10.7586/jkbns.2012.14.4.249. Korean.

Research Article

Facilitators and Barriers of the Triage Process based on Emergency Nurses' Experience with the Korean Triage and Acuity Scale: A Qualitative Content Analysis

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ABSTRACT

Purpose: Since 2016, the Korean Triage and Acuity Scale (KTAS) algorithm has been applied to the triage process in the emergency departments (EDs) of Korea. This study aimed to investigate the facilitators of and barriers to a well-run triage function based on how Korean emergency nurses perceived the triage process and their experiences with it.
Methods: Data were collected using focus group interviews from June 2018 to January 2019. Twenty emergency nurses were divided into two junior and four senior groups based on their level of clinical experience. All interviews were recorded as they were spoken and transcribed. Data were analyzed using qualitative content analysis.
Results: The participants recognized the need for the KTAS algorithm to efficiently classify emergency patients and were working on it properly. According to the data, we extracted 4 themes and 20 sub-themes. Four themes were as follows: (1) awareness about the necessity of triage, (2) facilitators to triage process, (3) barriers to triage process, and (4) suggestions for the establishment and development of triage.
Conclusion: From the findings of this study, various vulnerabilities of the triage process were identified, and solutions were suggested from the emergency nurses' perspective. Educational, staffing, financial support, and periodic updates of the KTAS are needed to promote the triage process in the future.

Introduction

The triage process works as a safety net in an emergency department (ED). More specifically, it is a rapid assessment system that allows medical professionals to quickly prioritize and treat urgent patients, whereas nonurgent patients are vetted, so they can safely wait for relatively minor treatments [1]. The triage process has, thus, led to improved patient safety in the ED, particularly by decreasing mortality rates and reducing overcrowding by ensuring that patients do not stay longer than needed [1–3]. Various scales have been developed to improve triage efficiency, with some depending on the medical environments of individual countries. The world's most commonly used type of triage scale classifies patients into one of five levels depending on their health status. Representative triage scales with tested validity include the Canadian Triage and Acuity Scales (CTAS), Emergency Severity Index (ESI) (USA), Australian Triage Scale (ATS), and Manchester Triage Scale (UK) [4]. These scales have been used as bases for developing new scales in diverse countries. In Korea, for instance, the Korean Triage and Acuity Scale (KTAS) was developed based on the CTAS [5].

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In the 2000s, overcrowding in the ED increased in Korea, and as a solution to this, the large hospitals' EDs tried to apply either a proven triage algorithm from abroad or a newly developed algorithm that could work just as well. It was for this reason that the KTAS was developed. This scale fits well with the emergency medical system and medical cost policy of Korea and has been used in EDs throughout the country since 2016 [5]. The KTAS is an algorithm designed to classify patients into five levels based on their symptoms, and emergency nurses are mainly in charge of the triage tasks [5]. The previous studies have primarily been conducted to confirm the reliability and validity of KTAS or verify the effectiveness of an educational program used for improving triage competency [6,7]. However, in addition to the application of the new algorithm, insight into the status of the triage process and improvement points based on the experience of emergency nurses who use the KTAS to perform triage tasks will be needed.

Several factors affect the decision-making processes used by emergency nurses when performing triage. In previous studies, factors influencing the triage process were mainly studied with a focus on barriers, and they identified some of these barriers. For example, differences in nurse competency at the individual level were identified as barriers to be overcome [8,9]. It was shown that these differences in emergency nurses' triage competency levels, which may result in a deterioration in the accuracy of the triage, were caused by variations in their knowledge, assessment skill, experience, and education levels [8]. Janssen [9] reported that individual factors including lack of knowledge, insight, and skills influenced the triage process, and that educational programs were being proposed as a way to solve them and facilitate the triage process. The Delphi study examined the role of triage nurses and emphasized the need for comprehensive educational programs [10]. The Emergency Nurse Association (ENA) in the United States and National Emergency Nurses Association (NENA) in Canada also emphasize that triage competence can be improved through a comprehensive, evidence-based triage education [11,12].

Emergency nurses have conflicts due to insufficient medical resources, space and patient flow fluctuations, and "triage fatigue" that occur during the triage process, all of which become a barrier [13]. In a study of US emergency nurses, insufficient staffing, language barriers, and burnout were suggested as barriers [14]. Emergency nurses experience more stress than any other ED workers because they have to triage many patients accurately and quickly with limited space and resources [8,13]. Burnout of the nurses in charge of the triage process can lead to mistriage and compromised patient safety [15,16]. Therefore, it is necessary to closely examine the triage process, identify facilitators and barriers, and seek feasible solutions.

Emergency nurses must perform triage based on the unique environments that define the medical systems in their respective countries of operation. In this case, continual research is needed to explore the factors that affect the triage process. In particular, since the KTAS algorithm has been recently applied to the triage process in Korea, studies on this issue can be said to be at the beginning stage. Although previous studies provided insight into triage barriers, the facilitators and barriers emphasized in these studies may differ from those in the medical environment that the new triage algorithm is being implemented, and the solutions to this may be different. Therefore, a discovery-oriented qualitative study that can derive important topics that affect a triage process using KTAS by comprehensively exploring the experiences of emergency room nurses performing triage tasks is needed. Regarding qualitative research methodology, focus group interviews (FGIs) are useful for collecting high-quality data in a way that allows participants to understand their thoughts and experiences within a relatively short period using the participants' interactions [17]. For a qualitative research exploring the triage process, FGI will be appropriate because by focusing on a specific topic and shared experiences of the participants, it provides insight into the issues under study.

Methods

Design

This study implemented a qualitative descriptive research design involving FGIs with emergency nurses to understand their perceptions about the facilitators and barriers to the triage processes from various career perspectives.

Participants and setting

This study aimed to gather diverse and comprehensive opinions about the hospital environment, triage process, and educational curricula provided to medical staff. For this purpose, qualitative interviews, in the form of FGIs with nurses from two EDs that had implemented the triage process, were conducted. The emergency medical system in Korea is divided into regional emergency center (REC) EDs, which are mainly responsible for severe emergency patients in the area, and local emergency center (LEC) EDs, which are mainly responsible for local emergency patients. This study included participants from both types of EDs. The GEC and LEC EDs handled approximately 45,000 and 40,000 emergency patient visits annually, respectively. These EDs classified patients by their emergency symptoms in accordance with the Emergency Medical Act of 1995, but then the LEC introduced ESI in 2000 and started a full-fledged triage process conducted by emergency nurses. As the KTAS became used nationwide in 2016, the two EDs adopted the KTAS algorithm into their triage processes, with nurses being responsible for performing them.

Because the locations of the two hospitals were more than 300 km apart, the focus group consisted of emergency nurses working in each ED for convenience and, as well as to ensure smooth interaction between the participants. The inclusion criteria of this study were (1) an emergency nurse, and (2) must have performed triage within the past month or received triage education. After explaining the study purpose and inclusion criteria to the nursing managers of the EDs, the managers recommended two nurses each (totaling four) who could speak clearly about the triage process. The researcher explained the research process in detail to the recommended nurses, and 18 additional recruitments were conducted following the recommendations of these nurses; a total of 22 eligible participants were assessed. Two of the eligible participants were excluded because there was a conflict between our FGI schedule and their personal schedules. Phone calls and text messages were used in the participant recruitment process.

Because triage perceptions may differ according to clinical experience, participant interactions may have important effects on the results of the FGIs [17]. For this reason, participants were divided into senior and junior focus groups. Based on the Clinical Career Development Model of Nurses, novice (1 year of clinical experience) and advanced beginner nurses (2—3 years of clinical experience) were assigned to the junior groups, and competent (4—6 years of clinical experience), and proficient nurses (7 or more years of clinical experience) were assigned to the senior groups [18]. The focus group consisted of six separate groups, with the two

junior groups consisting of three participants each and the four senior focus groups consisting of two, three, four, and five participants, respectively, bringing the total number of participants to twenty.

Data collection

Data were collected from June 2018 to January 2019. The interviews were held in a seminar room outside the hospitals to ensure convenience and the anonymity of all the participants. Prior to each interview, the researchers reevaluated the research methods, prepared the research questions to ensure a smooth process, and held discussions about the process as a whole. All the researchers have more than 12 years of clinical experience. The researchers have rich experience and knowledge about the triage process. The first researcher has worked in EDs for 12 years, 6 years of which she spent performing triage. The third researcher has 1-year experience working as a nursing manager in an ED. In addition, the first and second researchers are experts in qualitative research, and their works have been published in peer-reviewed journals. Considering their expertise in emergency nursing and the study's qualitative research methodology, we attempted to extract and describe the participants' experiences with the triage process in EDs. All FGIs were conducted solely by the first researcher (PA) as the moderator. While conducting the FGIs, the moderator also took memos on the main concepts, and since the FGIs were recorded in a video format, it was not necessary to have an additional researcher to take down field notes. All interviews were conducted using semistructured questionnaires that were prepared in the following order: introductory questions, transition questions, key questions, and ending questions (Table 1). All the researchers assisted in creating the interview questions based on the previous literature [8,13,14] and clinical experience. Open-ended questions and prompts were posed at the beginning of each interview to obtain clear information about what participants had experienced. This included questionnaire items such as "Please tell us about your experiences performing triage as an emergency nurse" and "What is triage in the ED?" The formal interview questions were asked in an order progressing from general to specific and positive to negative. Depending on the responses, the moderator checked the interview contents or asked additional questions to maintain momentum. The moderator reviewed the main points of the interview situation and content through debriefing sessions at the end of each interview. One FGI was conducted per group, with each interview ranging from 30 minutes to 1 hour (average of 42.14 minutes). All interviews were recorded in both video and audio format and then transcribed by a research assistant who was a nursing college student with experience in ED clinical practice. The first and second researchers finally confirmed the transcription data while watching the video, which included observing the participants' nonverbal expressions and characteristics such as facial expressions, speech, and gestures. If a transcription was considered insufficient, unclear, or difficult to understand, simple follow-up interviews were conducted via telephone within 10 minutes to ensure the data were sufficiently reliable for analysis. In particular, while analyzing the FGI of the senior group, an additional FGI was conducted within 48 minutes with two participants whose experiences needed further exploration. In this study, data saturation was reached after the 6th FGI: after this point, no new information could be obtained [23].

Data analysis

Collected data were analyzed via the inductive method, following the qualitative content analysis methods proposed by Elo and Kyngäs [19] and Mayring [20] using Nvivo 12.0 and MAXQDA2018 software. Qualitative content analysis is a research method designed to interpret data by checking their structure and meaning to gain better knowledge and understanding of the explored phenomenon [21,22]. The process consists of three stages, including the preparatory phase, organizational phase, and reporting phase (analysis and results) [21,22]. Data analysis begins by transcribing the data on the same day the FGI is completed. In this study, the main analysis process was conducted by scrutinizing transcribed contents and notes taken from the interview. The preparation phase began with the selection of analysis units [19,21]. In this study, meaningful sentences were selected as the analysis unit. Next, the researchers made efforts to understand the data, learn "what's going on," and get a holistic sense of it [23]. Participants' statements were read in sentence units to understand the data and context better. The researchers familiarized themselves with the data by watching the videos, listening to the recordings, and reading the interview data. At the organizational phase, analysis was conducted using an inductive approach, which started with organizing the qualitative data. This process included open coding, creation of categories, and abstraction. In the organizational phase, the researchers repeatedly read the data to perform open coding for meaningful statements, thus establishing subthemes. The research findings were reported after recategorizing and abstracting the open-coded data. During the generalization and abstraction processes, the researchers continually ensured that meanings were not separated from their contexts by comparing

Table 1 *Guide Questions of the Focus Group Interview.*

Introductory question
• Please tell us about your experiences with performing triage as an emergency nurse.
Transition questions
• What is triage in the EDs?
• How process do emergency nurses perform triage?
Key questions
• What factors or activities influence the triage process?
• What factors or activities help the triage process in the EDs?
• What are the factors that interfere with the triage process in the EDs?
• How desirable is it for triage to move forward in the future in your opinion?
Ending statements
• We have talked about the facilitators and barriers to the triage process in the EDs.
• (2~3 minutes after summary) What I've been talking about is an adequate summary of our conversation today.
• Please feel free to add anything that you think is necessary to improve triage process.

Note. ED = emergency department.

them with the raw data. The researchers also repeated the organizational phase by holding discussions until they were satisfied with their explanations of the research phenomenon. In some studies, a summative check was performed to confirm the results at the final stage of creating an inductive category for the qualitative contents analysis [20]. Additionally, a summative content analysis was conducted to confirm whether the findings included both junior and senior focus groups' interview data. Using this research method, the frequencies of codes that categorized the themes extracted from the junior and senior focus groups were identified.

Two researchers (first and second) initially performed data analysis to complete the open coding, categorization, and theme identification stages. After that, all the researchers reviewed the contents of the category over two meetings and revised the analysis results. After that, the second researcher further analyzed the summative content analysis, and the researchers confirmed the findings through one meeting and finally completed the data analysis.

Ethical considerations

As this study was conducted with nurses working at medical institutions, the research was approved by Institutional Review Boards (Approval No. CNUH-2018-079). The researchers then provided participants with explanations of the study purpose and all procedures. Participants' willingness to participate was confirmed orally in the first step during the selection process, and the researchers provided written and oral explanations of all procedures and obtained consent from all participants prior to the study's commencement. They were also told that the interviews would be recorded and videotaped to obtain relevant data. Specifically, it was announced that the video would be used only for analysis by the researchers for a comprehensive understanding of the FGI situation. They were told that interview data would be obtained through FGIs, transcribed, stored on computers, and used solely for research purposes, and that they could withdraw from the research at any time. Researchers made sure that the participants understood the study explanation and, if they agreed to the voice and video recording and the use of the study data, were asked to sign a written consent. The FGI began after receiving written consent from the participants. During the FGI, the participants were given numbers (e.g., 1, 2, 3, etc.) as names, to conceal their personal information. To protect privacy related to the data obtained during interviews, all identifying information was anonymized; the files were then encrypted and stored on the researcher's computer.

Rigor

For qualitative data, trustworthiness was based on data credibility, auditability, transferability, and confirmability, as suggested by both Lincoln and Guba, and Sandelowski [24,25]. More specifically, credibility was established by taking video and audio recordings of all the interviews, which were directly transcribed for analysis. To ensure that the analyses and interpretations were credible, data were completed using the "member check" process, meaning that participants were also shown the extracted research findings. Credibility was also assured by obtaining feedback about the analytic results from 1–2 participants of the six groups. All the research procedures were described in sufficient detail to ensure auditability. As themes and extracted raw data were presented in the research findings, transferability was ensured by noting the characteristics of both the hospitals related to the collected data and the general characteristics and clinical experiences of all 20 participants. As the confirmability of any research represents its neutrality, the researchers bracketed all biases and stereotypes found during data collection, analysis, and interpretation.

Results

Twenty nurses were recruited for participation. These individuals were then divided into 6 (30.0%) junior and 14 (70.0%) senior groups based on their levels of clinical experience. In terms of gender and age of the participants, 17 (85.0%) were female, with a mean age of 30 years. The mean length of experience in the ED was 5.26 years, while mean triage experience was 1.65 years. Six participants received official KTAS training and qualified as a KTAS provider. While these participants experienced triage around two to three times per week, they did not act as the main triage nurse during those shifts (Table 2).

The qualitative content analysis of the 20 emergency nurses' FGI data concerning their triage experiences resulted in 442 meaningful statements and 40 extracted codes. Similarities and differences between the codes were then compared, ultimately resulting in 4 themes and 12 subthemes (Table 3). Although inductive content analysis was used to develop the themes, which were categorized by open codes, an additional summative content analysis was used to quantify the frequencies of junior and senior focus groups who endorsed each of the codes and themes. Through the findings of the summative contents analysis, it was confirmed that the themes were extracted from both the junior and senior focus groups (Table 3).

Theme 1: Awareness about the necessity of triage

Effective system to find and treat urgent patients

All the participants said that triage was an essential system for classifying all patients in the ED as either urgent or nonurgent, thus enabling safe and efficient treatment. Participants also said that the ED only functions properly within the context of the medical system when the triage system works well. They indicated that triage was a crucial factor for the efficient use of limited medical resources, especially when attempting to identify and treat "hidden

Table 2 *General Characteristics of the Participants (N = 20).*

Characteristics	Junior group (n = 6)	Senior group (n = 14)	Total (N = 20)
	n (%) or Mean ± SD	n (%) or Mean ± SD	n (%) or Mean ± SD
Career level			
Novice	3 (15.0)	0 (0.0)	3 (15.0)
Advanced beginners	3 (15.0)	0 (0.0)	3 (15.0)
Competent	0 (0.0)	6 (30.0)	6 (30.0)
Proficient	0 (0.0)	8 (40.0)	8 (40.0)
Gender			
Women	5 (25.0)	12 (60.0)	17 (85.0)
Men	1 (5.0)	2 (10.0)	3 (15.0)
Age	25.17 ± 1.17	32.07 ± 4.28	30.00 ± 4.85
Education level			
Diploma	0 (0.0)	4 (20.0)	4 (20.0)
Bachelor's degree	6 (30.0)	8 (40.0)	14 (70.0)
≥Master's degree	0 (0.0)	2 (10.0)	2 (10.0)
Experience in nursing (year)	2.13 ± 1.27	8.63 ± 4.08	6.69 ± 4.60
Experience in the ED (year)	2.13 ± 1.27	6.59 ± 2.11	5.26 ± 2.81
Experience with triage (year)	0.83 ± 0.98	1.99 ± 1.46	1.65 ± 1.42
Type of ED			
REC	6 (30.0)	4 (20.0)	10 (50.0)
LEC	0 (0.0)	10 (50.0)	10 (50.0)

Note. ED = emergency department; LEC = local emergency center; REC = regional emergency center.

critical patients" first, as opposed to attending to patients on a "first come, first served" basis.

> I think triage is necessary not only from the perspective of the hospital but also from the perspective of the patient because the patient can receive the treatment they need at the right time if triage works well (Senior_FGI5, Participant 15).

Traffic light in the emergency department that helps resolve chaos

Most participants compared the triage process to "traffic control" or a "traffic light." In this regard, triage helps workers determine the proper order of treatment while resolving any chaos due to situations when the ED is overcrowded with patients. In the ED context, triage works as a signal for separating patients based on those who must quickly be admitted to the resuscitation room and those who can wait for medical staff. Treatment is thus administered through consistent rules. The participants said that anyone in the ED sees the necessity of triage. It is particularly necessary in complicated and crowded situations.

> I think I need triage in the ED because many patients visit the emergency room, sometimes 90 to 100 patients come. Since our medical staff cannot see all the patients in order with the same energy, I think that to resolve the congestion, patients who need to be given more attention and those who do not, depending on the patient's triage result, should be distinguished (Junior_FGI1, Nurse 1).

Table 3 *Themes and Subthemes Derived from the Emergency Nurses' Experience and Theme Frequencies of Junior and Senior Focus Groups.*

Theme	Subtheme	Frequencies		
		Junior focus group (n = 2)	Senior focus group (n = 4)	Total focus group (N = 6)
Awareness about the necessity of triage	• Effective system to find and treat urgent patients	2	9	11
	• Traffic light in the ED that helps resolve chaos	6	5	11
Facilitators to triage process	• Personal competence among nurses	7	49	56
	• Triage training programs for junior nurses	5	18	23
	• Firm determination - from the ED leader		15	15
Barriers to triage process	• Ambiguities in the KTAS algorithm	15	52	67
	• Lack of awareness about the function and necessity of triage	4	34	38
	• Inadequate triage nurse staffing and triage space in the ED	11	50	61
	• Lack of staged educational programs for enhancing triage competence	7	19	26
Suggestions for the establishment and development of triage	• Necessity of various forms of education	10	38	48
	• Periodic update of KTAS algorithm	2	24	26
	• Appropriate administrative support and compensation	1	39	40

Note. ED = emergency department; KTAS = Korean Triage and Acuity Scale.

> The reason that I think we need triage in the ED is that, if we think about the problem of not having triage .... The ED can be very chaotic, and there can be many problems if critical patients and noncritical patients are mixed together. It is easy to think of it like traffic control (Senior_FGI6, Participant 19).

Theme 2: Facilitators to triage process

Personal competence among nurses

The most important facilitator of an efficient triage was personal competence among the nurses. The role of a triage nurse was adopted by veteran shift nurses at each medical institution. The triage nurse plays important roles, both in determining the order of care for ED patients and allocating medical resources. As such, the job is typically filled by veteran nurses with sufficient ED experience and who are well acquainted with local medical resources and hospital systems, meaning they are able to provide proper explanations to patients and their caregivers.

To perform the role of a triage nurse properly, participants said that it was first necessary to obtain basic education on a variety of physical conditions, physiologies, and medicines. They also needed to develop their own intuition through sufficient experience. Furthermore, triage nurses must be skilled enough to find key points in ambiguous complaints, particularly during conversations with the patients themselves. Participants said that triage nurses should also be able to quickly examine health histories via electronic medical records (EMRs), and must complete medical records by quickly typing in both English and Korean.

> Triage is performed by the nurse with the most experience in the shift. So, most of the time it is done by nurses with almost 10 years of experience (Junior_FGI1, Participant 2).

> After calling the patient, you should be able to quickly review their history while the patient enters the triage room. I have to start (history taking) after I know about the patient. (…) Fast typing in Korean and English is important (FGI 5, Nurse 15).

Triage training program for junior nurses

Participants said that junior nurses benefited greatly from the process of giving cases and finding answers through discussions in the educational program run by the KTAS committee. Some of the participants who were triage educators created similar cases based on the KTAS committee's educational contents. These were used to educate emergency nurses on making appropriate decisions. Participants also said that comparing their own KTAS ratings with those of other KTAS officers helped with continuous education.

Triage-related content was offered through the educational programs for emergency nurses at some medical institutions. Junior participants were, thus, able to prepare themselves before becoming triage nurses. That is, they were able to establish a proper concept of the job through the triage component of the educational program, which also allowed them to ask senior nurses about the KTAS classifications. Some medical institutions tried to reduce instances of mistriage. For example, an initial training period would be set, in which a new officer would receive one-on-one practical instruction while working with a senior nurse.

> That program was very useful… During KTAS training… That is how I trained my juniors. I would make up situations (…) and about four people would perform KTAS together on the same scenario to look at the consistency… I still use this program (Senior_FGI 5, Nurse14).

When I started (triage) with KTAS, a senior watched over me and told me I have to do this and that. I did that in the beginning and, afterward, they would only (tell me) if I did something wrong ((Junior_FGI4, Participant 11).

Firm determination from the emergency department leader

Participants said it was important for the ED leader to exhibit firm determination in the context of triage. They indicated that the effectiveness of triage was dependent on whether the ED leader expressed continual interest in the overall process and made efforts to ensure that patient classifications were functional using the KTAS. They also said that these ED leaders were interested in staffing their shifts so that triage nurses could work properly, which entailed giving them authority to over the triage process.

KTAS became completely settled... because Director B came to the ED... All the things that were not good before disappeared or improved... because he provided feedback about KTAS classifications and respected the triage nurse's decision. Therefore, other staff members followed... I think feedback and attitude are really important (Senior_FGI6, Nurse 18).

Theme 3: Barriers to triage process

Ambiguities in the KTAS algorithm

Participants said that ambiguities in the KTAS created barriers. In fact, all the participants complained that the KTAS classifications for "urgency" did not always reflect reality. Some participants said that it was difficult to provide classifications based on patients' chief complaints because there was no KTAS track they thought was appropriate. Indeed, some of the proficient nurses said that the KTAS placed internal diseases at a higher urgency level than trauma. Furthermore, triage nurses said that the KTAS classifications were higher than expected for pain.

I think there are times when the KTAS contents are ambiguous. I think that it does not exactly point the patient's symptoms... (Junior_FGI1, Nurse 1).

I think... It seems to be talked about as a problem with KTAS... I think there is definitely a gap between trauma and non-trauma. Same pain... for example, when two people with abdominal pain and fractures visit the ED, the KTAS level for abdominal pain is higher than that for trauma... (Senior_FGI5, Nurse 14).

Lack of awareness about the function and necessity of triage

Among the many patients who visit the ED for urgent reasons, those who lack an understanding of the triage process are sometimes displeased. Some become angry when they cannot immediately see a doctor, especially when individuals who entered the ED after they did are treated first. By contrast, some patients enter the ED with what they or their caregivers believe is a very minor symptom but are still classified as urgent patients through the triage process. In these cases, patients may indicate they do not trust the medical staff and/or show uncooperative attitudes. This was considered a barrier to triage.

In principle, the triage process is classified based on KTAS standards. However, these classifications sometimes have inadequate consequences due to medical staff lacking awareness about the function and necessity of triage. Nonurgent patients are charged an emergency fee, meaning their out-of-pocket payments increase. Some participants said they intentionally increased the patients' priority to avoid patient complaints about the increased medical costs as a triage result. Moreover, they would sometimes alter the results of the triage process to reflect the doctor's request when there were discrepancies between their assessments and KTAS standards.

While I am performing triage, the patients pop in, cursing and yelling, "Why don't you see us in order?" or "Why don't you see me more quickly? Why is this process necessary?" They use disrespectful language, curse, get angry, and even if they do not come in (the triage room), they talk very loudly outside and rush things (Senior_FGI 6, Nurse 19).

A baby came in with a fever before he was one year old. He should have been rated at level 4 according to the pediatric fever standards. However, the professor saw him and said, "This baby is young, so please raise the KTAS. Please raise it to level 3 or higher." Therefore, I did (Senior_FGI3, Participant 8).

Inadequate triage nurse staffing and triage space in the emergency department

Although medical institutions perceive triage as an absolutely necessary component of the ED, the participants reported that the administrative support and staffing for this process was not sufficient. For example, only one triage nurse is employed for each shift, regardless of how many patients visit the ED. Triage nurses felt pressure because they must handle their jobs alone while on duty. This distinguishes them from other emergency nurses, who are able to work together while giving and receiving help. In this regard, the ED emergency nurses said they are often so inundated with work that they do not have time to visit the bathroom and experience constant pressure when attempting to have their meals. This creates an extremely difficult work environment. Very few nurses can fill this position. This often makes it difficult to perform triage correctly, especially during heavy task loads or overcrowding. Additional staffing is the most crucial area of need when ED crowding is severe. However, hospital managers often set hard limits on the number of workers, and would instruct the nurses to make their own adjustments within the emergency nurse workforce because it did not directly help with billing. Participants also said that an effective triage process was ensured by establishing independent spaces in consideration of patient flow. However, they were often not provided with the practical support needed to perform triage, particularly concerning space and staffing.

While the triage nurse worked 8 hours, or more than 9 hours for night shifts, at least 30 minutes to go to the bathroom, drink water, and eat food should be guaranteed... But there is nobody who can fill this position (FGI6, Participant 17).

There are limitations in the system, so we have to invest in the system and, of course, staffing to overcome these limitations. They do not provide support, but they keep telling us to show positive effects, so it is all stressful (FGI5, Nurse 14).

Lack of staged educational programs for enhancing triage competence

Triage competence entails accuracy and rapidity based on experience and knowledge. However, triage education only focuses on beginners. Triage nurses must therefore work alone when confronting difficulties with the classification process that arise due to ambiguities in the KTAS. This was considered a barrier to the efficient application of triage. In particular, nurses with more than four years of emergency experience felt that it was necessary to receive systematic education designed to enhance competence, but had no way of fulfilling this need. They instead asked senior nurses

for answers or simply continued to perform triage despite many related frustrations.

The education that informs cases frequently seen in the ED and various pain-related cases...I think, this education is needed (Junior_FGI1, Nurse 1).

As you work as a triage nurse, there is very little chance of getting an education like a beginner. I still want to learn more, so I hope I can spend some time with professionals and people who know the latest updates (Senior_FGI6, Nurse 19).

There are some people who are (performing triage) for the first time, but some people like me have done it a lot. People who have a lot of experience get similarly ambiguous (triage) cases. I would like it if these ambiguous cases were summarized and guidelines like "In this case, do triage this way" were reflected a bit more in the education (FGI3, Nurse 9).

Theme 4: Suggestions for the establishment and development of triage

Necessity of various forms of education

Participants said that formal education should be established to develop triage competence. They also expected specific programs for senior or junior nurses. This was believed to be a good way to gradually enhance triage competence. Participants suggested that appropriate training content should be offered for junior nurses to introduce them to the concept of triage and the KTAS guidelines, as well as provide them triage experience based on various practical cases. For senior nurses, they suggested a method of approaching solutions through discussion, with a particular focus on ambiguous cases. Most participants said that simple lectures were insufficient for triage education, instead suggesting that an app or Internet-based program that was not constrained by time or place would be better than a one-time gathering, especially considering the nature of nursing work. They also said that this type of education should be designed to strengthen motivation, and that education would have a more substantial effect if two-way communication were possible.

I think it would be nice to get triage education with an app or something like that. New nurses like me can study alone whenever they need it, perform triages, and score themselves...(Junior_FGI4, Nurse12).

If I have to log on to the computer and type my password on the website, it is too complicated and I would have to sit down to watch, right? Then, I would end up not watching it, so I wish there was an easy way to watch it. Not just in the hospital, but I could think to myself, "I'm going to work today. Should I watch it for about 10 minutes before I go to use KTAS?" I wish there was a mobile application that I could use... that I could watch on the bus... (Senior_FGI2, Nurses 4, 5, 6).

I would rather have a video that shows the patient's complaint, the level they are assigned, and the reasons for it. I think it would be nice to do something like watching a video and clicking on it (Senior_FGI6, Nurse 20).

Periodic update of KTAS algorithm

In order for KTAS to operate effectively, participants in the senior groups stated the need for a stabilization process that could consistently supplement current problems. They said this should involve manuals to help ED staff understand the KTAS more easily as well as regular updates. The KTAS should help reduce chaos in the ED rather than simply working as an administrative patient classification scale.

I hope that the KTAS algorism will be made clearer. It seems like an old standard. Some things do not fit the situation right now (Junior_FGI1, Nurse2).

I do not know why they do not make revisions when they publish so many papers or statistics about KTAS. I looked up some papers... Now that we have gathered that much data, I think it is time for a revision. However, they are not revising it and I feel a little... (Senior_FGI5, Nurse 14).

Appropriate administrative support and compensation

Participants said that practical administrative support would help prevent triage from becoming a process in name only. They also said that effective triage requires efficient staffing and an independent triage room. Furthermore, because only competent emergency nurses should play the role of KTAS officer, they suggested that KTAS could be more stably operated by offering these individuals additional monetary or status-based compensation.

There should be a space for triage, sufficient staffing, and the nurse should also be competent... (Senior_ FGI2, Nurse 4).

When nurses are tasked with triage, they are not promoted, but they tell each other that they "got a promotion," While in fact, they had not. Because the salary is the same... and the position and pay grade remain the same... (Senior_ FGI6, Nurse 17).

Discussion

This is a qualitative study exploring the experiences of emergency nurses in charge of the triage process in Korea, and attempting to view the reality and future directions of this process from the perspective of the practitioners. Through FGIs and qualitative content analysis, the results were derived with three themes for the awareness, facilitators, and barriers of the triage process in Korea, and one theme for the future development direction.

All participants stated that triage was a necessary process for efficient medical treatment in the ED and patient safety. Currently, the triage process, which forms part of almost all EDs globally, began in the early 1800s when wounded soldiers in the war of that era had to be moved to safety and treated according to the urgency of their injuries, and was introduced in US EDs after the 1950s as a way to resolve overcrowding [26]. The triage process was first introduced in Korean EDs in the mid-1990s [27], and is currently being performed using the KTAS, a newly developed algorithm [5]. Today, KTAS is still being used in the triage process in EDs nationwide, and this process is becoming increasingly essential in emergency medical systems for patient safety [5]. Previous studies have reported that most medical staffs agree on the need for a triage process in the ED and state that practitioners' eligibility should be further strengthened, requiring competent nurses to perform triage tasks [11,12,26,28]. ENA emphasizes that because triage is an important decision-making process that affects patient safety, registered nurses who have completed a triage-specific education must perform the triage task [1,11]. In Korea, a medical staff member who has acquired a KTAS provider certificate can perform the triage process [29], and the requirements for performing triage considering the global trend trends may be further strengthened in the future. Most triage tasks are performed by emergency room nurses, so the emergency nurse should recognize the necessity and perform the role with responsibility [11,12].

Through qualitative content analysis, it was found that the competence of emergency nurses in the triage process was a

major facilitator. On the other hand, it can be said that the differences in the nurses' competence may act as a barrier to the triage process. Hitchcock [8] reported that differences in knowledge, education level, and experience lead to varying levels of competence among the triage nurses, which may result in triage errors. In a study on the factors that affect triage implementation, the difference in nurses' competence resulting from differences in knowledge, skills, and insight is considered a barrier, and education, including official training, certification, and testing of knowledge is being proposed as a strategic way to solve this problem [9]. In this study, both junior and senior nurses reported to have attempted to improve their own abilities through education and experience. In particular, through the interviews of the junior group in this study, it was possible to confirm how beginners who want to start triage task adapt to the triage process. Such efforts to enhance personal capacity can lead to facilitators of triage process. The ENA in the United States and NENA in Canada also emphasize that triage competence can be improved through education targeted at various diseases, physical assessment skills, and the critical thinking needed to make accurate clinical judgments [11,12,30]. Therefore, competency-based systematic education will be needed to reduce the competency gap of emergency nurses and develop the triage process.

In this study, triage education was identified as a facilitator, barrier, and a suggestion for future development. Regarding the content of triage education, participants revealed different needs depending on their level of experience. In this study, the junior nurses group said they wished to learn more about the concept of triage, KTAS algorithm, and standardized cases. ENA has already stated the need for not only various qualification requirements including advanced cardiac life support certifications but also triage-specific educational programs [11,12]. Indeed, ENA provides individual educational content for triage nursing, including instructions for dealing with adult and pediatric patients, while the CTAS education program consists of information on its general concept, the process of application, the role of the triage nurse, case studies, and online educational discussions [31,32]. In Korea, nurses must complete 4.5 hours of regular education hosted by the KTAS committee. They must also pass both the pre- and posttests for triage qualification [29]. Here, training content is similar to the CTAS program, in that the text defines triage, provides details on related procedures, and offers a conversational description of a patient visit in which nurses give a KTAS classification [29]. In previous studies, educational programs were mainly comprised of content requested by junior nurses. In this study, emergency nurses who were rated as senior nurses stated the need for continued education to understand KTAS updates and ambiguous cases. Further, triage requires continual education rather than one-time learning. For this reason, quality improvements are ensured for emergency nurses when institutions offer various triage programs that are tailored to the specific educational needs of senior nurses in the form of certification renewals and/or supplemental education.

Participants offered a variety of opinions about educational designs and methods. Participants preferred two-way discussions and repetitive and convenient learning methods rather than one-time group training conducted only with lectures. The junior nurses said that it was useful to perform triage using KTAS on real patients and receive 1:1 feedback from seniors. In terms of training implementation, there are some points need to be considered. The method of practicing triage on actual ED patients was thought to pose safety risks, especially when triage nurses were not fully qualified. In addition, 1:1 training with on-site preceptors may be less harmful in terms of patient safety, but this is only possible in small groups, meaning that efficiency may ultimately be reduced when considering the time and costs of training. Therefore, a method using simulation or various content is preferred over real field education [33]. Among the alternatives proposed in this study, a more realistic and effective method may be to utilize various content forms to increase experience through repeat learning. A variety of new elements and methods have recently been implemented to enhance triage education, including video clips and podcasts [7,32]. Reports have shown that these factors improve decision-making in the triage context [7]. In line with the rapid development of indirect and remote education technologies, it may also be useful to establish a triage-specific educational program that implements various forms of content through information and communication technology.

Nurse competency and education programs are primarily focused on the triage accuracy. The goal of the educational program is to learn the KTAS algorithm to prevent triage errors and to help make accurate decisions [34]. However, in the triage process, speed is just as important as accuracy. In this study, participants provided practical opinions, not only concerning accurate decision-making but also about the need for quick processing during tasks such as searching for EMR and typing. These triage facilitators were extracted based on the direct experiences of triage nurses. While previous studies on this issue have solely focused on accurate decision-making, this study also revealed practical ways to improve triage from a more realistic perspective. Therefore, when developing a triage training program, it should include content focused on improving practical work speed along with training for accurate decision-making.

In this study, the lack of awareness of patients and medical staff about the necessity and function of triage served as a barrier to the triage process. Doctors' lack of awareness about the necessity of triage, along with friction between nurses and patients have been reported as barriers to the triage process [9,13,14]. In general, most patients visit the emergency room because they feel that their condition is urgent, so they expect to be treated first on arrival. Therefore, for the smooth running of the triage function, resolving the discrepancy and friction between emergency nurses and patient should be prioritized. To reduce the stress and burnout experienced by emergency nurses due to such friction, it is necessary to spread awareness that the "first come, first served" rule does not apply in the ED. The methods for improving cooperation among medical staff include the involvement of doctors in the implementation phase, organization of special meetings, and the education of doctors of other disciplines about triage by ED-doctors [9]. This will help medical staff to recognize the importance of the triage process, respect each other's opinions, and spread a culture of cooperation.

In this study, the perspective of the medical institution was extracted to highlight facilitators and barriers to the smooth operation of the triage function in EDs. In this regard, facilitators include the ED leader's determination to improve the system. In situations of overcrowding in the ED and insufficient interest/support from the leaders or hospital management, many nurses experience burnout due to heavy workloads, with some eventually considering triage a burden. This constitutes an important barrier. Emergency nurses are known to experience burnout in high-stress environments [13]. This is very important, as reports have shown that burnout can severely impact patient safety [15,16]. To prevent burnout, hospitals should provide additional nurse staff. A previous

study examined how emergency nurses were staffed by analyzing routine jobs, thus finding many barriers to triage, including overcrowding, pressures related to mistriage, and the urgent need to identify patients with limited time; triage nurses said their experiences in this special position were not sufficiently reflected [35]. Further research into these nurse staffing issues should provide evidence to help establish appropriate workforce numbers from the perspective of hospital executives. Future studies should therefore research how effective staffing for emergency nursing is accomplished, particularly focusing on the special stress and pressures that triage nurses experience. This study's findings clearly show that institutions should have standards to ensure proper staffing. Further, appropriate compensation should be given to triage nurses, as these individuals are tasked with making important decisions about patient safety under high stress.

In this study, factors related to the KTAS algorithm were reported as triage barriers. Specifically, participants said that the scale was both complicated and ambiguous, and that updates were needed to reflect the actual needs of front-line workers. Various studies have investigated the development and application of the KTAS, particularly regarding how mistriage results are reported in relation to pain standards, and most especially regarding the revision of the triage scale [6]. In this study, participants discussed cases in which the patient's chief complaints were not reflected by symptoms listed in the KTAS. They also related experiences in which mistriage was related to pain. The ambiguities and complexities reported as triage barriers may be reduced when these findings are accumulated and reflected in KTAS updates.

Despite these informative findings, there may be limitations to their generalizability because only facilitators and barriers to triage were identified based on the experiences of emergency nurses in Korea who used the KTAS. However, these limitations are difficult to avoid since any emergency medical system will reflect unique national characteristics. It is still possible to conduct in-depth comparisons with results from studies in countries that have developed and applied similar triage scales. As the KTAS was developed based on the CTAS model, it should particularly be possible to compare this study's findings with research findings from several Asian countries that use similar triage scales, including the TTAS in Taiwan and Japanese triage and acuity scale, which was also developed based on the CTAS.

Conclusions

To ensure effective triage, professionals must first understand the realities of the triage process, particularly from the perspectives of nurses, who are the main decision-makers. In this study, various vulnerabilities of the triage process were identified, and solutions were suggested from the perspective of emergency nurses. Educational, staffing, financial support, and periodic updates of the KTAS will help advance the triage process in the future. The findings will be useful both in developing various effective educational programs and KTAS renewal and establishment policies on triage process.

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Conflict of interest

The authors declare that they have no conflict of interest.

References

1. Emergency Nurses Association (ENA). Emergency severity index implementation handbook [Internet]. Schaumburg (IL): Emergency Nurses Association; 2020 [cited 2020 Jun 1]. Available from: https://www.ena.org/docs/default-source/education-document-library/esi-implementation-handbook-2020.pdf?sfvrsn=fdc327df_2
2. Rowe BH, Guo X, Villa-Roel C, Schull M, Holroyd B, Bullard M, et al. The role of triage liaison physicians on mitigating overcrowding in emergency departments: a systematic review. Acad Emerg Med. 2011;18(2):111—20. https://doi.org/10.1111/j.1553-2712.2010.00984.x
3. Evans C, Hughes C, Ferguson J. Improving patient safety through the introduction of a formal triage process. Emerg Nurse. 2017;24(9):19—25. https://doi.org/10.7748/en.2017.e1647
4. Kuriyama A, Urushidani S, Nakayama T. Five-level emergency triage systems: variation in assessment of validity. Emerg Med J. 2017;34(11):703—10. https://doi.org/10.1136/emermed-2016-206295
5. Park J, Lim T. Korean triage and acuity scale (KTAS). J Korean Soc Emerg Med. 2017;28(6):547—51. Korean.
6. Moon SH, Shim JL, Park KS, Park CS. Triage accuracy and causes of mistriage using the Korean Triage and Acuity Scale. PLos One. 2019;14(9):e0216972. https://doi.org/10.1371/journal.pone.0216972
7. Kim HJ, Kang HY. Effects of a web-based Korean triage and acuity scale learning program on triage self-efficacy and triage performance ability for nurses in emergency department. J Korean Acad Nurs. 2019;49(2):171—80. https://doi.org/10.4040/jkan.2019.49.2.171. Korean.
8. Hitchcock M, Gillespie B, Crilly J, Chaboyer W. Triage: an investigation of the process and potential vulnerabilities. J Adv Nurs. 2014;70(7):1532—41. https://doi.org/10.1111/jan.12304
9. Janssen MA, van Achterberg T, Adriaansen MJ, Kampshoff CS, Schalk DM, Mintjes-de Groot J. Factors influencing the implementation of the guideline triage in emergency departments: a qualitative study. J Clin Nurs. 2012;21(3-4):437—47. https://doi.org/10.1111/j.1365-2702.2011.03921.x
10. Ebrahimi M, Mirhaghi A, Mazlom R, Heydari A, Nassehi A, Jafari M. The role descriptions of triage nurse in emergency department: a Delphi study. Scientifica. 2016;2016. https://doi.org/10.1155/2016/5269815
11. Emergency Nurses Association (ENA). Emergency nursing core curriculum. 7th ed. Elsevier Saunders; 2018. p. 1-768.
12. The National Emergency Nurses Association (NENA). Role of the triage nurse [Internet]. Chilliwack (BC): National Emergency Nurses Association; 2019 [cited 2020 Jun 20]. Available from: https://nena.ca/w/wp-content/uploads/2014/11/Role-of-the-Triage-Nurse-2.pdf
13. Reay G, Smith-MacDonald L, Then KL, Hall M, Rankin JA. Triage emergency nurse decision-making: incidental findings from a focus group study. Int Emerg Nurs. 2020;48:100791. https://doi.org/10.1016/j.ienj.2019.100791
14. Wolf LA, Delao AM, Perhats C, Moon MD, Zavotsky KE. Triaging the emergency department, not the patient: United States emergency nurses' experience of the triage process. J Emerg Nurs. 2018;44(3):258—66. https://doi.org/10.1016/j.jen.2017.06.010
15. Rozo JA, Olson DM, Thu H, Stutzman SE. Situational factors associated with burnout among emergency department nurses. Workplace Health Saf. 2017;65(6):262—5. https://doi.org/10.1177/2165079917705669
16. Genly B. Safety and job burnout: understanding complex contributing factors. Prof Saf. 2016;61(10):45—9.
17. Krueger RA, Casey MA. Focus groups: a practical guide for applied research. 4th ed. Thousand Oaks, CA: Sage Publications, Inc. 2009. p. 63—81.
18. Jang KS. A study on establishment of clinical career development model of nurses [dissertation]. Seoul: Yonsei University; 2000. p. 1—201.
19. Elo S, Kyngäs H. The qualitative content analysis process. J Adv Nurs. 2008;62(1):107—15. https://doi.org/10.1111/j.1365-2648.2007.04569.x
20. Mayring P. Qualitative content analysis. Forum Qual Soc Res. 2000;1(2):20. https://doi.org/10.17169/fqs-1.2.1089
21. Son HM. Understanding and application of qualitative content analysis. J Korean Assoc Qual Res. 2017;3:56—63. Korean.
22. Hsieh H-F, Shannon SE. Three approaches to qualitative content analysis. Qual Health Res. 2005;15(9):1277—88. https://doi.org/10.1177/1049732305276687
23. Morse JM, Field PA. Nursing research: the application of qualitative approaches. 2nd ed. Cheltenham: Nelson Thornes; 1995. p. 103—39.
24. Sandelowski M. The problem of rigor in qualitative research. ANS Adv Nurs Sci. 1986;8(3):27—37. https://doi.org/10.1097/00012272-198604000-00005
25. Guba EG, Lincoln YS. Effective evaluation. San Francisco, CA: Jossey-Bass; 1981. p. 1—423.
26. Edwards TA. Art of triage. New York: Nova Science Publishers; 2014. p. 1—86.
27. Jung KY, Shin JS, Kim HS, Lee SJ. Pediatric triage in emergency department. J Korean Soc Emerg Med. 1994;5(2):347—55.
28. Mistry B, Balhara KS, Hinson JS, Anton X, Othman IY, E'nouz MAL, et al. Nursing perceptions of the emergency severity index as a triage tool in the United Arab Emirates: a qualitative analysis. J Emerg Nurs. 2018;44(4):360—7. https://doi.org/10.1016/j.jen.2017.10.012
29. Korean Triage and Acuity Scale(KTAS) Committee. KTAS Curriculum Introduction [Internet]. Seoul: The Korean Society of Emergency Medicine KTAS Committee; 2020 [cited 2020 Jun 20]. Available from: http://www.ktas.org/education/info.php
30. Chang W, Liu H-E, Goopy S, Chen L-C, Chen H-J, Han C-Y. Using the five-level taiwan triage and acuity scale computerized system: factors in decision

making by emergency department triage nurses. Clin Nurs Res. 2017;26(5): 651−66. https://doi.org/10.1177/1054773816636360

31. Atack L, Rankin J, Then K. Effectiveness of a 6-week online course in the Canadian Triage and Acuity Scale for emergency nurses. J Emerg Nurs. 2005;31(5):436−41. https://doi.org/10.1016/j.jen.2005.07.005

32. Emergency Nurses Association (ENA). Emergency nurses association acquires ESI triage program schaumburg [cited 2020 Jun 1]. Available from: https://www.ena.org/press-room/2019/10/23/emergency-nurses-association-acquires-esi-triage-program.

33. Recznik CT, Simko LM. Pediatric triage education: an integrative literature review. J Emerg Nurs. 2018;44(6):605−13.e9. https://doi.org/10.1016/j.jen.2018.01.003

34. Korean Triage and Acuity Scale committee. Korean triage and acuity scale manual. Paju: Koonja; 2017. p. 1−83.

35. Gräff I, Goldschmidt B, Glien P, Klockner S, Erdfelder F, Schiefer JL, et al. Nurse staffing calculation in the emergency department-performance-oriented calculation based on the Manchester Triage System at the University Hospital Bonn. PLos One. 2016;11(5):e0154344. https://doi.org/10.1371/journal.pone.0154344

Research Article

Incidence and Risk Factors of Cardio-Cerebrovascular Disease in Korean Menopausal Women: A Retrospective Observational Study using the Korean Genome and Epidemiology Study data

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S U M M A R Y

Purpose: Cardio-cerebrovascular diseases constitute the most common and fatal disease among menopausal women. However, the risk of cardio-cerebrovascular diseases in menopausal women compared to men has been underestimated, with insufficient related studies. Therefore, we examined the incidence and risk factors of cardio-cerebrovascular diseases among Korean menopausal women.
Methods: A retrospective observational study design with secondary analysis was conducted using data from the Korean Genome and Epidemiology Study survey. We used the study's data of 1,197 menopausal women, aged 40–64 years, who did not have cardio-cerebrovascular diseases at baseline and their related data from the biennial follow-ups over 14 years. Cardio-cerebrovascular diseases were defined as hypertension, coronary artery disease, or stroke. The incidence of cardio-cerebrovascular diseases was calculated per person-years, and multivariate Cox proportional hazards models were used to determine the predictors of cardio-cerebrovascular diseases during the follow-up period.
Results: Of the 1,197 cases, 264 were early or surgical menopausal women. The overall incidence of cardio-cerebrovascular diseases was 18.75 per 1,000 person-years. Early or surgical menopause (HR = 4.32, $p < .001$), along with family history of cardiovascular disease (HR = 1.87, $p = .024$), elevated blood pressure (HR = 1.79, $p < .001$), abdominal obesity (HR = 1.37, $p = .046$), or duration of menopause at the same age (HR = 1.01, $p = .001$), were strong predictors of cardio-cerebrovascular diseases.
Conclusion: Based on the results of this study, it is necessary to identify and closely monitor women with early or surgical menopause for cardiovascular and cerebrovascular diseases prevention. Also, prevention of cardio-cerebrovascular diseases through blood pressure and abdominal obesity management is vital for menopausal women.

Introduction

Cardio-cerebrovascular diseases, including cardiovascular and cerebrovascular diseases [1], are the leading cause of death for women worldwide, especially after the age of 40 years, increasing their mortality rate to exceed that of men in their 60s [2,3]. This tendency is caused by a decrease in estrogen levels after menopause, which worsens the functions of vascular endothelial cells, vascular responsiveness, and blood lipids, thereby accelerating the body mass index (BMI), fasting blood sugar, blood pressure (BP), and dyslipidemia [2,3]. Nonetheless, it has been reported that women underestimate the risk of cardio-cerebrovascular diseases due to low awareness and minimal engagement with preventive health practices [4]. Therefore, screening and prevention of cardio-cerebrovascular diseases are necessary for middle-aged women before and after menopause.

Furthermore, early menopause, in which a woman's menstruation stops before the age of 45 [5], and surgical menopause, due to removal of both ovaries before natural menopause [6,7], are hypothesized to be detrimental for cardiovascular health because of the early cessation of the protective effect of endogenous estrogen. Consequently, prolonged duration since the onset of menopause could result in a greater risk of cardio-cerebrovascular diseases [8]. The two-fold increase of cardio-cerebrovascular diseases risk in

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women below the age of 60 years who have experienced early menopause is troubling and necessitates advocacy, especially in the case of younger women. However, although postmenopausal women face more risks of developing various chronic diseases and require special attention and management [3,8], studies regarding the incidence of cardio-cerebrovascular diseases after menopause are limited. Also, the risk of cardio-cerebrovascular diseases in women is being ignored, with a common misconception among health professionals and the general public that cardio-cerebrovascular diseases predominantly affect men [4].

The topics predominantly explored encompass cross-sectional prevalence rates or risk assessment for individual chronic diseases [9] and research on acute health problems, such as hot flashes and depression [10,11]. Although women experiencing early or surgical menopause are subjected to a greater risk of chronic diseases [12], it is difficult to find a study validating the associated risk factors or differences with women undergoing natural menopause. Moreover, age at menopause is a significant factor for classifying menopausal types, such as early menopause and natural menopause. Interestingly, there are only a few studies on how age at menopause determines the risk factors and incidences of chronic diseases, although such issues are directly related to women's health.

Therefore, we aimed to identify the incidence of cardio-cerebrovascular diseases in Korean menopausal women and the factors affecting the incidence of cardio-cerebrovascular diseases. A large-scale cohort analysis is ideal for identifying incidences and risk factors for health problems by menopausal type because the incidence of early menopausal women in Korea, derived from national cohort data, is estimated at approximately 7%, which

includes artificial menopause [13,14]. Accordingly, this study used the Korean Genome and Epidemiology Study (KoGES) data, a large cohort study of the Korean general population, to evaluate the incidence and risk factors of cardio-cerebrovascular diseases in menopausal women.

Methods

Study design and population

This study involved a retrospective observational study design with secondary analysis using the national cohort data drawn from the KoGES. Details of the KoGES and the methods used have been comprehensively explored [15]. The KoGES Ansan and Ansung study, a large population-based study, recruited 10,030 Korean adults aged 40–69 at baseline from 2001 to 2002. The survey consisted of sociodemographic, lifestyle, and health questionnaires, a dietary interview, and anthropometric and clinical measurements. Follow-up surveys, from baseline, were conducted a further seven times biennially; thus, eight datasets were analyzed. To determine the development of cardio-cerebrovascular diseases in menopausal women during the 14-year data period, we excluded the following participants based on the baseline dataset: (1) those aged 65–69 years during the baseline survey (n = 1,313); (2) men (n = 4,165); (3) those with incomplete data at baseline (n = 684); (4) those with a history of hypertension, coronary artery disease (CAD), or stroke at baseline (n = 1,055); (5) those with history and/or treatment of cancer (n = 10); and (6) those still menstruating (n = 1,606). Finally, 1,197 participants were included in this study (Figure 1).


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┌─────────────────────────────────┐
│   KoGES Ansung-Ansan cohort study│
│      at baseline (n=10,030)      │
└─────────────────────────────────┘
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Person aged 65 – 69 years at baseline (n=1,313)
Men (n=4,165)
Persons with incomplete data at baseline (n=684)
Persons with hypertension, coronary artery diseases, or
        stroke at baseline (n=1,055)
Persons with history and/or treatment of cancer (n=10)
Persons who have still menstruation (n=1,606)

Included in this study
(n=1,197)

Natural menopause (n=933)

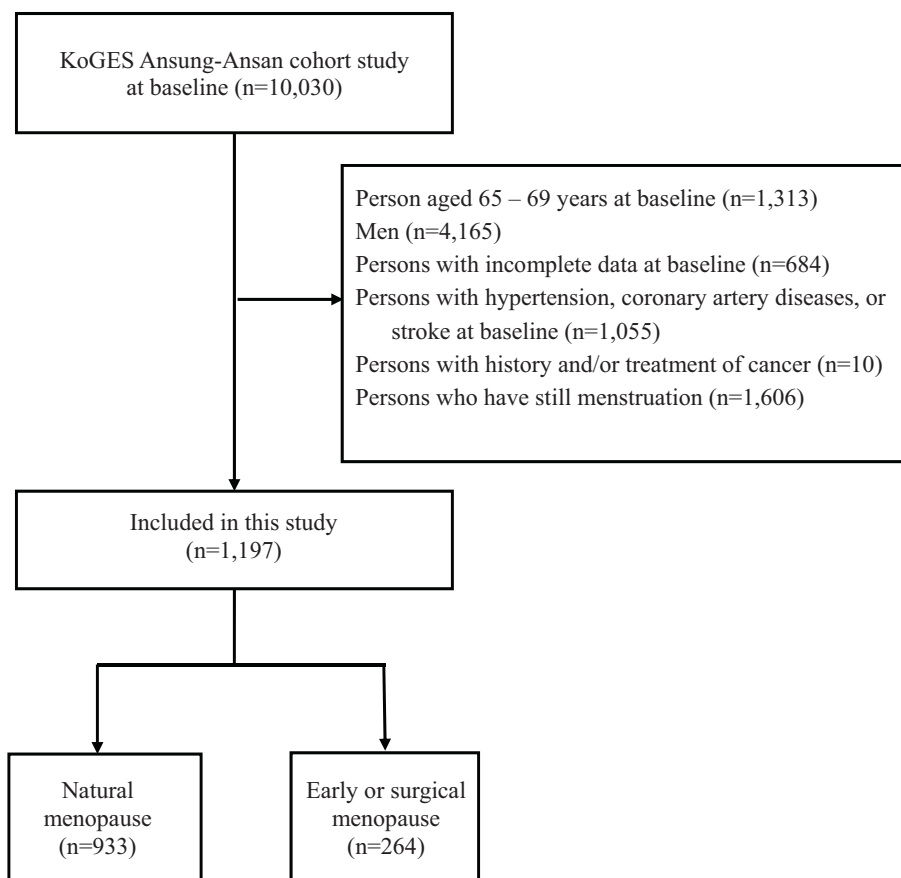Early or surgical menopause (n=264)

Figure 1. Flow chart of this study.

Measurement

The KoGES data were measured by trained interviewers using a questionnaire that included participants' sociodemographic information, lifestyle (i.e., smoking and drinking), perceived health status, medical information (i.e., personal and family medical history; the current status of disease treatment), and reproductive information (i.e., menopausal status and age at menopause). Anthropometric parameters (i.e., weight, height, and waist circumference) and BP were measured by a trained interviewer using standard methods. Blood samples were collected after at least 8 hours of fasting to measure lipid profiles, including total cholesterol, high-density lipoprotein cholesterol, and triglyceride levels; low-density lipoprotein (LDL) cholesterol was calculated [16].

Study variables

Cardio-cerebrovascular diseases

Cardio-cerebrovascular diseases included cardiovascular diseases (e.g., CAD, hypertension, etc.) and cerebrovascular diseases (e.g., cerebral hemorrhage, cerebral thrombosis, etc.) [1]. In this study, the presence of cardio-cerebrovascular diseases was identified in individuals with at least one of the following diseases: hypertension, CAD, or stroke. We established that the disease occurred if the participants answered yes to either of the following questions: (1) Have you been diagnosed with the above diseases by a physician since the last survey? (2) Have you been treated or medicated for the above diseases. The onset time of each disease was the age at which the participant reported the disease being first diagnosed or treated during a 14-year follow-up period.

Risk factors of cardio-cerebrovascular diseases

We identified certain sociodemographic, lifestyle, and health-related factors as risk factors for cardio-cerebrovascular diseases based on previous studies [9,17,18]. The sociodemographic factors included age, education, and monthly income. Age was reported during the baseline survey. Education was divided into three categories: elementary, middle, and above high school levels. Monthly income (Korean won) was divided as follows: low (<1 million), middle (≥1 million and <3 million), and high (≥3 million) levels.

Lifestyle and health-related factors included smoking, drinking, perceived health status, BMI, type of menopause, duration of menopause, family history of cardiovascular diseases, history of diabetes, BP, waist circumference, and LDL. Smoking and drinking were reclassified into the "No" (never and former smoker/drinker) and "Yes" (current smoker/drinker) groups. Perceived health status was reclassified into three categories (healthy, usual, and unhealthy) from a five-point Likert scale (*very healthy* to *very unhealthy*). BMI was categorized as normal (<23 kg/m^2) and overweight (≥23 kg/m^2) based on Korean population classification [19].

Menopause is classified into two types: natural and early or surgical. Based on the menopause guidelines [5,20], natural menopause is menopause in women over 45 years old who naturally experienced no periods for at least 12 months and had not been using hormonal contraception [20]. Therefore, we defined natural menopause as the menopausal state, which is not the consequence of medical treatment, hysterectomy, or bilateral oophorectomy in women over 45 years old. The standard age was set at 45 years because early menopause is defined as menopause onset at younger than 45 years old [5,20]. Early menopause was defined as the onset before the age of 45 due to occurring primary ovarian insufficiency or some unknown cause [5]. Surgical menopause was defined as menopause induced by a bilateral oophorectomy or a hysterectomy before the onset of natural menopause

[6,7]. The duration of menopause was defined as the period from the age at onset of menopause to the age at onset of cardio-cerebrovascular diseases.

BP was classified into two categories, namely normal BP (<120/80 mmHg), elevated BP (≥120/80 mmHg) based on the standard reported by the Korean Society of Hypertension [21]. Waist circumference was categorized into normal (<85 cm) and abdominal obesity (≥85 cm) groups [19]. LDL cholesterol was categorized into normal (<130 mg/dL) and high (≥130 mg/dL) groups.

Procedures and statistical analysis

Participants with an onset of cardio-cerebrovascular diseases were integrated as event cases; participants without cardio-cerebrovascular diseases up to the seventh follow-up survey and those without further follow-up data were censored. Descriptive statistics were used to summarize the baseline sociodemographic, lifestyle, and health-related factors. Hazard ratios (HRs) and 95% confidence interval (CI) were estimated to determine the association between risk factors (sociodemographic, lifestyle, and health-related factors) and incidence of cardio-cerebrovascular disease using Cox proportional hazards regression analysis based on the univariate and multivariate model. In the Cox proportional hazards regression analysis, the event was the occurrence of cardio-cerebrovascular diseases. Time-to-event for each patient was estimated from the baseline date to the date of reported diagnosis or treatment of cardio-cerebrovascular diseases, the date when the participant was censored due to withdrawal from the KoGES database (e.g., moving, refusing to participate, or dying), or the last date of follow-up. Before estimating the Cox proportional hazards models, we checked the basic assumption of the proportional hazard model by model fitness test using log minus log survival plot and confirmed that the incidence curve for cardio-cerebrovascular diseases according to risk factors maintains a constant vertical distance [22]. Second, as the duration of menopause was a time-varying covariate, a significance test was performed on the interaction between the covariate and time using the time-dependent Cox regression model [22,23]. After confirming that the proportional hazards assumption was satisfied, we used the Cox proportional hazards models.

In addition, the incidence of cardio-cerebrovascular diseases was calculated per person-years (py). Person-years is a statistic that represents how many new events occurred within the subject group during a specific period. Person-years of cardio-cerebrovascular diseases were calculated from the baseline data to the event development, or until the time of the last available follow-up data. The 14-year incidence of cardio-cerebrovascular diseases was calculated per 1,000 py by dividing the number of individuals who developed cardio-cerebrovascular diseases during follow-up by the total person-time. All analyses were performed using a 95% CI. Data analysis was performed using IBM SPSS Statistics version 25.0 for Windows (SPSS Inc., Chicago, IL, USA). Incidence analyses were performed using R 3.3.1 (R Foundation for Statistical Computing, Vienna, Austria).

Ethical consideration

The study protocol was approved by the Ethics Committee of the Korean Center for Disease Control and the Institutional Review Board of the author's institution (Approval no. AJIRB-SBR-EXP-19-136). The study was performed in accordance with the ethical standards outlined in the Declaration of Helsinki (as revised in Brazil 2013).

Results

Baseline sociodemographic and lifestyle, and health-related factors of participants

The mean age of participants was 54.57 ± 6.15 years. Women perceived as unhealthy accounted for up to 42.3%, and those who were overweight were 69.5% of the total sample. Most of the women did not have a family history of cardiovascular diseases or a history of diabetes. Among the 1197 menopausal women, 264 (22.1%) were categorized under early or surgical menopause, and the mean duration of menopause was 17.31 ± 7.67 years. The mean waist circumference and LDL cholesterol levels were 81.65 (±9.15 cm) and 119.87 (±32.18 mg/dL), respectively, and approximately 60% of the total sample was labeled normal BP, waist circumference, and LDL cholesterol levels (Table 1).

Incidence of cardio-cerebrovascular diseases during the 14-year follow-up

The total follow-up person-years was 12,108 years. Out of 1,197 menopausal women, a total of 227 developed cardio-cerebrovascular diseases. The incidence of cardio-cerebrovascular diseases was 18.75 per 1,000 py. Notably, hypertension had the highest incidence (16.21 per 1000 py) among these individual diseases (Table 2).

Table 1 *Baseline Sociodemographic and Lifestyle and Health-related Factors of Participants (N = 1,197).*

Characteristics	Categories	n (%)	Mean ± Standard Deviation
Age, in years	40–49	266 (18.3)	54.57 ± 6.15
	50–59	613 (42.3)	
	≥60	318 (39.4)	
Education	Elementary	640 (53.5)	
	Middle	267 (22.3)	
	Above high school	290 (24.2)	
Monthly income	High	134 (11.2)	
	Middle	527 (44.0)	
	Low	536 (44.8)	
Smoking	No	1149 (96.0)	
	Yes	48 (4.0)	
Drinking	No	874 (73.0)	
	Yes	323 (27.0)	
Perceived health status	Healthy	312 (26.0)	
	Usual	379 (31.7)	
	Unhealthy	506 (42.3)	
Body mass index, kg/m^2	<23 (Normal)	365 (30.5)	24.60 ± 3.15
	≥23 (Overweight)	832 (69.5)	
Type of menopause	Natural	933 (77.9)	
	Early or surgical	264 (22.1)	
Duration of menopause, in years	≤10	231 (19.3)	17.31 ± 7.67
	11-20	595 (49.7)	
	>20	371 (31.0)	
Family history of cardiovascular disease	No	1137 (95.0)	
	Yes	60 (5.0)	
History of diabetes	No	1127 (94.2)	
	Yes	70 (5.8)	
Blood pressure, mmHg	Normal (<120/80)	721 (60.2)	
	Elevated (≥120/80)	476 (39.8)	
Waist circumference, cm	<85 (Normal)	774 (64.7)	81.65 ± 9.15
	≥85 (Abdominal obesity)	423 (35.3)	
Low-density lipoprotein, mg/dL	<130 (Normal)	759 (63.4)	119.87 ± 32.18
	≥130 (High)	438 (36.6)	

Risk factors for the incidence of cardio-cerebrovascular diseases in menopausal women

The log minus log survival plot indicated that the cardio-cerebrovascular disease incidence curve according to risk factors was maintained at a constant distance [22]. Also, in the time-dependent Cox regression model, the significance probability of the duration of menopause was not statistically significant (*p* = .944) [22,23]. Thus, the proportional hazards assumption was satisfied; because the duration of menopause was significantly associated with age (r = .436, *p* < .001), the interaction term of the duration of menopause and age was included in the multivariate Cox proportional hazard models.

Using Cox proportional hazard models, we investigated the risk factors for the development of cardio-cerebrovascular diseases during the follow-up period. In the univariate model, age, education (high school and above), monthly income (low), history of diabetes, elevated BP, and duration of menopause were revealed as independent risk factors of cardio-cerebrovascular diseases, respectively. In the multivariate model, early or surgical menopause was a strong risk factor of cardio-cerebrovascular diseases (HR = 4.32, 95% CI = 2.93-6.36). Additionally, having a family history of cardiovascular diseases (HR = 1.87, 95% CI = 1.09-3.21), elevated BP (HR = 1.79, 95% CI = 1.37-2.36), abdominal obesity (HR = 1.37, 95% CI = 1.01−1.86), and a long duration of menopause at the same age (HR = 1.01, 95% CI = 1.00−1.01) were also independently associated with progression to cardio-cerebrovascular diseases (Table 3).

Discussion

This study evaluated the incidence as well as the risk factors of the development of cardio-cerebrovascular diseases in a representative sample of Korean menopausal women, including residents of both rural and urban areas. Early or surgical menopause, family history of cardiovascular diseases, elevated BP, abdominal obesity, and a long duration of menopause at the same age were critical factors influencing the incidence of cardio-cerebrovascular diseases in women.

In this cohort, the overall incidence of cardio-cerebrovascular diseases was 18.75 per 1,000 py during a 14-year follow-up. Among the cardio-cerebrovascular diseases, the incidence of hypertension was high at 16.21 per 1000 py, but the incidence rates of CAD and stroke were low at 2.53 and 1.92 per 1000 py, respectively. These findings indicate that hypertension is a common disease compared to CAD or stroke in Korean menopausal women over time. Among menopausal women, hypertension is highly prevalent and is a crucial health problem [24,25], yet less than half of those with hypertension receive adequate treatment and care [25]. Therefore, behavioral interventions are essential to reduce the occurrence of hypertension among menopausal women during this transition. In addition, the incidence of hypertension and CAD in this study is relatively higher than those in previous studies [24,26,27]. This may be due to several factors, including survey area,

Table 2 *Incidence of Cardio-Cerebrovascular Diseases during 14-year Follow-up.*

	Cardio-cerebrovascular diseases	Hypertension	Coronary artery disease	Stroke
Event, n	227	212	33	25
Person-year [a]	12.108	13.081	13.060	13.046
Incidence	18.75	16.21	2.53	1.92

[a] In thousands.

Table 3 *Risk Factors of the Incidence of Cardio-cerebrovascular Diseases.*

Characteristics	Categories	Unadjusted		Adjusted	
		HR (95% CI)	P	HR (95% CI)	P
Age, in years		1.05 (1.03—1.08)	<.001	1.09 (1.02—1.16)	.012
Education	Middle	0.73 (0.52—1.01)	.054	0.94 (0.66—1.35)	.743
(vs. Elementary)	Above high school	0.51 (0.35—0.72)	<.001	0.75 (0.49—1.14)	.176
Monthly income	Middle	1.51 (0.86—2.65)	.155	1.26 (0.71—2.24)	.429
(vs. High)	Low	2.34 (1.35—4.07)	.003	1.59 (0.88—2.88)	.124
Smoking (vs. No)	Yes	1.06 (0.52—2.14)	.874	1.21 (0.58—2.53)	.616
Drinking (vs. No)	Yes	0.93 (0.69—1.25)	.616	1.03 (0.76—1.41)	.847
Perceived health status	Usual	1.09 (0.76—1.56)	.631	1.05 (0.73—1.51)	.797
(vs. Healthy)	Unhealthy	1.27 (0.91—1.77)	.163	1.14 (0.81—1.61)	.451
Body mass index (vs. Normal)	Overweight	1.17 (0.87—1.57)	.292	0.98 (0.70—1.37)	.898
Type of menopause (vs. Natural)	Early or surgical	0.83 (0.60—1.15)	.270	4.32 (2.93—6.36)	<.001
Duration of menopause, in years		0.92 (0.90—0.94)	<.001	0.57 (0.46—0.72)	<.001
Family history of CVD (vs. No)	Yes	1.19 (0.70—2.00)	.523	1.87 (1.09—3.21)	.024
History of diabetes (vs. No)	Yes	1.67 (1.06—2.64)	.029	1.35 (0.84—2.17)	.215
Blood pressure (vs. Normal)	Elevated	2.24 (1.72—2.91)	<.001	1.79 (1.37—2.36)	<.001
Waist circumference (vs. Normal)	Abdominal obesity	1.54 (1.19—2.00)	.001	1.37 (1.01—1.86)	.046
LDL cholesterol (vs. Normal)	High	1.08 (0.83—1.41)	.579	1.09 (0.83—1.44)	.528
Age * Duration of menopause				1.01 (1.00—1.01)	.001

Note. CI = confidence interval; CVD = cardiovascular diseases; HR = hazard ratio; LDL = low-density lipoprotein.

sex and age of participants, and longer follow-up period. This study used the national data that recruited a large cohort and followed up for 14 years using sampling designs and standardized data collection. Thus, it can be said that the incidence of cardio-cerebrovascular diseases specified in this study represents the incidence of Korean menopausal women.

Among risk factors of the incidence of cardio-cerebrovascular diseases, early or surgical menopause was the most important factor influencing future cardio-cerebrovascular diseases in a population-based sample of Korean menopausal women. Our findings align with other large-scale epidemiologic studies of early menopause and cardio-cerebrovascular diseases [12,28], which reported that early menopause had a significantly higher risk of developing cardiovascular disease and stroke than natural menopause. Furthermore, not only the type of menopause but also the time since onset of menopause has been reported as a factor affecting the occurrence of CAD and cardiovascular diseases [8,10,18]. Meta-analysis showed that women with higher age of menopause and shorter periods of time after the onset of menopause had a relatively low risk of CAD [8,18]. Ley et al [10] reported that a shorter period of reproductive life is associated with a high risk of cardiovascular diseases. This phenomenon is in line with the aforementioned outcomes denoting that the longer the menopause period, the higher the risk of cardiovascular diseases. The most noticeable physiological change during menopause is decreased endogenous estrogen and a subsequent change in ovarian function [3,8,18]. Therefore, early estrogen loss in menopausal women might be associated with adverse cardiovascular disease risk factors, such as impairment of vascular function and increased expression of inflammatory cytokines [3,29]. These factors are associated with obesity, diabetes, and hypertension [8]. Therefore, it is necessary to regularly monitor women experiencing early menopause to determine whether they develop cardio-cerebrovascular diseases and provide active lifestyle modification interventions to prevent these diseases.

Our analysis also revealed that women with a family history of cardiovascular diseases had a higher risk of cardio-cerebrovascular diseases than women who did not. This finding is in line with previous studies that show that the incidence of cardiovascular diseases is high for any family history of CAD [30]. Notably, family history is a cardinal factor in a patient's health history, as there can be shared family health-related behaviors, environmental traits,

and genetic traits [31,32]. Nonetheless, screening tests for high-risk patients with a family history are often neglected in clinical settings, and significant data, including sex, onset age, number of relatives, and prognosis of families with cardiovascular diseases, have not been collected adequately [32]. Considering that a family history of cardiovascular diseases has been regarded as a prime risk factor for developing future cardiovascular diseases [31,32], a proactive assessment of family histories and targeted risk reduction interventions should be conducted during initial assessments for high-risk groups.

Notably, women with elevated BP were found to experience a higher risk of developing cardio-cerebrovascular diseases than those with normal BP levels. This outcome is similar to the results of previous meta-analyses of prospective cohort studies [33,34], which indicate that elevated BP is associated with a significant risk of developing or dying from cardio-cerebrovascular diseases. In this study, the rate of elevated BP was 39.8%, which is higher than the average rate of 36.7% reported for Asian adults [34]. This difference is because, unlike previous studies with adults over the age of 20 years, this study targeted middle-aged or older women (40—64 years old). However, given that elevated BP is likely to develop into hypertension, it is necessary to screen these high-risk patients and initiate aggressive interventions focused on lifestyle modification to achieve BP goals.

Next, abdominal obesity was a significant risk factor for cardio-cerebrovascular diseases in this study. Our findings agree with previous studies, including population-based cross-sectional studies that have depicted that abdominal obesity is associated with a higher risk of coronary heart disease in Korean and American adults [35,36]. During menopause, women undergo inevitable changes in the accumulation of body fat, thereby increasing lipids and accelerating blood vessel remodeling. Obesity is known to be closely related to the occurrence of cardio-cerebrovascular diseases, but recent studies have reported that higher waist circumference increases the risk of CAD even after BMI adjustment [8,36]. Therefore, to identify high-risk groups, we need to measure the level of general adiposity using BMI and body composition by simultaneously measuring waist circumference.

Our study has several limitations. First, since data about the occurrence of cardio-cerebrovascular diseases is dependent on the participants' self-report without medical record confirmation,

the possibility that the occurrence of cardio-cerebrovascular diseases has been underreported cannot be excluded. Therefore, further studies are needed to investigate connections using claims-based databases. Second, information about hormone therapy-related characteristics (i.e., hormone use, age at use, or dose after menopause) and psychosocial characteristics (i.e., depression and anxiety) were not obtained. Considering that these characteristics may be potential confounding variables for the cardio-cerebrovascular diseases, it is necessary to conduct follow-up studies that include this data. Third, there may be differences in the duration of the reproductive life span between patients with surgical menopause close to a natural menopause and younger patients with surgical menopause before 45 years of age. Further research is needed to confirm the difference in the incidence rate of cardio-cerebrovascular diseases and risk factors between subgroups according to the cause of menopause. Finally, since this study was based on data from community residents in Korea, and although this national population cohort was recruited using sampling designs and standardized data collection, attention should be paid while generalizing the results to the entire Korean population.

Conclusions

The results of this study revealed a high risk of cardio-cerebrovascular disease, especially in women experiencing early or surgical menopause and long periods of menopause. In addition to that, family history of cardiovascular diseases, elevated BP, and abdominal obesity have also been found to be independent risk factors of cardio-cerebrovascular diseases in women. Therefore, in order to prevent cardio-cerebrovascular disease in menopausal women, health providers should evaluate both types and duration of menopause to screen and monitor high-risk groups. In addition, in public health promotion and health care services, it is essential to provide comprehensive interventions focusing on managing blood pressure and abdominal obesity for menopausal women. In the future, it is suggested to conduct a multiregional cohort study to identify risk factors for cardio-cerebrovascular disease, targeting early menopausal women.

Author Contributions

Jin-Hee Park: Conceptualization and methodology, Formal analysis, Writing—original draft preparation and writing—review and editing, Supervision, Funding acquisition; **Eun Ji Seo:** Conceptualization, Formal analysis, Writing—original draft preparation, Visualization; **Sun Hyoung Bae:** Conceptualization, Formal analysis, Writing—original draft preparation and writing—review and editing.

Data statement

The data in this study were obtained from the KoGES (4851-302), National Research Institute of Health, Centers for Disease Control and Prevention, Ministry for Health and Welfare, Republic of Korea. All data generated or analyzed during this study are included in this published article.

Consent for publication

As part of the informed consent process, permission was sought from the participants to be able to use the collected data in a publication, with the participants remaining anonymous.

Funding

Ethics approval and consent to participate

Informed written consent was obtained from all participants in accordance with the Declaration of Helsinki guidelines. The Institutional Review Board of Ajou University approved the study protocol (IRB No. AJIRB-SBR-EXP-19-136).

Conflict of interest

The author declare no conflicts of interest.

Acknowledgments

References

1. Luepker RV, Lakshminarayan K. 9.2 Cardiovascular and cerebrovascular diseases. In: Oxford Textbook of Public Health [Internet]. 5th ed. London: Oxford University Press; 2009 [cited 2021 May 6]. Available from: https://oxfordmedicine.com/view/10.1093/med/9780199218707.001.0001/med-9780199218707-chapter-0902
2. Appelman Y, van Rijn BB, Ten Haaf ME, Boersma E, Peters SA. Sex differences in cardiovascular risk factors and disease prevention. Atherosclerosis. 2015;241(1):211—8. https://doi.org/10.1016/j.atherosclerosis.2015.01.027
3. Maffei S, Guiducci L, Cugusi L, Cadeddu C, Deidda M, Gallina S, et al. Women-specific predictors of cardiovascular disease risk - new paradigms. Int J Cardiol. 2019;286:190—7. https://doi.org/10.1016/j.ijcard.2019.02.005
4. Daugherty SL, Blair IV, Havranek EP, Furniss A, Dickinson LM, Karimkhani E, et al. Implicit gender bias and the use of cardiovascular tests among cardiologists. J Am Heart Assoc. 2017;6(12):e006872. https://doi.org/10.1161/JAHA.117.006872
5. National Health Service. Early menopause [Internet]. London: NHS; 2021 [cited 2021 May 6]. Available from: https://www.nhs.uk/conditions/early-menopause/
6. Georgakis MK, Beskou-Kontou T, Theodoridis I, Skalkidou A, Petridou ET. Surgical menopause in association with cognitive function and risk of dementia: a systematic review and meta-analysis. Psychoneuroendocrinology. 2019;106:9—19. https://doi.org/10.1016/j.psyneuen.2019.03.013
7. Kingsberg SA, Larkin LC, Liu JH. Clinical effects of early or surgical menopause. Obstet Gynecol. 2020;135(4):853—68. https://doi.org/10.1097/AOG.0000000000003729
8. Muka T, Oliver-Williams C, Kunutsor S, Laven JSE, Fauser BCJM, Chowdhury R, et al. Association of age at onset of menopause and time since onset of menopause with cardiovascular outcomes, intermediate vascular traits, and all-cause mortality: a systematic review and meta-analysis. JAMA Cardiol. 2016;1(7):767—76. https://doi.org/10.1001/jamacardio.2016.2415
9. Sun Y, Ruan X, Mueck AO. Dependency of cardiovascular risk on reproductive stages and on age among middle-aged Chinese women. Climacteric. 2017;20(5):484—90. https://doi.org/10.1080/13697137.2017.1357691
10. Ley SH, Li Y, Tobias DK, Manson JE, Rosner B, Hu FB, et al. Duration of reproductive life span, age at menarche, and age at menopause are associated with risk of cardiovascular disease in women. J Am Heart Assoc. 2017;6(11):e006713. https://doi.org/10.1161/jaha.117.006713
11. Mishra GD, Kuh D. Health symptoms during midlife in relation to menopausal transition: British prospective cohort study. BMJ. 2012;344(1):e402. https://doi.org/10.1136/bmj.e402
12. Wellons M, Ouyang P, Schreiner PJ, Herrington DM, Vaidya D. Early menopause predicts future coronary heart disease and stroke: the Multi-Ethnic Study of

Atherosclerosis. Menopause. 2012;19(10):1081–7.
https://doi.org/10.1097/gme.0b013e3182517bd0

13. Choe SA, Sung J. Trends of premature and early menopause: a comparative study of the US National Health and Nutrition Examination survey and the Korea National Health and Nutrition Examination survey. J Kor Med Sci. 2020;35(14):e97. https://doi.org/10.3346/jkms.2020.35.e97

14. Hong JS, Yi SW, Kang HC, Jee SH, Kang HG, Bayasgalan G, et al. Age at menopause and cause-specific mortality in South Korean women: Kangwha cohort study. Maturitas. 2007;56(4):411–9.
https://doi.org/10.1016/j.maturitas.2006.11.004

15. Kim Y, Han BG, KoGES group. Cohort profile: the Korean Genome and epidemiology study (KoGES) consortium. Int J Epidemiol. 2017;46(4):e20.
https://doi.org/10.1093/ije/dyv316

16. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem. 1972;18(6):499–502.
https://doi.org/10.1093/clinchem/18.6.499

17. Park CY, Lim JY, Park HY. Age at natural menopause in Koreans: secular trends and influences thereon. Menopause. 2018;25(4):423–9.
https://doi.org/10.1097/gme.0000000000001019

18. Zhu D, Chung HF, Dobson AJ, Pandeya N, Brunner EJ, Kuh D, et al. Type of menopause, age of menopause and variations in the risk of incident cardiovascular disease: pooled analysis of individual data from 10 international studies. Hum Reprod. 2020;35(8):1933–43. https://doi.org/10.1093/humrep/deaa124

19. Seo MH, Kim YH, Han K, Jung JH, Park JG, Lee SS, et al. Prevalence of obesity and incidence of obesity-related comorbidities in Koreans based on national health insurance service health checkup data 2006-2015. J Obes Metab Syndr. 2018;27(1):46–52. https://doi.org/10.7570/jomes.2018.27.1.46

20. National Institute for Health and Care Excellence. Menopause: diagnosis and management [Internet]. London: NICE; 2015 [cited 2020 Nov 18]. Available from: https://www.nice.org.uk/guidance/ng23/

21. Kim HC, Ihm SH, Kim GH, Kim JH, Kim K, Lee HY, et al. 2018 Korean Society of Hypertension guidelines for the management of hypertension: part I-epidemiology of hypertension. Clin Hypertens. 2019;25(1):16.
https://doi.org/10.1186/s40885-019-0121-0

22. Bae JM, Park GH. An illustrated guide to medical statistics using SPSS. Seoul: Hannarae; 2012. p. 293–322. Korean.

23. Song KL, Chon JS. Survival analysis using SPSS. Seoul: Hannarae; 2013. p. 159–208. Korean.

24. Lacruz ME, Kluttig A, Hartwig S, Löer M, Tiller D, Greiser KH, et al. Prevalence and incidence of hypertension in the general adult population: results of the CARLA-Cohort Study. Medicine. 2015;94(22):e952.
https://doi.org/10.1097/md.0000000000000952

25. Sylvester MA, Brooks HL. Sex-specific mechanisms in inflammation and hypertension. Curr Hypertens Rep. 2019;21(7):53.
https://doi.org/10.1007/s11906-019-0959-2

26. Kim JY, Hong JY, Kim DK. Association of sudden sensorineural hearing loss with risk of cardiocerebrovascular disease: a study using data from the Korea National Health Insurance Service. JAMA Otolaryngol Head Neck Surg. 2018;144(2):129–35. https://doi.org/10.1001/jamaoto.2017.2569

27. Kim JY, Kim MS, Kim MH, Kim DK, Yu MS. Bell palsy and the risk of cardiocerebrovascular disease: a population-based follow-up study. Laryngoscope. 2019;129(10):2371–7. https://doi.org/10.1002/lary.27802

28. Honigberg MC, Zekavat SM, Aragam K, Finneran P, Klarin D, Bhatt DL, et al. Association of premature natural and surgical menopause with incident cardiovascular disease. JAMA. 2019;322(24):2411–21.
https://doi.org/10.1001/jama.2019.19191

29. Young L, Cho L. Unique cardiovascular risk factors in women. Heart. 2019;105(21):1656–60. https://doi.org/10.1136/heartjnl-2018-314268

30. Moonesinghe R, Yang Q, Zhang Z, Khoury MJ. Prevalence and cardiovascular health impact of family history of premature heart disease in the United States: analysis of the National Health and Nutrition Examination Survey, 2007-2014. J Am Heart Assoc. 2019;8(14):e012364.
https://doi.org/10.1161/jaha.119.012364

31. Centers for Disease Control and Prevention. Know your risk for heart disease [Internet]. Atlanta: CDC; 2019 [cited 2020 Nov 20]. Available from: https://www.cdc.gov/heartdisease/risk_factors.htm

32. Imes CC, Lewis FM. Family history of cardiovascular disease, perceived cardiovascular disease risk, and health-related behavior: a review of the literature. J Cardiovasc Nurs. 2014;29(2):108–29.
https://doi.org/10.1097/jcn.0b013e31827db5eb

33. Guo X, Zhang X, Guo L, Li Z, Zheng L, Yu S, et al. Association between prehypertension and cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. Curr Hypertens Rep. 2013;15(6):703–16.
https://doi.org/10.1007/s11906-013-0403-y

34. Huang Y, Cai X, Liu C, Zhu D, Hua J, Hu Y, et al. Prehypertension and the risk of coronary heart disease in Asian and Western populations: a meta-analysis. J Am Heart Assoc. 2015;4(2):e001519.
https://doi.org/10.1161/jaha.114.001519

35. Kim HY, Kim JK, Shin GG, Han JA, Kim JW. Association between abdominal obesity and cardiovascular risk factors in adults with normal body mass index: based on the sixth Korea National Health and Nutrition Examination Survey. J Obes Metab Syndr. 2019;28(4):262–70.
https://doi.org/10.7570/jomes.2019.28.4.262

36. Sun Y, Liu B, Snetselaar LG, Wallace RB, Caan BJ, Rohan TE, et al. Association of normal-weight central obesity with all-cause and cause-specific mortality among postmenopausal women. JAMA Netw Open. 2019;2(7):e197337.
https://doi.org/10.1001/jamanetworkopen.2019.7337

Research Article

Risk Factors Preventing Immediate Fall Detection: A Study Using Zero-Inflated Negative Binomial Regression

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ABSTRACT

Purpose: Falls are the most common accidents in healthcare facilities, and timely intervention can have a positive effect on the hazards and trauma experienced by patients after a fall. This study determined the factors affecting the time taken to detect a fall.
Methods: A total of 3,470 cases of falls reported through the Korea Patient Safety Reporting and Learning System were included in the analysis. A zero-inflated negative binomial regression method was used for this retrospective secondary data analysis study.
Results: There were 537 patients whose falls were not detected immediately; the count model was used to predict risk factors that delayed fall detection. Women aged 60—69 years—compared to those below 60 years and an evening nursing shift, compared to a day shift—were identified as significant factors. The fall detection time of about 2,933 patients was zero; therefore, the logit model was applied to predict a patient's possibility of belonging to the group whose fall was detected immediately. Comparisons of tertiary hospitals with general hospitals and hospitals, of the evening shift with the day shift, and of the day shift with the night shift indicated significant influencing factors.
Conclusions: These findings can assist nurses in recognizing patient and hospital characteristics related to delayed fall detection. Strategies to improve patient safety in healthcare facilities that focus on patient characteristics such as age can be recommended. Furthermore, nurse staffing requires improvement to detect fall incidents immediately.
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Introduction

Falls are the most common accidents among hospitalized patients [1,2]. In acute-care US hospitals, approximately three to five falls occur per 1,000 patient bed days [3,4]. In a 2013 study of Korean general hospitals with over 500 beds, fall rates were high at 3.87 cases per 1,000 discharged patients per year and 0.55 cases per 1,000 patient days [5]. Timely fall detection enables patients to receive appropriate treatment within a shorter period [6]. Thus, rapid fall detection and prompt response are paramount [7] and may minimize the aftereffects of a fall, such as emotional anxiety and fear of falling again. Notably, most falls occur at night when the lighting is dim, and patients may feel that it is burdensome to ask a nurse for help [8,9]. Falls increase patients' morbidity, mortality,

hospitalization days, and healthcare costs [10]. Even without injuries, falls can trigger fear, anxiety, stress, and depression, which can have various adverse outcomes, such as a reduction in physical activity [11]. Accordingly, the ongoing effort is being directed toward developing various strategies and interventions to reduce the prevalence of falls from a nursing perspective [11].

Swift fall detection—in addition to the development of interventions—may reduce the risk of adverse outcomes. If a fall occurs, the nurse may not become aware of it immediately, and the patient may perceive that it is their fault. Thus, the patient may refrain from notifying the medical staff of such accidents. Despite the importance of prompt fall detection and response, previous studies have focused on reporting the actual number of falls and identifying their contributing factors. Few studies have investigated the importance of timely fall recognition and response by medical staff, including nurses. The opportunity for appropriate patient treatment decreases when there is a delay in fall detection, which is potentially detrimental to overall patient outcomes. Thus, there is a need for studies focusing on this issue.

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A study investigating accidental falls found that the level of registered nurse (RN) staffing in a medical unit is positively correlated with the number of unassisted falls [12]. This finding implies that the allocation of nurses is a key factor. A systematic review explained the components of fall prevention programs that emphasized assessment, supervision, and assistance with transfer and toilet use and that these factors were related to sufficient nurse staffing level [13]. In South Korea, the standard for patients per RNs in tertiary hospitals, general hospitals, and hospitals is 2.5 or less, and the proportion of general hospitals (including tertiary hospitals) meeting the standards was 63%, whereas only 19% hospitals met the standard, which means that the allocation of nurses differs based on the type of medical institution [14]. Thus, the appropriate response to accidents such as falls and the measures for prompt detection and treatment may differ accordingly.

There may be differences in the occurrence of adverse fall outcomes depending on where and at what time the fall occurred during the nursing shift. In the hospital room, intensive-care unit, emergency room, and other locations, the medical staff may have different time limits to confirm a fall accident. This difference may be due to varying nurse allocations, the severity of the patient's condition, their duration of hospitalization, and work shifts. Indeed, considerable patient movements occur during the day and evening shifts. Conversely, most patients are asleep during night shifts. Accordingly, there are relatively fewer nurses on duty during the night shift, and they tend to spend more time at the nurses' station. In such cases, it would plausibly take them longer to identify adverse outcomes.

It should be noted that no study has thoroughly investigated the influence of these factors on fall identification. Moreover, there is no information regarding what improvements are necessary to facilitate a rapid response to falls. Therefore, the present study analyzed the time taken to detect a fall in relation to factors such as the type of Korean healthcare facility, fall location, and medical staff's working shift. Apart from determining the factors influencing the time taken to detect a fall, this study considered the improvements required for immediate fall detection.

When the Patient Safety Act was enacted in July 2016, the Korea Patient Safety Reporting and Learning System (KOPS) was introduced to systematically collect data regarding patient accidents. The KOPS reports patient accidents in medical institutions. These data are available to the public on the KOPS website of the Korea Institute for Healthcare Accreditation (KOIHA), which is tasked with promoting both public awareness and the quality of care provided in medical institutions. This study utilized the KOPS data for 2018 to investigate the impact of these characteristics on the time lag between fall occurrence and discovery. This information could facilitate the development of enhanced preventive measures. Particularly, there could be future discussions regarding nursing interventions based on the factors that influence the time taken to detect falls.

This study aims to (1) examine the differences in fall severity related to the time until fall detection, (2) compare the time taken to detect falls in different healthcare facilities according to the specific type of medical institution and patient characteristics, and (3) verify the factors that affect the time taken to detect a fall.

Methods

Design

This retrospective study utilized secondary KOPS data on patient accidents at medical institutions. The data are available to the public through the KOIHA.

Sample and setting

Raw data on patient safety/accident cases reported to the KOPS were downloaded from the KOIHA website on 30 November 2020 [15]. The fall incidents occurred in 2018 were included and the incidences at psychiatric hospitals and Korean medicine hospitals and the cases with missing information were excluded in analysis. Among 9,250 patient safety incidents, of which 8,483 cases had occurred in 2018 and 3,906 were fall incidents. Moreover, 85 incidences at psychiatric hospitals and Korean medicine hospitals were excluded because of heterogeneity of hospital type, and 351 cases with missing information concerning the accident occurrence and discovery times were also excluded. Finally, 3,470 cases were included in the analysis. This study conceptualized a fall as a sudden and unintentional change of posture, to a place lower than the current body position, causing the individual to sit or lie on the floor. Information such as the patient's gender and age was included in this study; however, personal identifiable information was excluded. Furthermore, the type of medical institution, location of each fall, time of occurrence, and time of identification were included.

Measurements

The gender and age of the patients who experienced falls were classified on a nominal or ranking scale. Healthcare facilities were categorized as tertiary hospitals, general hospitals, hospitals, and long-term—care hospitals. Each fall was categorized in accordance with the incident location as follows: patient room and intensive-care unit, emergency room, examination room, injection room, treatment room, outpatient room, and others (e.g., operation room, recovery room). Fall times were classified as 7 a.m. to 3 p.m. (day shift), 3 p.m. to 11 p.m. (evening shift), and 11 p.m. to 7 a.m. (night shift). This was based on the typical starting time of the day shift (7 am) [16] and the three-shift work schedule divided equally into 8 hours per shift.

The time until fall detection was calculated by subtracting the time when the fall occurred from the time it was detected. The original data comprised six levels of fall severity: no hazard, recovery without sequelae after treatment or temporary damage or side effects, long-term damage or side effects, permanent damage or side effects, and death. This study adapted these into three categories: near-miss (no harm), adverse events (recovery without sequelae after treatment or temporary damage or side effects), and sentinel events (long-term damage or side effects, permanent injury and disability upon discharge, or death).

Data analysis

Descriptive statistics such as frequency and percentage were used for patients' gender and age, type and location of the healthcare facility, fall location, and time until fall detection. Based on the time until fall detection, participants were divided into three categories: those with falls detected immediately, those with falls detected within 60 minutes and those with falls detected after 60 or more minutes, expressed as frequency and percentage. In addition, means, standard deviations, medians, and ranges were calculated.

A chi-squared test was used to verify the difference of fall severity based on fall detection time. Another was conducted to determine the differences between fall detection times based on the characteristics of the patients and medical institutions. Logistic regression analysis was used to identify factors influencing whether a fall was immediately detected. Furthermore, the zero-inflated negative binomial regression (ZINBR) was used to identify the factors that influenced the time until fall detection. As the time until fall detection was most commonly 0 and the standard

deviation was larger than the mean, the analysis was performed using ZINBR. The ZINBR can account for the over-dispersion of count data, handle issues related to the presence of many zero values, and improve the overall explanatory power by accounting for zero values [17].

Ethical consideration

As this study was based on secondary data analysis, the aims and methods were reviewed and approval was exempted by the Institutional Review Board of the first author's institution (Approval no. SMU-EX-2020-11-001).

Results

General characteristics of participants with a fall experience

Table 1 presents the data from 3,470 patients who had experienced falls. Of these, 1,677 (48.3%) were women and 2,609 (75.2%) were aged above 60 years. Furthermore, the higher the age of the patient, the greater the frequency of falls. Falls predominantly occurred in general hospitals (45.7%), and the most common location was the patient room or the ICU (61.3%). In terms of nurses' shifts, 37.9%, 36.4%, and 25.8% of the falls occurred during the day, night, and evening shifts, respectively. The average time until fall detection was 22.06 (±114.11) minutes. A total of 2,933 (84.5%) falls were detected immediately. A total of 293 (8.4%) cases were detected between 1 and 60 minutes after the fall, while 244 (7.0%) were detected 60 or more minutes after the fall. Concerning patient safety, fall severity was observed in the following order: adverse events (1,968 cases, 56.7%), near-miss events (1,145 cases, 33.0%), and sentinel events (357 cases, 10.3%).

Table 1 *Characteristics of Patients with Fall Experience (N = 3,470).*

Variables	Categories	n (%)/Mean ± SD
Gender	Men	1,668 (48.1)
	Women	1,677 (48.3)
	Unknown	125 (3.6)
Age (years)	<60	754 (21.7)
	60≤ <70	650 (18.7)
	70≤ <80	925 (26.7)
	≥80	1,034 (29.8)
	Unknown	107 (3.1)
Hospital type	Tertiary	555 (16.0)
	General hospital	1,586 (45.7)
	Hospital	467 (13.5)
	Long-term−care hospital	862 (24.8)
Location where fall occurred	Patient room or ICU	2,126 (61.3)
	Emergency room	62 (1.8)
	Examination room, IR, TR, or Outpatient room	107 (3.1)
	Other[a]	1,175 (33.9)
Nurses' shifts	Day (7 p.m.−3 p.m.)	1,314 (37.9)
	Evening (3 p.m.−11 p.m.)	894 (25.8)
	Night (11 p.m.−7 a.m.)	1,262 (36.4)
Time until fall detection (min)	0	2,933 (84.5)
	0< <60	293 (8.4)
	≥60	244 (7.0)
	Mean ± SD	22.06 ± 114.11
	Median (Min−Max)	0 (0−1,320)
Fall severity	Near-miss	1,145 (33.0)
	Adverse event	1,968 (56.7)
	Sentinel event	357 (10.3)

Note. ICU = intensive-care unit; IR = injection room; SD = standard deviation; TR = treatment room.
[a] Others: operation room, recovery room, etc.

Differences in fall severity based on the time until fall detection

There was a significant difference in fall severity for each group based on the time of fall detection ($\chi^2 = 15.07$, $p = .005$) (Figure 1). The group with a fall detection time of 60 or more minutes had significantly fewer cases (22.5%) of near-miss accidents than the group with immediate fall detection (34.0%) or the group with a detection time of less than 60 minutes (31.4%). Adverse events (66.4%) were significantly more frequent in the group with a detection time of 60 or more minutes after a fall than in the other two groups: 56.0% and 56.3% in the group with immediate fall detection and the group with a detection time of under 60 minutes, respectively.

Differences in the time until fall detection according to the patients' general characteristics

At the individual level, statistically significant differences in the time until fall detection were observed with reference to gender ($\chi^2 = 12.67$, $p = .013$) and age ($\chi^2 = 23.54$, $p = .003$) (Table 2). Falls were detected later for women than for men. Older patients' falls were not immediately detected ($\chi^2 = 23.54$, $p = .003$).

At the hospital level, hospital type ($\chi^2 = 38.19$, $p < .001$), location of fall ($\chi^2 = 22.77$, $p = .007$), and nurses' shifts ($\chi^2 = 195.48$, $p < .001$) were variables that made a significant difference in the fall detection time. The frequency of immediately detected falls was highest in general hospitals, followed by long-term−care hospitals and tertiary hospitals ($\chi^2 = 38.19$, $p < .001$). Regarding the location of the fall, the number of patients whose falls were detected immediately was highest in the patient room and ICU and lowest in the emergency room ($\chi^2 = 22.77$, $p = .007$). The number of patients whose falls were not detected immediately corresponded to nurses' shifts ($\chi^2 = 195.48$, $p < .001$); falls were lowest during the night shift, followed by the day and evening shifts.

Factors influencing the time until fall detection

Table 3 describes the factors influencing the time until fall detection using multiple logistic regression and the ZINBR analyses. Through logistic regression analysis, the following factors were found to be significant: age ≥80 years versus <60 years (odds ratio [OR] = 1.41, $p = .020$), general hospitals (OR = 1.40, $p = .026$) and hospitals (OR = 2.23, $p < .001$) versus tertiary hospitals, and night (OR = 2.08, $p < .001$) and evening shifts (OR = 0.58, $p < .001$) versus a day shift.

The ZINBR analysis was performed to account for diversiform data regarding the fall detection times. In the likelihood ratio test, the significance probability was smaller than .001, indicating that the data explained the model well. There were 537 patients whose falls were not detected immediately, and the count model predicted the risk factors that affected the delayed fall detection. Being women ($b = 0.55$, $p = .007$), aged 60−69 years compared to below 60 years ($b = 0.72$, $p = .031$), and the evening shift compared to the day shift ($b = 1.51$, $p < .001$) were identified as significant factors in this model. Furthermore, 2,933 patients had a fall detection time of zero; therefore, the logit model was applied to predict the possibility of belonging to the group whose fall was detected immediately. The comparisons of tertiary hospitals with general hospitals ($b = -0.48$, $p = .022$) and hospitals ($b = -1.07$, $p < .001$), of the evening shift ($b = 0.82$, $p < .001$) with the day shift, and of the day shift with the night shift ($b = -1.08$, $p < .001$) were significant in this model. Thus, patients in general hospitals and hospitals were more likely to belong to the risk group whose falls were detected later, as were patients who fell during the night shift, followed by those who fell during the day and evening shifts.

Time until fall detection (min)

	Near-miss	Adverse event	Sentinel event	Total
⬤ 0	998 (34.0)	1,641 (56.0)	294 (10.0)	2,933, (100.0)
⬤ 1–60	92 (31.4)	165 (56.3)	36 (12.3)	293 (100.0)
⬤ ≥60	55 (22.5)	162 (66.4)	27 (11.1)	244 (100.0)

Fall severity (N (%))

Figure 1. Differences in fall severity based on time until fall detection (N = 3,470).
Note. The chi-square statistic was used to compare the mean difference between groups, χ^2 (*p*) = 15.07 (*.005*).

Discussion

It has been consistently reported that an early nurse intervention after a patient's fall can minimize the patient's disability [18]. However, to the best of our knowledge, no study has been conducted on fall detection times. This study offers new evidence by determining the fall detection time and elucidating its influencing factors, which have not been verified till date. This study's findings go beyond confirming the risk factors for falls as reported in the previous studies [19]. Furthermore, this study is important because it is the first to determine whether the time until fall detection affects the fall severity. Because there are few existing studies on fall detection time, we initially examined whether the time until fall detection influenced fall severity. As hypothesized, when falls were detected immediately, there were significantly fewer sentinel events (long-term damage or side effects, permanent damage or side effects, or death) or adverse effects (recovery without sequelae after treatment or temporary damage or side effects). Previous studies have suggested that delayed or absent nursing care, including observing a fall, was a risk factor in exacerbating patients' health status [20,21]. In this study, the fall detection time was

identified as a direct variable causing patient injury; therefore, it was important to determine its related factors.

Multiple logistic regression was used to verify the differences between the group whose falls were detected immediately and those whose falls were not. There was a significant difference in gender and fall location variables compared to that of the ZINBR analysis method. Logistic regression analysis increases the likelihood of losing a substantial amount of information by condensing and examining data in a dichotomy for various frequencies [22]. At the individual level, factors affecting the time until fall detection using the ZINBR analysis included female gender and older age in patients whose falls were not detected immediately. However, there were no significant differences in gender or age among patients whose falls were detected immediately. These results are consistent with those reported in the previous studies. Specifically, the older the patient's age, the greater the lapse in self-management [23] and the greater the delay in reporting safety accidents [24]. These results were considered to have a more significant impact on the severity of the patient's condition [25]. Elderly patients tend to delay accident reporting because of communication problems, gait disorders, sensory dysfunction, and

Table 2 *Differences in Time until Fall Detection Based on General Characteristics (N = 3,470).*

Variable	Category		Time until fall detection (n (%))			χ^2 (*p* value)
			0min	1–60 min	≥60 min	
Individual level	Gender	Men	1,411 (84.6)	137 (8.2)	120 (7.2)	12.67 (.013)
		Women	1,403 (83.7)	151 (9.0)	123 (7.3)	
		Unknown	119 (95.2)	5 (4.0)	1 (0.8)	
	Age (years)	<60	657 (87.1)	54 (7.2)	43 (5.7)	23.54 (.003)
		60≤ <70	544 (83.7)	47 (7.2)	59 (9.1)	
		70≤ <80	777 (84.0)	83 (9.0)	65 (7.0)	
		≥80	853 (82.5)	105 (10.2)	76 (7.4)	
		Unknown	102 (95.3)	4 (3.7)	1 (0.9)	
Hospital level	Hospital type	Tertiary	489 (88.1)	35 (6.3)	31 (5.6)	38.19 (<.001)
		General hospital	1,321 (83.3)	155 (9.8)	110 (6.9)	
		Hospital	366 (78.4)	43 (9.2)	58 (12.4)	
		Long-term–care hospital	757 (87.8)	60 (7.0)	45 (5.2)	
	Location of fall	Patient room and ICU	1,785 (84.0)	204 (9.6)	137 (6.4)	22.77 (.007)
		Emergency room	60 (96.8)	0 (0.0)	2 (3.2)	
		Examination room, IR, TR, and outpatient room	97 (90.7)	3 (2.8)	7 (6.5)	
		Others	991 (84.3)	86 (7.3)	98 (8.3)	
	Nursing shifts	Day (7 p.m.–3 p.m.)	1,141 (86.8)	85 (6.5)	88 (6.7)	195.48 (<.001)
		Evening (3 p.m.–11 p.m.)	825 (92.3)	0 (0.0)	69 (7.7)	
		Night (11 p.m.–7 a.m.)	967 (76.6)	208 (16.5)	87 (6.9)	

Note. ICU = intensive-care unit; IR = injection room; TR = treatment room.

Table 3 Factors Influencing Time until Fall Detection (N = 3,470).

Variables		Categories	Logistic regression (Time until fall detection: 0 or not)		Zero-inflated negative binomial regression					
					Count model			Logit model		
			Odds ratio (95% CI)	p value	Coefficient	LL, UL	p value	Coefficient	LL, UL	p value
Individual level	Gender (vs. Men)	Women	1.07 (0.88, 1.31)	.487	0.55	0.15, 0.95	.007	0.07	−0.22, 0.36	.620
		Unknown	0.36 (0.08, 1.57)	.174	−6.07	−9.50, −2.65	.001	−0.83	−5.00, 3.35	.698
	Age (years) (vs. <60)	60≤ <70	1.30 (0.96, 1.77)	.091	0.72	0.07, 1.37	.031	−0.21	−0.64, 0.22	.332
		70≤ <80	1.20 (0.90, 1.60)	.208	0.44	−0.17, 1.05	.158	−0.13	−0.53, 0.27	.511
		≥80	1.41 (1.06, 1.88)	.020	0.23	−0.37, 0.82	.450	−0.39	−0.80, 0.02	.064
		Unknown	0.77 (0.15, 3.91)	.748	5.87	1.86, 9.88	.004	2.37	−1.82, 6.56	.268
Hospital level	Hospital type (vs. tertiary)	General hospital	1.40 (1.04, 1.88)	.026	−0.22	−0.84, 0.41	.497	−0.48	−0.89, −0.07	.022
		Hospital	2.23 (1.57, 3.17)	<.001	0.29	−0.45, 1.03	.439	−1.07	−1.63, −0.51	<.001
		Long-term–care hospital	0.96 (0.68, 1.35)	.798	0.03	−0.69, 0.74	.943	0.05	−0.41, 0.51	.830
	Location where the fall occurred (vs. patient room and ICU)	Emergency room	0.20 (0.05, 0.84)	.028	−2.33	−5.16, 0.50	.107	1.32	−0.52, 3.15	.159
		Examination room, IR, TR & Outpatient room	0.72 (0.37, 1.42)	.343	1.06	−0.47, 2.58	.174	0.53	−0.29, 1.34	.205
		Others	1.16 (0.94, 1.43)	.165	0.23	−0.24, 0.70	.341	−0.18	−0.48, 0.13	.252
	Nurses' shifts (vs. day)	Evening (3 p.m.–11 p.m.)	0.58 (0.43, 0.78)	<.001	1.51	0.79, 2.23	<.001	0.82	0.45, 0.78	<.001
		Night (11 p.m.–7 a.m.)	2.08 (1.67, 2.59)	<.001	−0.25	−0.72, 0.23	.314	−1.08	−1.50, −0.67	<.001

Likelihood ratio = 60.49 (p < .001), Vuong test = 7.32 (p < .001).
Note. ICU = intensive-care unit; IR = injection room; TR = treatment room; CI = confidence interval; LL = lower limits; UL = upper limits.

complex diseases, which are common in this age group [26]. Nevertheless, these results should be interpreted carefully as they did not show significant differences among elderly individuals (age ≥70 years). In many national-level fall assessment guidelines, the female gender has been considered a risk factor for falls because hormonal changes reduce bone mineral density [27,28]. Importantly, this study confirmed that old age and gender were risk factors not only for the occurrence of falls but also for delayed fall detection. These results indicate the need to establish a system that enables nurses to quickly detect falls and provide education on fall prevention for women and elderly individuals.

Regarding the type of healthcare facility, patients in tertiary hospitals were more likely to be in the group whose falls were detected immediately than those in other hospital types. In addition, the time taken to detect a fall was higher during the night shift than during other shifts. Tertiary hospitals have a lower RN-to-patient ratio than other hospital types [29], and night shifts have fewer nurse duty hours per patient per day than other shifts [30]. As no direct relationship was observed in the current study, these findings should be interpreted with caution. It is possible to infer, however, that a lack of nurses affects the time required to report patient safety accidents. Previous studies have found that nurse staffing levels are predictors of patient falls [31], and this study confirmed that the delayed detection of patient safety accidents was related to an insufficient number of nurses. Therefore, to prevent any negative effects on patient health, nurse staffing levels must be considered [29,32]. Unlike previous studies, this study did not reveal any differences regarding hospital location and fall detection time. In the previous studies on location and patient safety, the frequency and severity were highest for accidents that occurred in the inpatient or treatment room [33]. Particularly, in a multi-patient room, patient risk events may occur more often because of inaccurate patient identification and noncompliance with drug administration regulations [33]. Based on these previous findings, the fact that the variables in this study considered all hospitalization rooms, without distinguishing between multi-patient and single-patient rooms, needs to be considered. Therefore, it is necessary to further explore the differences in patient accident detection times in accordance with the characteristics of the various hospital units.

A limitation of this study is that it included self-reported data of medical institutions, medical staffs, patients, and caregivers. Therefore, the results may have been underestimated, and there may be subjective interpretations and omissions depending on the informant. However, in South Korea, with the enforcement of the Patient Safety Act in 2016, the Ministry of Health and Welfare's Patient Safety Report and Learning System is being implemented. The reliability of the data can be guaranteed by confirming the contents of the reports and excluding false and duplicate reports from the KOPS. Notably, the number of accident reports has increased since the enforcement of the law. The second limitation of this study is the lack of relevant variables in the secondary data. Data on other important individual characteristics (e.g., underlying disease, self-efficacy), fall-related characteristics (e.g., history of falls, nutritional status, drug use), and organizational-level variables (e.g., nurses' educational level, ward culture) that may affect the fall detection time were not examined and could not be reflected in the results. In addition, it is difficult to generalize the findings because each healthcare institution has a different level of patient safety reporting. However, because this study utilized secondary data, it accessed extensive data from several different-sized medical institutions. In terms of the nursing research, the use of the ZINBR, which can reliably be used to analyze data comprising large quantities of zero values within continuous data, was significant [22]. This study presents methods to analyze data

that could be appropriate for future nursing studies on abuse, suicide attempts, and specific problem behaviors with similar characteristics.

Theoretically, it could be assumed that fall detection times affect patient safety and its influencing factors. However, it was difficult to interpret these results with confidence, because no previous study has identified this relationship and criteria for detection time that affect the fall patient's health. Future studies should build upon the present findings by examining the variables that influence the fall detection time and discovering cut-off point of the time. Furthermore, the importance of developing interventions to reduce fall detection time also needs to be recognized. In the future, this new evidence on delayed fall detection should be verified through replication studies using various data sources.

Conclusion

Timely interventions for fall patients have a positive effect on the hazards and trauma caused by the accident. The current study examined these differences, determined the factors affecting delayed fall detection, and provided essential evidence for improving policies governing the timely detection and treatment of fall accidents.

This study confirmed that, on an individual level, fall detection time may be higher in the case of female patients and those aged above 60 years. Regarding the hospital level, delayed fall detection is more likely to occur in general hospitals and hospitals than in tertiary hospitals and during night shifts. It is paramount for hospitals to improve the quality of conditions and nursing staff and for nurses to enhance patient education regarding fall prevention and management as well as regularly oversee safety instructions. This study recommended strategies to improve patient safety in healthcare facilities, such as continuous monitoring of fall risks and occurrences, education for nurses and patients, and improved nurse staffing.

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Conflict of interest

The authors declare that they have no competing interests.

References

1. Anderson O, Boshier PR, Hanna GB. Interventions designed to prevent healthcare bed-related injuries in patients. Cochrane Database Syst Rev. 2012;1. https://doi.org/10.1002/14651858.cd008931.pub2
2. Anderson DC, Postler TS, Dam TT. Epidemiology of hospital system patient falls: a retrospective analysis. Am J Med Qual. 2016;31(5):423–8. https://doi.org/10.1177/1062860615581199
3. Bouldin ED, Andresen EM, Dunton NE, Simon M, Waters TM, Liu M, et al. Falls among adult patients hospitalized in the United States: prevalence and trends. J Patient Saf. 2013;9(1):13–7. https://doi.org/10.1097/pts.0b013e3182699b64
4. Oliver D, Healey F, Haines TP. Preventing falls and fall-related injuries in hospitals. Clin Geriatr Med. 2010;26(4):645–92. https://doi.org/10.1016/j.cger.2010.06.005
5. Choi EH, Ko MS, Yoo CS, Kim MK. Characteristics of fall events and fall risk factors among inpatients in general hospitals in Korea. J Korean Clin Nurs Res. 2017;23(3):350–60. https://doi.org/10.22650/JKCNR.2017.23.3.350. Korean.
6. Yu X. Approaches and principles of fall detection for elderly and patient. In: HealthCom 2008-10th international conference on e-health networking, applications and services, IEEE. 2018. p. 42–7. https://doi.org/10.1109/HEALTH.2008.4600107
7. Healey F, Darowski A, Lamont T, Panesar S, Poulton S, Treml J, et al. Essential care after an inpatient fall: summary of a safety report from the National Patient Safety Agency. BMJ. 2011;342:d329. https://doi.org/10.1136/bmj.d329
8. Fischer ID, Krauss MJ, Dunagan WC, Birge S, Hitcho E, Johnson S, et al. Patterns and predictors of inpatient falls and fall-related injuries in a large academic hospital. Infect Control Hosp Epidemiol. 2005;26(10):822–7.
9. Cho MS, Lee HY. Factors associated with injuries after inpatient falls in a tertiary hospital. J Korean Clin Nurs Res. 2017;23(2):202–10. https://doi.org/10.22650/JKCNR.2017.23.2.202. Korean.
10. Hill KD, Vu M, Walsh W. Falls in the acute hospital setting—impact on resource utilisation. Aust Health Rev. 2007;31(3):471–7. https://doi.org/10.1071/ah070471
11. Miake-Lye IM, Hempel S, Ganz DA, Shekelle PG. Inpatient fall prevention programs as a patient safety strategy: a systematic review. Ann Intern Med. 2013;158(5):390–6. https://doi.org/10.7326/0003-4819-158-5-201303051-00005
12. Staggs VS, Dunton N. Associations between rates of unassisted inpatient falls and levels of registered and non-registered nurse staffing. Int J Qual Health Care. 2014;26(1):87–92. https://doi.org/10.1093/intqhc/mzt080
13. Spoelstra SL, Given BA, Given CW. Fall prevention in hospitals: an integrative review. Clin Nurs Res. 2012;21(1):92–112.
14. Cho SH, Lee JY, June KJ, Hong KJ, Kim Y. Nurse staffing levels and proportion of hospitals and clinics meeting the legal standard for nurse staffing for 1996~2013. J Korean Acad Nurs Adm. 2016;22(3):209–19. https://doi.org/10.11111/jkana.2016.22.3.209. Korean.
15. Han WG. Korean patient safety incident report 2018[internet]. Seoul: Korean Institute for Healthcare Accreditation; 2018 [Cited 2020 Nov 19]. Available from: https://www.kops.or.kr/portal/board/stat/boardDetail.do
16. Lee S, Jung H, Shin S, Jang J, Kim J, Yoon G, et al. Survey of analysis and improvement of working[internet]. Sejong: Institute for Health and Social Affairs; 2018. Available from: https://www.kihasa.re.kr/publish/report/list?page=1&type=all. Korean.
17. Zaninotto P, Falaschetti E. Comparison of methods for modelling a count outcome with excess zeros: application to Activities of Daily Living (ADLs). J Epidemiol Community Health. 2011;65(3):205–10. https://doi.org/10.1136/jech.2008.079640
18. Recio-Saucedo A, Dall'Ora C, Maruotti A, Ball J, Briggs J, Meredith P, et al. What impact does nursing care left undone have on patient outcomes? Review of the literature. J Clin Nurs. 2018;27(11-12):2248–59. https://doi.org/10.1111/jocn.14058
19. Najafpour Z, Godarzi Z, Arab M, Yaseri M. Risk factors for falls in hospital inpatients: a prospective nested case control study. Int J Health Pol Manag. 2019;8(5):300–6. https://doi.org/10.15171/ijhpm.2019.11
20. Jangland E, Teodorsson T, Molander K, Muntlin Athlin Å. Inadequate environment, resources and values lead to missed nursing care: a focused ethnographic study on the surgical ward using the Fundamentals of Care framework. J Clin Nurs. 2018;27(11-12):2311–21. https://doi.org/10.1111/jocn.14095
21. Schubert M, Glass TR, Clarke SP, Aiken LH, Schaffert-Witvliet B, Sloane DM, et al. Rationing of nursing care and its relationship to patient outcomes: the Swiss extension of the International Hospital Outcomes Study. Int J Qual Health Care. 2008;20(4):227–37. https://doi.org/10.1093/intqhc/mzn017
22. Tu W, Liu H. Zero-inflated data. In: Wiley StatsRef: statistics reference online. 2014. p. 1–7. https://doi.org/10.1002/9781118445112.stat07451.pub2
23. Buetow S, Kiata L, Liew T, Kenealy T, Dovey S, Elwyn G. Approaches to reducing the most important patient errors in primary health-care: patient and professional perspectives. Health Soc Care Community. 2010;18(3):296–303. https://doi.org/10.1111/j.1365-2524.2009.00904.x
24. Hurst K. UK ward design: patient dependency, nursing workload, staffing and quality—an observational study. Int J Nurs Stud. 2008;45(3):370–81. https://doi.org/10.1016/j.ijnurstu.2006.09.007
25. Royal College of Nursing. Guidance on safe nurse staffing levels in the UK [Internet]. London: Author; 2010 [cited 2011 Apr 28]. Available from: https://www.rcn.org.uk/professional-development/publications/pub-003860#orderTab
26. Farrow A, Reynolds F. Health and safety of the older worker. Occup Med. 2012;62(1):4–11. https://doi.org/10.1093/occmed/kqr148
27. Gale CR, Cooper C, Aihie Sayer A. Prevalence and risk factors for falls in older men and women: the English Longitudinal Study of Ageing. Age Ageing. 2016;45(6):789–94. https://doi.org/10.1093/ageing/afw129
28. Kim J, Lee W, Lee SH. A systematic review of the guidelines and Delphi study for the multifactorial fall risk assessment of community-dwelling elderly. Int J Environ Res Publ Health. 2020;17(17):6097. https://doi.org/10.3390/ijerph17176097
29. Kim J, Kim S, Park J, Lee E. Multilevel factors influencing falls of patients in hospital: the impact of nurse staffing. J Nurs Manag. 2019;27(5):1011–9. https://doi.org/10.1111/jonm.12765
30. Min A, Scott LD. Evaluating nursing hours per patient day as a nurse staffing measure. J Nurs Manag. 2016;24(4):439–48. https://doi.org/10.1111/jonm.12347
31. Lake ET, Shang J, Klaus S, Dunton NE. Patient falls: association with hospital Magnet status and nursing unit staffing. Res Nurs Health. 2010;33(5):413–25. https://doi.org/10.1002/nur.20399
32. Aiken LH, Cerón C, Simonetti M, Lake ET, Galiano A, Garbarini A, et al. Hospital nurse staffing and patient outcomes. Rev Med Clin Condes. 2018;29(3):322–7. https://doi.org/10.1016/j.rmclc.2018.04.011
33. Milstein R, Schreyoegg J. The relationship between nurse staffing levels and nursing-sensitive outcomes in hospitals: assessing heterogeneity among unit and outcome types. Health Pol. 2020;124(10):1056–63. https://doi.org/10.1016/j.healthpol.2020.07.013

Research Article

Development and Validation of an Instrument for Measuring Parenting Stress among Clinical Nurses

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A B S T R A C T

Purpose: Clinical nurses who are mothers of preschool-aged children experience extreme parenting stress linked to their hospital work environment and shift work, differing from that generally experienced by mothers. This study aimed to develop and validate a parenting stress scale that considers the clinical nurses' form of work and its characteristics.
Methods: The scale items were initially derived from in-depth interviews and a literature review and were revised and modified based on the results of content validity testing by experts. The developed instrument was evaluated using data from 157 clinical nurses in South Korea who were mothers of preschool-aged children.
Results: In the instrument validation stage, 19 items categorized in four factors (psychological burden, physical and mental fatigue, work shift, and work environment) were derived from construct validity, and the cumulative explanatory power was 56.6%. Furthermore, the convergent and discriminant validity and external construct were confirmed. Cronbach's α of the final instrument was .86 (range: .81—.86). The validity and reliability of the newly developed parenting stress scale for clinical nurses were established in this study; it uses a 4-point Likert scale. A higher mean score by factor indicates a higher level of parenting stress experienced by clinical nurses.
Conclusion: This instrument would be beneficial to measure the level of parenting stress among nurses who work in hospitals and evaluate factors related to their parenting stress to devise effective interventions.
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Introduction

According to the Survey of Inactive Nurses by the Korean Nurses Association, women's life events such as marriage, pregnancy, childbirth, and childrearing are important factors contributing to career disruption among nurses [1]. In a study analyzing the relationship between gender role values, the labor market structure, and the birth rate in 24 countries using Organization for Economic Cooperation and Development and World Values Survey data, Brinton and Lee [2] classified South Korea as a country that accepts women's economic participation but still holds traditional gender role values. It is in line with a social atmosphere that attributes more parenting responsibility to women than men. A total of 77.2% of Korean women and 35.6% of Japanese women agreed with the item "Having children limits parents' employment and career opportunities" in a questionnaire survey conducted by the Korea Women's Development Institute with men and women living in Seoul and Tokyo [3]. Women in Korea struggle to maintain work—family balance when they have children, and many eventually quit their jobs.

Among women's various occupations, nursing is particularly difficult to combine with rearing children because of family-unfriendly work hours, such as shift work and weekend shifts, along with excessive workload [4]. Thus, married clinical nurses with children require a higher work—home balance than nurses without children or unmarried nurses; carrying on with work becomes challenging, and they may consider resigning [5,6].

In research related to parenting by clinical nurses, clinical nurses reported feeling "guilt for not fulfilling their duties as mothers"; particularly, they felt heartbroken for not having enough time to

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care for their children and felt that all the problems with their children were their fault [1]. Another study found that nurses have difficulties in terms of spending time with their children, as they cannot routinely engage in activities with them because of irregular daily patterns of shift work and have trouble focusing on their children as they feel pressured to sleep early to work an early morning shift the next day [7]. There are several other work-related reasons for high parenting stress among nurses, including being physically and mentally tired, which leads them to misdirect their stress and frustration onto their children, only to regret doing so afterward, as well as the inability to be notified during work or leave work early when their child is sick [7]. Particularly, nurses who work an 8-hour rotating shift while rearing preschool-aged children struggle with dropping off and picking up their children at daycare because of their work schedule, which requires early morning or late-night work [5]. In addition, preschool age is a critical period for growth and development, and mothers' parenting stress is more critical in this period than at other times [8]. This is because this is a critical period for building mother–child attachment, and high perceived mental and psychological parenting stress in working mothers who fulfill multiple roles has adverse effects on their parenting [9], with parenting stress increasing turnover [10].

As discussed previously, parenting stress experienced by clinical nurses is associated with shift work, weekend shifts, low flexibility in the work schedule, and caregiving work–related characteristics. The Parenting Stress Scale (PSS; 1997) by Kim and Kang [11], generally used to assess parenting stress in nurses in Korea, was developed to measure general parenting stress based on daily stress from childrearing, the burden of parental roles, and guilt for having children reared by others. Furthermore, the Parenting Stress Index Short Form by Abidin [12] also measures general parenting stress based on the parent, parent–child relationship, and child domains. However, these instruments are limited when measuring parenting stress experienced by nurses, which differs from the general parenting stress experienced by mothers. Accordingly, this study aimed to develop and validate an instrument to specifically assess parenting stress among clinical nurses who are mothers of preschool-aged children.

Methods

Design

This study developed and validated an instrument to assess parenting stress in clinical nurses who rear preschool-aged children, with reference to the instrument development process suggested by DeVellis [13]. Therefore, this study proceeded in two stages. The first stage was instrument development, during which the preliminary items—based on a literature review and focus group interviews—were developed. The preliminary items were then validated by experts, and a pilot test was conducted. The second stage was instrument validation. Item analysis and validity and reliability testing were performed to finalize the instrument.

Ethics

After obtaining approval from the institutional review board at a university hospital, the author's affiliation (Approval no. SMC 2019-10-089-001), nurses who agreed to participate were informed of the purpose, method, data collection, and duration of the study, voluntary study participation and withdrawal, lack of disadvantages from study withdrawal, and confidentiality of collected data.

The questionnaire was distributed to those who voluntarily consented to participate. All participants provided informed consent for the research, and their anonymity was preserved. Permission was received from the copyright holder to use and translate copyrighted instruments/software used in the research.

Step 1: Instrument development

Derivation of preliminary items

One-to-one interviews were conducted with five nurses who reared preschool-aged children to examine the characteristics of parenting stress among clinical nurses. After building rapport, the interviews with clinical nurses lasted at least an hour, and a comfortable environment was fostered to help the nurses talk about the challenges they encountered in raising their children while working at a hospital. Then, the properties of parenting stress derived from the interviews were integrated with those found through a literature review [4,14–16]. Clinical nurses' parenting stress was broadly divided into personal and environmental dimensions. The personal dimension included "psychological burden," "anxiety and guilt," and "physical and mental fatigue" factors, whereas the environmental dimension included "work shift," "work environment," and "awareness of others' judgment" factors. The preliminary items for the PSS for clinical nurses who raise preschool-aged children were developed based on these results, with a total of 41 items being initially derived (Figure 1).

Determination of measurement scope

This study used an even-numbered scale to remove central response tendency because it has been shown that if a neutral response is available, participants who are reluctant to choose extreme responses or to respond at all may choose it, which can restrict the variance of measurements [17]. Thus, a 4-point Likert scale was used: 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree).

Content validity testing

The content validity of the instrument was assessed by a panel of six experts comprising two psychiatric nursing professors, two pediatric nursing professors, and two female health nursing professors. It was assessed using a 4-point scale ranging from 1 (not relevant) to 4 (highly relevant), and experts were asked to present any opinions about items that required revision as well as about the items overall. The item content validity index (I-CVI) and scale content validity index (S-CVI) were calculated for the preliminary items. The S-CVI used the S-CVI/average (S-CVI/Ave) and S-CVI/universal agreement (S-CVI/UA). Two items in the "psychological burden" factor and two items in the "awareness of others' judgment" factor with an I-CVI below .78 were deleted [18]. As per experts' comments, the meanings of eight items were clarified, one item was added to the "work environment" factor, and one item was added to the "awareness of others' judgment" factor. In the second content validity test, all items had an I-CVI of .83 or higher, the S-CVI/Ave was .99, and S-CVI/UA was .95. Consequently, 39 items were included in the preliminary tool.

Pilot test

To examine the applicability of the preliminary tool, a pilot test was conducted with seven clinical nurses who raised preschool-aged children to assess the time required to complete the survey, item comprehension, and item length. It took an average of 9 minutes to complete the survey, and none of the items were considered difficult to understand or too long.
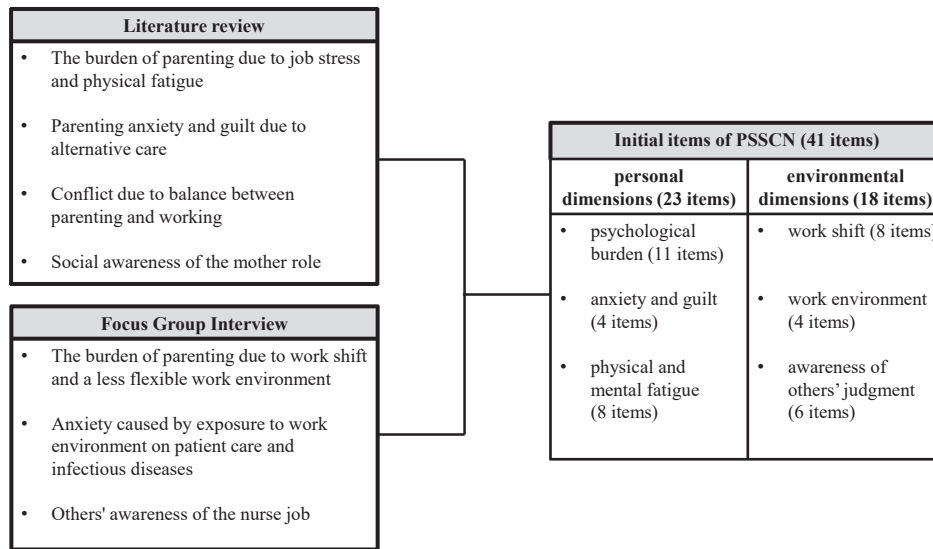
Figure 1. Derivation of preliminary items.

Step 2: Instrument validation

Participants

Nurses who worked in general hospitals in two regions and were mothers of preschool-aged children were enrolled to test the validity and reliability of the instrument. The inclusion criteria were (1) female clinical nurses who work in a hospital, (2) parent of a preschool-aged child, and (3) informed consent to participate in the study. The exclusion criteria were: (1) parent of twins, (2) nurses not involved in direct patient care, and (3) single mothers. In consideration of the minimum sample size of 150 for factor analysis and a 10% withdrawal rate, a total of 165 questionnaires were distributed, and 161 were retrieved. After excluding questionnaires unsuitable for analysis because of missing responses, 157 participants were included in the final sample. This satisfied the minimum required sample size of 150 for factor analysis [19,20].

Data collection

First, after explaining the purpose and procedure of this study to the relevant institutions, data were collected between November 1 and 30, 2019, from four general hospitals in two regions of South Korea that approved the collection. Recruitment announcements were posted in the nurse education rooms in the four general hospitals. Second, participants who wished to participate in this study were checked for the inclusion criteria. The purpose, procedure, and method of the study were explained, and sufficient understanding was confirmed.

If there was a willingness to participate voluntarily, a questionnaire was conducted after obtaining written consent.

Instruments

The questionnaire consisted of nine items for demographic characteristics, 39 items developed in this study, and 11 items of the PSS developed by Kim and Kang [11] and modified by the Korea Institute of Child Care and Education (KICCE; 2015) to test the criterion validity. Cronbach's α for the KICCE version of the PSS was .82 in this study.

Data analyses

The data collected to test the reliability and validity of the instrument were analyzed using SPSS 21.0 (IBM. Corp., Armonk, NY, USA). Participants' demographics were summarized using descriptive statistics and frequency analysis. To evaluate construct validity, first, item analysis was performed using correlation coefficients, and second, exploratory factor analysis (EFA) was conducted using maximum likelihood estimation and oblique rotation. Oblique rotation—which is more robust than orthogonal rotation and promax rotation and is the most common rotation method—was used [21]. Kappa, which refers to the level of permitted correlation between factors, was set to 4 [22]. Third, the convergent and discriminant validity of the final instrument was tested using the multitrait-multimethod matrix, which examines the correlations of each item, both with their respective factors and the remaining factors. Fourth, criterion validity was tested based on the correlation between the finalized instrument and the KICCE version of the PSS. Finally, the reliability of each factor and the overall instrument were assessed using Cronbach's α.

Results

Sample characteristics

The mean age of the participants was 36.19 ± 3.36 years, and the mean length of their clinical career was 13.64 ± 3.14 years. Regarding job positions, 44.0% were staff nurses, 48.4% were charge nurses, and 7.6% were head nurses. The most common type of work shift was the 8-hour rotating shift (53.5%), followed by full-time (28.0%), mixed (9.6%), and 12-hour rotating shift (8.9%). In terms of education, 5.1% had an associate degree, 69.4% had a bachelor's degree, and 25.5% had a master's degree or higher. The majority of the participants (73.2%) had one preschool-aged child, whereas 24.2% had two, and 2.6% had three or more. Most of the participants (89.8%) lived with their children, and 94.9% used a childcare facility. While 64.3% were dissatisfied with their spousal support, 26.1% were satisfied (Table 1).

Table 1 *Sample Characteristics (N = 157).*

Characteristics	Categories	*n*	%	Mean	*SD*	Range
Age (years)	≥29	6	3.8			
	30−39	123	78.4			
	≤40	28	17.8			
	Total			36.19	3.36	28.00-43.00
Career (years)	>10	21	13.4			
	10−15	82	52.2			
	<15	54	34.4			
	Total			13.64	3.14	5.00-20.67
Job position	Staff nurse	69	44.0			
	Charge nurse	76	48.4			
	Head nurse	12	7.6			
Work shift	Rotating 8-hour shift	84	53.5			
	Rotating 12-hour shift	14	8.9			
	Mixed	15	9.6			
	Full-time	44	28.0			
Education level	Associate degree	8	5.1			
	Bachelor's degree	109	69.4			
	Master's degree or higher	40	25.5			
Number of preschool-aged children	1	115	73.2			
	2	38	24.2			
	≥3	4	2.6			
Living with child	Yes	141	89.8			
	No	16	10.2			
Use childcare facility	Yes	149	94.9			
	No	8	5.1			
Satisfaction with spousal support	Very satisfied	3	1.9			
	Satisfied	41	26.1			
	Dissatisfied	101	64.3			
	Very dissatisfied	12	7.7			

Note. SD = standard deviation.

Construct validity: item analysis

First, the skewness and kurtosis of each item were examined to determine the normality of the collected data. The skewness values ranged from −1.09 to 0.40, and kurtosis values ranged from −1.04 to 1.35. As the absolute value of skewness and kurtosis did not exceed 3 and 10, respectively, the assumption of normality was met [23].

Next, to examine the contribution of each item, the correlations of each of the 39 items with the overall items were examined. Items 29 and 35 had a correlation coefficient below .30 and were thus deleted for having low discriminatory power [24]; the correlation coefficients for the remaining 37 items with the overall items ranged from .30 to .70 (Table 2).

Construct validity: EFA

To determine whether the 37 items selected through item analysis were suitable for EFA, the Kaiser−Meyer−Olkin statistic was calculated, and Bartlett's test of sphericity was performed. The Kaiser−Meyer−Olkin value was .66, and χ^2 in the test of sphericity was 4011.90 ($df = 666$, $p < .001$), based on which the data were determined to be suitable for EFA [25].

In the first round of EFA, factors with an eigenvalue of 1 or higher were extracted, and to determine the number of factors, the 4- and 10-factor models on the scree plot were considered. Although at least three items are required for a single factor [26,27], the 10-factor model contained factors that only consisted of two items; thus, 10 factors were considered excessive. Thus, in the second round of EFA, the number of factors was set to four. Items were extracted based on the following criteria: communality of .3 or higher, factor loading of .30 or higher, and a difference of factor loading between factors of .20 or higher [24]; the reference values were taken from the rotated pattern matrix. Twelve items were considered for deletion in the second round, three items were

considered for deletion in the third round, and three were considered for deletion items in the fourth round, as they did not meet the criteria; they finally deleted based on the judgment that they lacked distinctive characteristics. In the fifth round of EFA, 19 items in four factors were considered as final. Factor 1 had an eigenvalue of 3.28, explanatory power of 17.3%, and the factor loadings of the six items included were .63 or higher. Factor 2 had an eigenvalue of 2.61, explanatory power of 13.7%, and the factor loadings of the five items included were .62 or higher. Factor 3 had an eigenvalue of 2.95, explanatory power of 15.6%, and the factor loadings of the five items included were .60 or higher. Factor 4 had an eigenvalue of 1.90, explanatory power of 10.0%, and the factor loadings of the three items included were .66 or higher. The cumulative explanatory power of the four factors was 56.6% (Tables 2 and 3).

Convergent and discriminant validity

The multitrait-multimethod matrix showed that the correlation coefficients of the 19 items with their respective factors all exceeded .40, with a range of .64−.87, showing a scaling success rate of 100% for convergent validity. Furthermore, the correlation coefficients of each item with other factors ranged from -.06 to .46. As each item correlated to a lesser extent with other factors than their respective factors, discriminant validity was established [28] (Table 3).

External construct validity

The Pearson correlation coefficient for the relationship between the PSS for clinical nurses developed in this study and the KICCE version of the PSS was significant at .36 ($p < .001$). The correlations of each of the four factors of the developed scale with the PSS were also significant at .19−.31 (Table 4).

Table 2 *Analysis of Item Appropriateness for the 19 Items and Four Factors of the Parenting Stress Scale for Clinical Nurses (N = 157).*

Factor/item	Mean ± SD	Item and total correlation	Communality	Factor loading
Psychological burden				
8. There are times when I feel like my child is falling behind other kids because I am a working mother.	2.52 ± 0.77	.57**	.54	0.74
5. I feel sorry for my child for being left out because I can't actively meet with other mothers.	2.76 ± 0.74	.53**	.61	0.74
3. It's so overwhelming to keep up with the massive parenting information because I am a working mother.	3.08 ± 0.66	.46**	.50	0.73
4. I feel anxious for not having any channels or social parties to obtain parenting information from because I work.	2.90 ± 0.70	.51**	.50	0.71
9. I can't properly discipline my child because I work.	2.54 ± 0.69	.57**	.47	0.64
1. I am not confident whether I can be a good mother while working.	2.60 ± 0.70	.56**	.47	0.63
Physical and mental fatigue				
14. I have inadvertently let out my frustration or gotten mad while taking care of my child.	3.29 ± 0.64	.56**	.67	0.74
18. I'm so exhausted when my child clings only onto me.	3.18 ± 0.63	.31**	.46	0.72
16. I have felt annoyed when my child wanted me to play with him/her.	2.95 ± 0.71	.53**	.59	0.72
30. I feel burdened because the stress I get from patients and colleagues at the hospital affects my parenting.	2.80 ± 0.76	.45**	.46	0.62
21. I'm so burned out at work that taking care of my child at home becomes troublesome.	2.73 ± 0.67	.47**	.41	0.62
Work shift				
25. I feel sorry because I can't be with my child when he/she goes to bed or wakes up due to my shift work.	3.01 ± 0.86	.50**	.83	0.86
26. I feel sorry because I can't spend enough time with my child due to shift work and weekend shifts.	3.10 ± 0.77	.51**	.69	0.83
27. I am worried that the irregular lifestyle due to my shift work will harm my child's health.	2.62 ± 0.84	.70**	.71	0.74
23. I feel sorry because my child's life became irregular due to my shift work.	2.92 ± 0.86	.54**	.52	0.65
28. I feel sorry for my colleagues because I often request my work schedule to fit around my child's schedule.	2.45 ± 0.92	.36**	.45	0.60
Work environment				
32. I have been worried about infecting my child when I come home after providing care for a patient with an infectious disease.	3.36 ± 0.66	.41**	.70	0.84
33. I am worried that my child will be unfairly treated for having a nurse mother when epidemics break out (e.g., MERS, SARS). (Example: Child gets rejected at daycare because he/she is considered a potential source of infection).	3.45 ± 0.68	.30**	.55	0.77
34. I am worried that the toxic substances I encounter at the hospital (e.g., drugs, disinfectants) will be passed on to my child.	3.15 ± 0.72	.52**	.63	0.66

Note. SD = standard deviation.
**p < .01.

Table 3 *Convergent and Discriminant Validity (N = 157).*

Item no.	Factor 1: psychological burden	Factor 2: physical and mental fatigue	Factor 3: work shift	Factor 4: work environment	Total
8	.77	.17	.23	.12	
5	.81	.26	.12	.24	
3	.73	.03	.07	.10	
4	.79	.15	.17	.16	
9	.75	.20	.28	.21	
1	.74	.24	.28	.17	
14	.26	.80	.39	.16	
18	.06	.72	.07	.11	
16	.28	.80	.21	.26	
30	.06	.74	.29	.14	
21	.23	.75	.19	.15	
25	-.01	.36	.84	.38	
26	.13	.26	.83	.32	
27	.35	.28	.86	.42	
23	.20	.37	.78	.28	
28	.30	-.06	.64	.03	
32	.23	.19	.23	.87	
33	.16	.05	.22	.84	
34	.18	.30	.46	.85	
Number of items	6	5	5	3	19
Eigenvalue	3.28	2.61	2.95	1.90	-
Explanatory power	17.3	13.7	15.6	10.0	56.5
Cronbach's α	.86	.82	.84	.81	.86

Table 4 *Correlation Coefficients Between Factors (N = 157).*

Measures	PSS by KICCE	PSSCN total	Factor 1	Factor 2	Factor 3	Factor 4
PSS by KICCE	1					
PSSCN total	.36**	1				
Factor 1: psychological burden	.31**	.69**	1			
Factor 2: physical and mental fatigue	.26**	.64**	.23**	1		
Factor 3: work shift	.19*	.75**	.25**	.30**	1	
Factor 4: work environment	.22**	.57**	.22**	.22**	.36**	1

Note. KICCE = Korean Institute of Child Care and Education; PSS = Parenting Stress Scale; PSSCN = Parenting Stress Scale of Clinical Nurse.
*$p < .05$; **$p < .01$.

Reliability

The reliability of the instrument was evaluated using the Cronbach's α coefficient, which measures internal consistency. Cronbach's α for the final instrument was .86. Internal consistency was thus established with a value of Cronbach's α of .86 for Factor 1, .82 for Factor 2, .84 for Factor 3, and .81 for Factor 4 [29] (Table 3).

Finalization of the instrument

The PSS for clinical nurses finally contained 19 items categorized in four factors: six items for Factor 1 "psychological burden," five items for Factor 2 "physical and mental fatigue," five items for Factor 3 "work shift," and three items for Factor 4 "work environment." Each item is rated on a 4-point Likert scale: 1 (strongly disagree), 2 (disagree), 3 (agree), and 4 (strongly agree). As the instrument has different number of items for each factor, the mean score for each factor is calculated to allocate scores evenly across factors. The total score ranges from 4 to 16, with a higher score indicating a higher level of parenting stress among clinical nurses (Appendix A).

Discussion

This is the first study to develop and validate an instrument for assessing parenting stress in nurses raising preschool-aged children. The following four factors in two dimensions were extracted through validity testing: Factor 1 "psychological burden" and Factor 2 "physical fatigue" in the personal dimension and Factor 3 "work shift" and Factor 4 "work environment" in environmental. Some items in the preliminary factors "anxiety and guilt" and "awareness of others' judgment" were deleted. The percentage of variance explained was similar across factors: 17.3% by Factor 1, 13.7% by Factor 2, 15.6% by Factor 3, and 10.0% by Factor 4.

Factor 1, "psychological burden," represents the burden of raising a child while working as a clinical nurse. Most instruments used in previous studies also include items about psychological burden in their measurement of parenting stress. In the one developed by Kim and Kang [11], daily stress, burden and distress of parenting role, and guilt for relying on other care providers all fall under the psychological burden; the instrument developed by Abidin [12] also includes psychological burden using a domain named "parents' pain." In the previous study of clinical nurses who are mothers of preschool-aged children, daily stress and psychological burdens accounted for a high proportion of parenting stress [9]. According to the 2019 Survey About Parenting Policies for Establishing a Happy Parenting Culture conducted by the KICCE [30], the mean distribution of parenting roles for mothers and fathers was 7.0 and 3.0 out of 10, respectively, which shows that mothers still have a heavy psychological burden from parenting in Korean society.

Factor 2, "physical and mental fatigue," consists of items measuring physical fatigue caused by parenting and the extent to which the burden of potential emergencies and burnout caused by stress with patients and coworkers may lead to parenting stress. It is in line with the report that emotional and physical exhaustion, apathy, helplessness, and desensitization to patients and families are central constructs related to compassion fatigue in nurses [31]. Nursing requires intense concentration to care for patients, long working hours, and inevitable emergencies and irregularity, which ultimately generates work–family conflicts [32]. In addition, female nurses have higher work–family conflicts than male nurses [33,34] and differ in psychological health conditions [34]. The factor of physical and mental fatigue as parenting stress of clinical nurses who are mothers of preschool-aged children can be considered reasonable.

Factor 3, "work shift," encompasses nurses' concerns regarding their inability to take care of children because of rotating shift work and weekend shifts and having a harmful influence on their children as a result of an irregular living environment. It showed similar results to a previous study in which married rotating shift nurses had higher life–work conflict than nonshift nurses [35]. Japan has implemented various forms of work shifts, including day work without night overtimes, nighttime-only shifts, flex time (flexibility regarding when to start and finish work), and work sharing (multiple workers taking charge of one position) [1]. Such systems with various forms of work shifts are lacking in Korea, as Korean policies mainly focus on women in full-time jobs or working standard hours, highlighting the requirement to implement alternative shift forms for rotating shift workers.

Factor 4, "work environment," represents concerns about transmitting infectious diseases and epidemics that are present in the hospital to their children or harming them in some way, which is consistent with previous reports that mothers are more stressed about being exposed to uncontrolled infections [36]. Nurses who went through the Middle East Respiratory Syndrome outbreak in Korea in 2015 experienced firsthand the risk of infecting themselves, colleagues, and families and expressed concerns about the threat of contagious illnesses [37]. This factor includes items specifically tailored to the nursing profession that are not present in existing tools.

In our study, the correlation between our instrument and the KICCE version of the PSS, to test the criterion validity, was .36. The correlations of the "work shift" (.19) and "work environment" (.22) factors were relatively low. It can be considered to reflect the nature of the nursing profession, which involves special work shifts, such as rotating shifts, holiday shifts, and on-call shifts as well as special tasks such as providing care to patients with communicable diseases.

From the preliminary items, items in the "anxiety and guilt" and "awareness of others' judgment" factors were deleted. First, the items in the anxiety and guilt factor were modified based on the tool

developed by Kim and Kang [11], and the factor encompasses items pertaining to anxiety caused by surrogate parenting and feeling sorry for the child. In the past, parents had high levels of parenting stress because of anxiety and guilt for relying on surrogate parenting [11]. In recent years, parents use childcare facilities regardless of the mother's employment status [38], and parenting guilt does not differ according to the mother's employment status [39]. Hence, it seems that anxiety and guilt because of surrogate parenting is not unique to working mothers. Furthermore, guilt felt by working mothers was reported to be associated with the social perception and role conflict in which heavier responsibilities are imposed upon women [40], which may explain why the "awareness of others' judgment" factor that reflects a social perception demanding more sacrifice and responsibility from mothers was deleted along with the "anxiety and guilt" factor. Therefore, this instrument is significant as a measure of parenting stress that reflects modern trends, and additional studies are required regarding this matter.

The PSS for clinical nurses has a different number of items for each factor; thus, the mean score for each factor was calculated to ensure that the total score does not heavily rely on any one of the factors, instead reflecting all concepts of parenting stress identified in the instrument development stage. Furthermore, this enables comparisons of scores by factors to determine which aspect of parenting stress is high. The mean parenting stress among clinical nurses was 11.86 ± 1.55 in our study, and by factors, the mean scores were 2.73 ± 0.54 for "psychological burden," 2.99 ± 0.52 for "physical and mental fatigue," 2.82 ± 0.66 for "work shift," and 3.32 ± 0.59 for "work environment." The score for the "work environment" factor of parenting stress was the highest, and parenting stress on the environmental dimension was higher than personal. These results are in line with the previous finding that parenting stress among clinical nurses is related to shift work and work environment [5,7]. Although the instruments that have been used in the past to measure nurses' parenting stress have focused on personal dimensions, such as psychological burden and guilt, the PSS for clinical nurses developed in this study will enable more in-depth research on parenting stress among clinical nurses.

There are some limitations to this study. First, the study findings might not be generalized to all clinical nurses who are mothers of preschool-aged children, as this study only included nurses from general hospitals in two regions of Korea. Second, the analysis could not consider child-related factors, such as character and temperament. Third, the sample size was relatively small to implement pilot tests. Fourth, a test–retest correlation could not be additionally confirmed in reliability verification. Finally, confirmatory factor analysis was not performed for the instrument developed in this study. Therefore, it is necessary to repeat studies with more diverse and large populations. Further studies to confirm the factor structure are also required.

Despite these limitations, the validated instrument presented in this study can be used to measure parenting stress among nurses raising preschool-aged children to devise specific interventions for this population to lower their parenting stress level. Moreover, this instrument can provide an opportunity to lay a foundation for making relevant policies for this population.

Conclusions

This study aimed to develop and validate an instrument for measuring the parenting stress of clinical nurses who are mothers of preschool-aged children, which considers work shifts and job-specific characteristics. First, the instrument was developed through literature review, in-depth interviews, and content validity testing, and the items were finalized by testing their construct validity, convergent and discriminant validity, criterion validity,

and reliability. Finally, the PSS for clinical nurses contained 19 items in four factors: "psychological burden," "physical and mental fatigue," "work shift," and "work environment." Each item is rated on a 4-point Likert scale from "strongly disagree" (1) to "strongly agree" (4), with a higher mean score for each factor indicating a higher level of parenting stress among clinical nurses. The PSS for clinical nurses developed in this study can be beneficial for assessing the level of parenting stress among clinical nurses who raise preschool-aged children, considering different aspects of stress. By studying factors of parenting stress, interventions can be designed to lower it in this population. Based on our findings, hospital managers will be able to lay a foundation for solving problems related to clinical nurse staffing and career disruption by developing efficient strategies for managing parenting stress among clinical nurses who raise preschool-aged children.

Relevance for clinical practice

In Korea, many nurses raising preschool-aged children choose to quit their jobs. It decreases the quality of patient care and generates problems for hospitals' personnel management. This situation may be related to nurses' parenting stress. The instrument developed in this study will be easy to use at clinical sites and beneficial for assessing the level of clinical nurses' parenting stress considering its different aspects. In addition, the scale can provide a foundation to design efficient strategies for managing parenting stress among clinical nurses and tackle problems related to clinical nurse staffing and career disruption. In particular, active support and interventions by hospitals, nursing associations, and the state are required to reduce stress by identifying which aspects of nurses' lives are stressful.

References

1. Lee YS, Lee SM, Lee JS, Lee HM. The lived experiences of childrearing with specific focus on the nurses on three-shift schedules. J Qual Res. 2015;16(2): 71−84. https://doi.org/10.22284/qr.2015.16.2.71. Korean.
2. Brinton MC, Lee D. Gender-role ideology, labor market institutions, and post-industrial fertility. Popul Dev Rev. 2016;42(3):405−33. https://doi.org/10.1111/padr.161
3. Hong SA. Announcement of the survey on marriage and family values of the 20s and 40s in Korea and Japan [Internet]. Seoul, Korea: Korean Women's Development Institute; 2019 [cited 2019 Oct 30]. Available from: https://www.kwdi.re.kr/plaza/bodoView.do?page=1&idx=124259
4. Jung HJ, Cho Chung HI. Adaptation process of nurses who return to work after parental leave. J Kor Acad Nurs Adm. 2016;22(1):33−45. https://doi.org/10.11111/jkana.2016.22.1.33. Korean.
5. Hwang N, Jang I, Park E. Factors influencing the intent to return to practice (work) of inactive RNs. J Kor Data Inf Sci Soc. 2016;27(3):791−801. https://doi.org/10.7465/jkdi.2016.27.3.791. Korean.
6. Mazurenko O, Gupte G, Shan G. Analyzing US nurse turnover: are nurses leaving their jobs or the profession itself. J Hosp Adm. 2015;4(4):48−56. https://doi.org/10.5430/jha.v4n4p48
7. Kim JI, Yeom JW, Park SK, Jeong HH, Min UJ, Park SH, et al. Experience of conflict in three shift nurses rearing more than two kids: phenomenological study. Kor J Women Health Nurs. 2018;24(3):252−64. https://doi.org/10.4069/kjwhn.2018.24.3.252. Korean.
8. Bang EJ. A relationship between parenting stress, parenting knowledge, and parenting self-efficacy of mother with infant. Educ Theory Pract Infant Young Child. 2018;3(2):61−81. Korean.
9. So JY, Ha YJ. Converged influencing factors on the career commitment of general hospital nurses with preschool children. J Kor Converg Soc. 2020;11(5): 341−51. https://doi.org/10.15207/JKCS.2020.11.5.341. Korean.
10. Kang SJ, Kim SY. The relationship among nurses' 0arenting stress and turnover intention. J Kor Acad Nurs Adm. 2011;17(4):508−15. Korean.
11. Kim KH, Kang HK. Development of the parenting stress scale. (Original work published in Korean). Fam Environ Res. 1997;35(5):141−50. Korean.
12. Abidin RR. Parenting stress index: Manual. 3rd ed. Odessa, FL: Psychological Assessment Resources; 1995. p. 1−124.
13. DeVellis RF. Scale development: theory and applications. 3rd ed. Thousand Oaks, CA: Sage Publications; 2012. p. 73−115.
14. Kim YS, Kwon MK. Nurse's parenting stress. Kor Parent Child Health J. 2010;13(2):86−94. Korean.
15. Oh JW, Moon YS, Park IS. A Study of nurses' working stress, child-rearing stress and parenting attitude. J Digit Pol Manag. 2013;11(10):469−81. https://doi.org/10.14400/JDPM.2013.11.10.469. Korean.
16. Yu KZ. Parenting stress, job stress, and parenting behaviors in nurses. J Kor Child Care Educ. 2013;9(2):5−21. Korean.
17. Dumas J. Usability testing methods: subjective measures, Part II- measuring attitudes and opinions. Am Inst Res. 1999;9:1−5.
18. Polit DF, Beck CT, Owen SV. Is the CVI an acceptable indicator of content validity? Appraisal and recommendations. Res Nurs Health. 2007;30(4):459−67. https://doi.org/10.1002/nur.20199
19. Anderson JC, Gerbing DW. Structural equation modeling in practice: a review and recommended two-step approach. Psychol Bull. 1988;103(3):411−23. https://doi.org/10.1037/0033-2909.103.3.411
20. Holbert RL, Stephenson MT. Structural equation modeling in the communication sciences, 1995−2000. Hum Commun Res. 2002;28(4):531−51. https://doi.org/10.1111/j.1468-2958.2002.tb00822.x
21. Panaretos D, Tzavelas G, Vamvakari M, Panagiotakos D. Investigating the repeatability of the extracted factors in relation to the type of rotation used, and the level of random error: a simulation study. J Data Sci. 2020;18(2): 390−404. https://doi.org/10.6339/JDS.202004_18(2).0010
22. Hendrickson AE, White PO. Promax: a quick method for rotation to oblique simple structure. Br J Stat Psychol. 1964;17(1):65−70. https://doi.org/10.1111/j.2044-8317.1964.tb00244.x
23. Kline RB. Principles and practice of structural equation modeling. New York: The Guilford Press; 2011. p. 74−7.
24. Hair JF, Black WC, Babin BJ, Anderson R. Multivariate data analysis. 7th ed. Upper Saddle River, NJ: Prentice-Hall; 2010. p. 109−37.
25. Kaiser HF. An index of factorial simplicity. Psychometrika. 1974;39(1):31−6.
26. Costello AB, Osborne JW. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. Practical Assess Res Eval. 2005;10(7):1−9. https://doi.org/10.7275/jyj1-4868
27. Raubenheimer J. An item selection procedure to maximize scale reliability and validity. SA J Ind Psychol. 2004;30(4):59−64.
28. Campbell DT, Fiske DW. Convergent and discriminant validation by the multitrait-multimethod matrix. Psychol Bull. 1959;56(2):81−105. https://doi.org/10.1037/h0046016
29. Kline P. The handbook of psychological testing. 2nd ed. London: Routledge; 2000. p. 11−6.
30. Kim DH, Lee JH, Lee HM. KICCE poll for establishing the culture of happy child care (I) [Internet]. Seoul, Korea: Institute of Child Care and Education; 2017 [cited 2020 Jan 7]. Available from: http://repo.kicce.re.kr/handle/2019.oak/934
31. Henson JS. Burnout or compassion fatigue: a comparison of concepts. Medsurg Nurs. 2020;29(2):77−95.
32. Zandian H, Sharghi A, Moghadam TZ. Quality of work life and work-family conflict: a cross-sectional study among nurses in teaching hospitals. Nurs Manag (Harrow). 2020;27(2):23−31. https://doi.org/10.7748/nm.2020.e1881
33. AlAzzam M, AbuAlRub RF, Nazzal AH. The relationship between work-family conflict and job satisfaction among hospital nurses. Nurs Forum. 2017;52(4): 278−88. https://doi.org/10.1111/nuf.12199
34. Zurlo MC, Vallone F, Smith AP. Work-family conflict and psychophysical health conditions of nurses: gender differences and moderating variables. Jpn J Nurs Sci. 2020;17(3):e12324. https://doi.org/10.1111/jjns.12324
35. Vaghar MI, Masrour MJ. A comparative study of satisfaction and family conflicts among married nurses with different working hours. J Fam Med Prim Care. 2019;8(2):472−6. https://doi.org/10.4103/jfmpc.jfmpc_395_18
36. Mo Y, Deng L, Zhang L, Lang Q, Liao C, Wang N, et al. Work stress among Chinese nurses to support Wuhan in fighting against COVID-19 epidemic. J Nurs Manag. 2020;28(5):1002−9. https://doi.org/10.1111/jonm.13014
37. Kim Y. Nurses' experiences of care for patients with Middle East respiratory syndrome-coronavirus in South Korea. Am J Infect Contr. 2018;46(7):781−7. https://doi.org/10.1016/j.ajic.2018.01.012
38. Yu HM, Kang EJ, Kwon MK, Park JA, Kim DH, Kim GJ, et al. 2018 National child care survey-childcare center survey report [Internet]. Sejong, Korea: Ministry of Health and Welfare; 2019 [cited 2021 Apr 7]. Available from: http://www.mohw.go.kr/react/jb/sjb030301vw.jsp?PAR_MENU_ID=03&MENU_ID=032902&CONT_SEQ=349978&page=1
39. Nho H, Kim S. The effect of parental counseling on parenting efficacy and parenting guilt. Welfare. Educare. 2020;24(2):57−78. https://doi.org/10.22590/ecee.2020.24.2.57. Korean.
40. Jung TY, Roh HJ. Differences between the employed and the unemployed mothers in parenting guilt and behaviors. Kor J Woman Psychol. 2005;10(2): 211−31. Korean.

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Research Article

Self-care Experiences of Adolescents with Spinal Muscular Atrophy

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ABSTRACT

Purpose: We examined the self-care experiences of adolescents with spinal muscle atrophy (SMA) and their perceptions of the interactions between their body and the environment.
Methods: We interviewed ten adolescents with SMA aged 13—18 years regarding personal care practices. Purposive sampling was conducted in two medical centers in northern Taiwan. Data were analyzed using the Giorgi analysis method.
Results: Four constitutions were identified: (1) limited space for independent development, (2) multiple reconstructions of self-image to improve physical ability, (3) self-care of disease, and (4) developing activity styles to accommodate social culture.
Conclusion: The self-care lived experiences of patients reflect dynamic changes in the body and environment. Self-existence was exhibited by adjustment, practice, and creativity of physical activity to integrate into society. Nursing staff should understand the self-care experiences and needs of adolescents with SMA to develop a database of self-care skills. This study recommended that nursing staff improve their ability to guide patients in taking care of themselves by developing body awareness self-care courses and individual care plans in response to various stages of disability to help patients delay deterioration, realize their physical potential, and promote independence and social development.
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Introduction

Spinal muscular atrophy (SMA) is an autosomal recessive neuromuscular disorder. Although rare, it has an extremely high mortality rate among infants. This systematic review estimates the incidence to be 1 case per 11,000 live births [1], with approximately 30 newborn babies suffering from this disease annually in Taiwan [2]. SMA can be classified into four types. The onset of Type I SMA is usually before 6 months of age. Patients cannot sit or control their head and most die of respiratory tract infections before the age of two. The onset of Type II SMA is generally between 6 and 18 months after birth, leaving patients unable to stand or walk. Patients with this type of SMA usually die of pulmonary infection in adolescence, while survivors mostly suffer from scoliosis due to persistent muscle weakness, which can affect lung function and cause dyspnea, thus requiring supportive respiratory therapy to maintain life. In Type III SMA, symptoms usually appear 18 months after birth; with this type of SMA, patients experience proximal muscle weakness on the contralateral limb. They can walk, but not far, and some patients require a wheelchair. Finally, patients with Type IV SMA usually only experience muscle weakness in old age [3,4]. Medicine can alleviate the symptoms of SMA and prolong individuals' life spans. However, the complex disease can cause numerous complications that further challenge children with SMA and their parents with care needs, lowering their quality of life [5,6]. Studies in Taiwan covering the past decade suggest that repeat emergency room visits and hospitalization rates among

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children with neuromuscular genetic diseases are as high as 56.8% and 55.6%, respectively [7]. Orem [8] believes that self-care can help individuals make appropriate, reliable, and effective adjustments to maintain their life, health, happiness, and well-being according to factors influencing their development and living environment. Therefore, if children with SMA can learn self-care activities (e.g., symptom monitoring), their health deterioration may be slowed. Engaging patients in their own self-care can positively impact their physical health, reduce the number of emergency room visits, and improve the quality of life [6,9]. However, there are few articles from 1984 to 2020 on self-care of children with SMA; any discussion on the phenomenon is still obscure. Some studies indicate that children with SMA can manage their symptoms and life, such as resting at appropriate times, eating nutritious food, keeping warm in cold weather, or using aids to complete activities [9—12]. Others, however, assert that children with SMA show poor self-care ability, and patients with SMA types I, II, or III are often less able to perform daily self-care activities, such as dressing, bathing, and moving, when they are more physically paralyzed due to the disease [13,14]. Hence, it is necessary to further explore the self-care experience of children with SMA.

Rivière [15] proved that although children with SMA do not experience sports such as healthy children, they could still achieve space cognition skills during a manual search for hidden objects. They believed that children with SMA could develop their own alternative methods to acquire the ability to perform spatial activities in normal spaces. This also highlights that children can perform self-care behaviors to break through the limitations of their activities. At present, most documents in Taiwan describe difficulties due to their physical defects in the life of patients with SMA. Yang and Li [16] reported on one school-aged patient's anger and frustration at her peers' rejection because of her physical disability. Hsu [17] found that in addition to being unable to walk, adolescents with SMA also experienced deterioration in their hand muscle strength, making home, school, and self-care activities more challenging for some and impossible for others. They can participate in activities, which are mostly static activities. Interaction with peers is usually good, but peers cannot play with them outdoors as it is difficult for them to go out alone. Some studies have also pointed out that adolescents with SMA need to use wheelchairs or hand aids to help them integrate into school life [18,19]. Merleau-Ponty [20] believes that an individual's behavior is expressed through body intentionality and presented in physical activities. Thus, this theory can help us reflect on our experience from another transcendent perspective.

However, few Taiwanese studies have reflected on the self-care experiences of adolescents with SMA from the Merleau-Ponty's theoretical point of view. For other diseases, significant literature on patients' body response process and self-care behavior produced from their experience of illness and treatment exists. Such studies found that patients have the following response processes and self-care behaviors: perception of physical changes, understanding of physical changes, gradual self-integration of body space and self-rehabilitation ability, regaining control, and self-management of the body [21,22]. As for social participation, Bjorbaekmo and Engelsrud [23] illustrated that children with heart disease can judge the limitations of their physical endurance and use self-care strategies suitable for their conditions to participate in peer activities. Although the earlier mentioned studies are a reference for children's self-care, each disease has its own particularity. Therefore, because patients with SMA are characterized by persistent and irreversible physical degeneration and often alternate between life balance and imbalance, it is necessary to explore in depth how they should respond and adjust their bodies to start the self-care process based on their own perspective.

Methods

Study design

This study investigated the self-care experiences of adolescents with SMA using the Husserl phenomenological method. This method can help the researchers obtain evidence regarding the essence of the self-care experience in the interaction between the body and the environment based on the subjective data of adolescents with SMA [24]. In addition, this method also helps researchers reflect on the intersubjective relationship between the participants and others—by uncovering the visible and invisible phenomena in the shared world of intersubjectivity, it reveals the full picture of the self-care phenomenon [24].

Setting and sample

Purposive sampling was used to select participants from two medical centers in Taiwan. The selection criteria were as follows: aged 13—18 years, an established diagnosis of SMA, located in northern Taoyuan County, and no language barriers. The patients and their guardians were asked to sign a research consent form. Ten adolescents participated in this study and completed it.

Ethical considerations

The study was approved by the Ethics Committee of the Institutional Review Board of a medical foundation (Approval no. 201411027RIND). Before the interview, the research process was explained to all the participants and their guardians, both orally and in the written form. The interviews were conducted after all the participants and their guardians completed the written informed consent forms. Measures to promote participant safety included ensuring confidentiality and informing participants of any physical discomfort or emotional risks that might result from participation in this study. In addition, during the study, the researchers paid attention to patients' needs. For example, when a patient reported that he wanted to change his clothes during an interview, the researcher paused the interview and waited until the patient felt comfortable before continuing with the interview.

Data collection

Data were collected through in-depth interviews. Phenomenology emphasizes grasping truth and attempting to describe "phenomena." In this study, the researcher collected data on lived experiences of self-care in the world where the body is presented in the way it is presented. The data were collected from April 09, 2015 to April 08, 2016. The interviews focused on experiences related to adolescents' physical condition and activities. The participants were asked about their physical condition; what the changes in their daily activities they had; what kinds of physical discomfort they had; what experiences they had in taking care of themselves when they were sick; what games they played; what activities they liked; what they did at school, at home, during leisure time, and indoors or outdoors; what they thought of these activities; and how they took care of their bodies during these activities. Therefore, research was held at places convenient for participants, where they could freely express themselves. As such, 9 participants were

interviewed at home, while one participant was interviewed in a quiet part of a restaurant. Before each interview, participants were contacted. The researcher explained the purpose of the interview to the participants and assured them of the confidentiality and integrity of the data. The interview was recorded, and important verbal and nonverbal behaviors were also documented with field notes. In addition, important verbal and nonverbal behaviors were documented with field notes. During the interview, the researcher asked for clarifications of unclear details. On average, each participant was interviewed twice. Each interview took about one to three hours. When the data of the tenth subject were collected, data analysis showed that the data were completely saturated, and data collection stopped.

Data analysis

Data analysis was based on the Giorgi analysis method that focuses on a verbatim draft of the interview and is supplemented by interview notes. Giorgi's method involves four steps. First, to gain an overview of the data, this study followed the principle of phenomenological reduction; the contents of the interviews were read repeatedly to fully understand the patients' self-care lived experiences. Second, to determine the meaning units in the data, the first author reread the interview records to determine units of meaning close to the participants' lived experience, to uncover the meaning of unit descriptions, and to determine all relevant phenomena. Third, to interpret participants' natural attitudes as phenomenological sensitive expressions, the authors reviewed the data and classified and generalized the units of meaning to form constitutions and subconstitutions. After continuous discussions with the research team, the first author revised the constitutions and gave a representative example to describe, examine, and explain the constitutions using the language of the participant and to confirm that all data were consistent. During data analysis, to improve the sensitivity of interpretations of the interview data, researchers reviewed existing literature related to the constitutions constructed. This was repeated until the participants' language was congruent with the meaning of the unit, and the information was mainly based on the views of the participants. The authors consolidated the data and translated the daily life descriptions of the participants into professional terms, making all data and terminology consistent. Consolidation of data into universal terms was especially important in reporting to academic groups and presenting the basic structure of the lived experiences of participants. The final step was synthesizing all units of meaning into a consistent statement to provide a general description of the lived experiences of patients and form the essential structure of this phenomenon [25].

The trustworthiness of this study was maintained by adhering to Guba and Lincoln [26] principles of credibility, dependability, transferability, and confirmability. To enhance credibility, use the strategy of long-lasting engagement in the research field with participants. After establishing a relationship with the participants, observe the participation and understand the data to obtain rich data and build trust. To allow for transferability, the researchers provided detailed descriptions, not just the behavior and experiences but their context as well, so that healthcare professionals could understand patient self-care management. Regarding dependability, the interview content was verified with peers, and the analyzed data were reviewed to ensure data consistency. Finally, to improve the research's confirmation, the findings were discussed with the research team. The explanation is not based on the researcher's point of view but on the participants' data to maintain the neutrality of the data. The researcher retained the complete interview data and supporting documents to provide important evidence for future reviews during the analysis process.

Results

Among the ten adolescents, there were six boys and four girls (age range: 13-18 years). Nine participants were unable to walk but continued to go to school. Most of them were the eldest children in their families, but one was the only child (Table 1).

The lived experiences of self-care as felt by the patients in their body are intertwined with the world through several constructs, such as limited space for independent development, multiple reconstructions of self-image to improve physical ability, self-care of disease, and developing activity styles to accommodate social culture (Table 2). For all subconstitutions, sensing body changes to regionalize body boundaries and coordinating the rhythm of the living body were the most reported self-care behaviors by patients (Table 2). Table 3 is an example that demonstrates how the Giorgi method can be applied to transcript analysis.

Constitution 1: limited space for independent development

Patients assumed that the disorder had branded their body; this was often demonstrated when their bodies could not be exposed to life or social culture. When their condition worsened, they were usually shocked and nervously told their family that they could not control their bodies. As they grew older, their conditions critically deteriorated, and they often felt embarrassed at being unable to perform developmental tasks or socialize with their peers.

Embarrassment caused by disability and the need for assistance

Participants reported that it was impossible to predict where the disorder will affect their bodies. They experienced physical deterioration usually unaccompanied by pain. As such, they commonly discovered their disease when they lost the ability to participate in life activities. They felt that their disability limited their space for activity. However, the disease gradually eroded their ability to take care of themselves, and they often needed assistance, which made them feel very embarrassed, especially in front of their peers.

> E: "I do not like it when other people feed me at school because many of my classmates are there. I get embarrassed. I feel that it does not matter; it is just a meal. We always need someone to help us, but I feel that no one will like me because there are always adults around."

Dependency on others for daily life

Patients felt that they needed to wait for the help of others before they could participate in activities. As they grew, they became more incapacitated, making them impatient as they had to wait longer for the help of others. Some participants mentioned

Table 1 *Characteristics of Adolescents With Spinal Muscular Atrophy (N = 10).*

ID	Age (years)	Gender	Type of SMA	Sibling order
A	16	Men	Type II	1
B	18	Men	Type III	1
C	15	Men	Type II	1
D	17	Men	Type II	2
E	18	Women	Type II	3
F	15	Men	Type III	1
G	16	Women	Type II	2
H	14	Women	Type II	1
I	13	Men	Type III	Single
J	14	Women	Type II	2

Note. SMA = spinal muscular atrophy.

that they found that more of the things they used to be able to do on their own now required others' help, making them feel like they were losing more independence every year.

F: "After I could not walk, it was not convenient to go downstairs. I try not to go out. If I want to buy something, I will ask my brother or sister to buy it for me."

Constitution 2: multiple reconstructions of self-image to improve physical ability

The disorder caused the patients' bodies to change frequently. When changes occurred, they would test whether their bodies were experiencing a temporary disability or permanent deterioration. They thought that the boundaries of the body were clear and that they could protect themselves from injury during activities. After sensory integration, they readjusted their concept of physical ability. They wanted to develop new behaviors as they grew up. Therefore, they tested and actively trained themselves to perform new physical activities and seek new abilities.

Sensing body changes to regionalize body boundaries

Participants expressed that changes in the shape and function of their bodies often affected their lives. In particular, changes to internal body structure were difficult to recognize from appearance. They needed to be aware of physical or life changes and accepted the changes to set a new range of activities to avoid the crisis of life imbalance. The following were the most common changes: inability to move sideward, inability to sit upright or to raise the head, slowed down writing, and inability to support their hands. Participants believed that being alert to physical changes would prevent the risk of injury during activity.

H: "Once, I took a shower, sat in a low chair, then felt pain in my abdomen. I felt a lump under the liver, but later I found out that it was a kidney."

Patients felt that they were sensitive to changes in body strength, which is often used in daily living.

A: "I found that my body had no energy, so I thought about what happened to me. It was my shampoo. It seems that there is a certain ingredient that caused me to temporarily lose strength after washing."

Coordinating the rhythm of the living body

To complete daily routines independently, participants described the use of certain body parts to help other parts maintain and expand/increase their physical abilities. They used strong hands to help weak hands or feet to move or take things. They would lower their heads so their hands could comb their hair, clean their faces, or eat. They did not rely on others for activities that they thought they could perform.

J: "My hair is difficult to comb, and it hurts me when others help me comb it. I do not raise my hands high; instead, I lower my head so that my hands can comb my curly hair."

Some participants changed their body positions or internal forces to coordinate body movements. They would move their hands from vertically or horizontally to change positions. When sitting in a wheelchair, they would tilt their upper body to one side

to relieve the parts of the lower body that experienced pressure for long periods.

C: "My left hand has almost no strength. When I am in bed, my left hand will first rest on my head. If my shoulders are sore, I will force my hands to slide down. If I want to move, I then shake my hands out horizontally."

Actively training one's body

Participants expressed difficulty in making time for rehabilitation since they were going to school. They would value the strength training of the hands and would require themselves to complete activities of daily living, such as turning over, cleaning the body, and pouring water, to train their ability. They would also take dumbbells or heavy objects to train their hand strength, increasing the weight of items to improve their physical strength. They also used video games to train their fingers to be flexible. In foot training, some people practiced walking, standing, or sliding chairs with wheels.

B: "When I wash my hair, I wash it myself. I raise my hands to my head. I think it is a remarkably simple rehabilitation. For me, of course, these are the essential abilities in life, such as pouring water, drinking water, and putting books down. I will do it myself and use it as a form of training."

Constitution 3: self-care of disease

Patients experiencing diseases often live an uncomfortable life and are unable to perform certain activities. Minor symptoms often turned into severe symptoms and worsening or life-restricting physical conditions. To prevent serious illness, they compressed their abdomen to help expel sputum to prevent serious illness. They had to pay more attention to these activities than their peers. They would also identify external environmental hazards and build physical self-care methods into their daily lived experiences.

Physically understanding proper methods for self-care

They felt that they had to be aware of their physical symptoms. They often ignored small colds, consequently developing possibly life-threatening bouts of asthma exacerbations or pneumonia. They thought sputum usually accumulates in the throat, which is normal for them; however, they needed to determine the location, color, and quantity of the sputum or sore throat to avoid colds. They also noticed pressure sores and changes in the angle of scoliosis. They trained themselves to regulate and relax their breathing to maintain their lung function. When a cold occurred, they used the thickness of the sputum to judge the degree of damage and planned to compress the abdomen or use a sputum clearing machine to help them cough and expel sputum effectively.

E: "When the sputum is thick, I try to cough. It was thicker a few days ago, and now it is better and thinner. Judging by its color, a yellow color indicates that there is still an infection. Sputum can be yellow and green. Green sputum indicates a serious condition."

The patients expressed that they had to plan appropriate ways to maintain their lungs according to life events and time.

D: "I attended a lesson at three o'clock and used the incentive spirometer for 20 minutes after class. Then, I was able to suck three balls each time. I turned the incentive spirometer upside

Table 2 *Self-care Experience of Adolescents With Spinal Muscular Atrophy.*

Constitution	Subconstitution	Self-care behavior described by the patient
Limited space for independent development	Embarrassment caused by disability and the need for assistance	B.E.G.I.J
	Dependency on others for daily life	C.F.J
Multiple reconstructions of self-image to improve physical ability	Sensing body changes to regionalize body boundaries	A.B.C.D.E.F.G.H.I.J
	Coordinating the rhythm of the living body	A.B.C.D.F.G.J
	Actively training one's body	A.B.E.F.G.I
Self-care of disease	Physically understanding proper methods for self-care	A.B.D.E.G
	Identifying an integrated environmental crisis	ACDEG
Developing activity styles to accommodate social culture	Use of everyday items to compensate for physical activity limitations	A.B.E.F.G
	Communion of the intercorporeity form of perceptual interaction	F.G.I
	Responding to the body to create a personal entertainment style	A.B.E.F.G

Note. A-J: Subject Identification Code.

down and used the blow ball method. I could only blow two balls."

Identifying an integrated environmental crisis

The patients expressed that instead of expecting a change in the external environment, it was better to adapt to the environment. Their bodies were more susceptible to illness than ordinary adolescents; an adolescent without SMA could experience illness, but that same illness would manifest more severely and require longer recovery time compared with our participants. Therefore, they would gauge the environment's threat to their body and take precautions to protect themselves better than adolescents without SMA. When a classmate caught a cold, they would wear a mask or ask the classmate to wear a mask. Although they felt that their feet had lost their walking function, they maintained awareness of the weather, protected the comfort of their feet, and avoided poor

blood circulation. They would also keep a distance from colliding adolescents to prevent injury. Some patients stated that having nerve atrophy made them very sensitive to the pain of collision. Occasionally, their activities were limited and could not be avoided immediately; in those cases, they would pay attention to the environment.

> C: "I get a cold easily; it's so bad! Once, I caught a cold from a classmate and rested at home for four weeks. …. .Now if I see that any of my classmates have a cold, I ask them to put on a mask; otherwise, I wear a mask."

Constitution 4: developing activity styles to accommodate social culture

Participants reported that they performed differently from their peers in the same activities, such as taking exams or further studies.

Table 3 *Example of Steps In Giorgi's Descriptive Phenomenological Method.*

Collecting data	Step 2: extracting meaning units	Step 3: transforming meaning units	Contributing meaning units to the constituent
C: I get a cold easily; it's so bad! Once, I caught a cold from a classmate and rested at home for four weeks. Interviewer: Super miserable, huh? C: Yes, I finished the second monthly exam last time. Interviewer: Yes C: I became sick for four weeks Interviewer: Well, four weeks in a row! C: I got an infection from my classmates, and I rested at home for four weeks. Now if I see that any of my classmates have a cold, I ask them to put on a mask; otherwise, I wear a mask.	He said he caught a cold easily and his physical condition was terrible! Once, he caught a cold from a classmate and had to rest at home for four weeks. Unable to attend school and participate in activities, he felt miserable. He said he contracted a cold, presumably from his classmates, after finishing the second monthly exam. Normally, students may go to school with a minor cold or return to good health after taking 2-3 days off. However, he thinks that cold can become severe in children with spinal muscular atrophy and they need a long time to recover. This time when he contracted a cold, he could not go to school for four weeks; thus, most of his activities in this semester were confined to his home. Henceforth, whenever he finds that a classmate has a cold, he would ask his classmate to wear a mask; otherwise, he would wear a mask himself.	His weakness makes him vulnerable to respiratory diseases. Once, he caught a cold from a classmate and rested at home for four weeks. Unable to attend school and participate in activities, his physical activity was restricted and he felt miserable being unable to interact with the outside world. He contracted the cold, presumably from his classmates, after he finished the second monthly exam. Normally students can still go to school with a minor cold or can recover from a severe cold by taking 2-3 days off. However, he thinks that since he suffers from spinal muscular atrophy, a small cold could turn into a serious lung disease and take a long time to recover. During the illness, he could not go to the school for four weeks. Most of his activities during this semester were confined to his home. However, the cold disrupted his daily routine, including studying at school and interacting with classmates, which made him feel miserable. He felt his body was very fragile and prone to even the slightest infections. He realized he had to take proper care of himself to stay safe from diseases. Whenever he sees a classmate with cold, he asks him to wear a mask; otherwise, he himself would wear a mask to school.	Wear a mask to protect the body Identify the environmental crisis Find ways to take care of oneself

They would explore items to help their body expand its ability to participate in activities, reach their goals, and gain confidence. For them, interacting with others meant not relying entirely on others for protection. They would adjust their physical activities during dynamic interactions and try to protect others from harm to help themselves and others. They believed that they must develop personal lifestyles to engage in current social activities and connect with the world.

Use of everyday items to compensate for physical activity limitations

Some participants expressed that they would observe and experience the similarities and differences between their activities and others' activities. They believed that although they could not complete activities as naturally as others, they could use everyday objects or assistive devices to help them complete the tasks. They raised their hands with mats, extended their arms with sticks to fetch something or switch on lights, used ropes to help open and close doors, and modified items to help themselves in class or during exams.

A: "At noon, I sat in a wheelchair and used some cushions to raise the tabletop. I can also take a nap on the table with my classmates. Some patients will go to the health room to lie down and sleep, but I do not want to. I feel weird doing that."

Aside from assistive devices, some participants converted everyday items into more suitable ones for their use. These modified items helped save energy and time.

G: "During the exam, others use 2B pencils, but I use 9B. The 9B pencil is darker than the 2B, which saves my strength and time. You should also choose the eraser you think is the fastest and will quickly erase the wrong answer. Cutting it in half will give you eight corners and can erase faster."

Communion of the intercorporeity form of perceptual interaction

Participants perceived that their bodies were often dependent on family assistance for movement. During passive dependence, the body needed to actively initiate coordination, assist in the movement of the body, and help the family of the patient avoid injury during body movements. They felt that their and others' bodies needed to work together to achieve a coordinated rhythm in their interactions with each other and that their body was cooperating with others assisting them. Long-term operations are required for physical coordination during these experiences, and changing movements form the tacit operations between the body of the patient and the helper.

I: "I did not want grandma to fall too. When I fell, I asked her to help me hold the chair and let me hold it. She made little effort to help me support my body so I could stand up."

Responding to the body to create a personal entertainment style

Participants believed that they needed to adjust their circadian rhythm to participate in outdoor activities independently with friends. They were aware of when their body was exhausted and how and when to lie down to restore physical strength or continue to participate in activities with their peers. They would also search for social resources and arrange situations that suited their physical conditions, so they could visit bookstores, watch movies, or go to scenic spots with friends.

A: "I could go to my favorite singer's concert with my friends. We bought tickets online four months in advance and chose the barrier-free area, close to the door, so it was very convenient for me to come out and go to the toilet. The whole concert was from 2 PM to 10 PM, and I did not leave at all."

They mediated toilet time and helped themselves independently participate in peer leisure activities.

B: "I like to go out alone with my classmates without needing my parents to accompany me. I have trouble going to the toilet because I do not have the strength to shift my hip to the toilet. So I reduce the amount of water I drink and the time I go to the toilet."

Discussion

This study used a phenomenological approach to explore the self-care experience in adolescents with SMA, according to Merleau-Ponty's perspective [20]. The first result found that participants' perception of the body may be able to drive physical intentionality and produce self-care behaviors. Many symptoms of SMA are invisible to us, and we need to be aware of them through the body. Merleau-Ponty [20] believed that the body is intertwined with life. Therefore, when the disease alters life, it prompts the patient to pay attention to the past physical existence and the appearance of the disease [20]. Initially, the disease often makes the patient feel unfamiliar with the current body. The perception of the body can help them reflect on the physical changes caused by disease and clarify problems in life [22]. When they understand the problem, physical intentionality can target their needs and produce self-care behaviors.

When patients' bodies showed dynamic deterioration, positive strategies, such as sensitivity to their own bodily changes, coordination, training, and so on, may be used to rebuild their boundaries. According to Merleau-Ponty [20], "the formation of the body boundary" means that through the process of interaction between the body and the outside world, "physical self-reflection" presents the whole internal and external localized experience for assimilation into their habitual life. Relevant studies have pointed out that body acceptance, self-identify, and use of self-protection strategies can enhance patients' reconstruction of body image [27,28]. Therefore, patients should be encouraged to perform life activities to train physical movement, coordination or strengthen their advantages in life to help them accept the body image. This study also found that patients would test whether hand mobility was temporarily or permanently deteriorated. Russo et al [29] asserted that body awareness can help the body perceive changes in its interaction with the environment. As such, participants can reflect on the process of interaction between the body and the environment, which can help them understand the physical threats caused by the environment and generate self-protective behavior to prevent body image disorders.

The parents cannot control the disease. The quality of life for both the adolescents and the parents can be enhanced by making the adolescents responsible for as much of their self-care as they can handle, as the parents' labor and care burdens will only increase over time, which can lead to burnout [3]. In particular, SMA causes internal changes to the adolescents' bodies. Adolescents must still feel themselves and construct appropriate care methods [6]. Although adolescents with SMA cannot cough hard enough to clear sputum from the respiratory tract, they can feel and analyze the signs of the disease and prevent its occurrence. This can help reduce the burden of parental care and affirm the child's care ability. Clinical care

usually lacks instructions on self-care practices to guide adolescents with SMA. Therefore, nurses should thoroughly explore self-care behaviors to construct guidelines for disease management. Committed self-care routines can help patients fight their bodies' deterioration and improve their physical well-being.

Concerning "communion of the intercorporeity form of perceptual interaction", the patients asserted that although they needed others' help for certain activities, the relationship was interactive. These results were similar to those of Yamaguchi and Suzuki [30] and Haugdahl et al [31]. Through physical interaction with others, the participants can experience and imitate the behavior of others, thereby adjusting and shaping the way of self-care and learning to care for others. This study found that when patients interact with others, sympathy is generated, which drives patients to take meaningful action and develop independent behaviors to maintain the health of others.

Moreover, the participants indicated that their bodies had different means of expression but could participate in social activities with their peers. These results are similar to those of Graham et al [32] and Wintels et al [33]. During the process of interaction, they may achieve the purpose of participation through watching, feeling, and using methods. This study found that interaction with peers can stimulate patients' potential for self-care. In line with other studies, the present study agrees on the importance of peer interaction [34,35]. When the patients' bodies are placed in a social and cultural structure with peers, they perform development tasks at each stage of the life cycle. In addition, when playing with their peers, they will use social resources or Internet resources to arrange the most suitable environment for their bodies in advance to ensure their personal safety. This process enables patients adjust their physical habits and develop self-care skills.

Practice implications

If patients fear that SMA is eroding their body space and inhibiting independent development, clinical staff should help them understand the stages of development of the individual and the disease and provide information about the patient's prognosis. Given the nature of SMA, patients face multiple changes regarding self-image and physical ability. Therefore, nursing staff should develop physical awareness self-care courses and personal care plans for all stages of disability to help patients delay deterioration and realize their physical potential. Moreover, this course includes awareness of internal and external changes in the body, symptoms, and changes in life and self-care needs. Nursing staff should work with rehabilitation specialists to help patients incorporate physical exercise into activities of daily living to rebuild their self-image and physical ability. Discussions on safe and executable life activities should be held with patients and their parents. In addition, they must be encouraged to perform simple self-care behaviors and increase self-confidence to rebuild their self-image and physical abilities. Nursing staff should facilitate regular exchanges of experiences in self-care skills with patient groups. Because patients are not very mobile, communication software can be set up to increase the timelines of health education and the density of communication and visits. Finally, peer interaction can help adolescents take care of themselves. Plans for improving self-care skills and participating in social activities should be tailored to the adolescents' personality, helping them once again to participate in social culture and group activities.

Limitations

There may be some possible limitations in this study. This study focused on adolescents with Type II and Type III SMA. Therefore, the results of the study cannot be transferred to other types of patients with SMA. In addition, the interview times varied, and they were longer for some participants because the researchers hoped that the participants could maintain a relaxed attitude and have sufficient time to talk. All the interviews were completed based on the comfort of the participants, so the narratives were rich and detailed. However, the researcher will avoid long interview times in the future as they could affect the credibility of the data.

Conclusions

This study used Merleau-Ponty's view of body perception [21] to determine how adolescents with SMA respond to diseases and life changes in their social and cultural contexts and develop self-care processes. The development of self-care behavior is related to the patient's experience of perceiving bodily changes when the patient interacts with others and things. The experience in self-care behavior may be able to encourage patients to regain control of their body and promote the development of self-independence and personality. In addition, this experience can also help patients develop resilience to cope with the transition crisis and adapt to life. Furthermore, the experience can also help patients expand their world. It enables patients to protect themselves when interacting with external things, continue to participate in social activities, and maintain relationships with others, thereby developing more self-care skills, caring and protecting others' behavior, and promoting social development.

This study can help nursing staff to understand the patients' body, environment, and interaction with others while generating self-care behaviors to enhance disease management and participation in activities and society. It is recommended that nurses not only develop rehabilitation plans for patients performing life activities in the future but also explore the impact of peers on social participation activities.

Ethical statements

Author contributions

Bao-Huan Yang: Conceptualization, Methodology, Data collection, Data analysis, Writing- Original draft preparation and Editing.
Chia-Ying Chung: Methodology, Data analysis
Wen-Chin Weng: Methodology, Data analysis
Kao-Wen Lo: Methodology, Data analysis
Yuh-Shiow Li: Methodology, Data analysis, Revise the manuscript

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Conflict of interest

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References

1. Mercuri E, Finkel RS, Muntoni F, Wirth B, Montes J, Main M, et al. Diagnosis and management of spinal muscular atrophy: part 1: recommendations for diagnosis, rehabilitation, orthopedic and nutritional care. Neuromuscul Disord. 2018;28(2):103–15. https://doi.org/10.1016/j.nmd.2017.11.005

2. Gu SH. Spinal muscular atrophy. SMA[Internet]. Taipei: TW Health Promotion Administration (ROC); 2017 [cited 2020 Dec 12] Available from: https://www.hpa.gov.tw/Pages/ashx/File.ashx?FilePath¼~/File/Attach/9561/File_9000.pdf

3. Vaidya S, Boes S. Measuring quality of life in children with spinal muscular atrophy: a systematic Literature review. Qual Life Res. 2018;27(12):3087–94. https://doi.org/10.1007/s11136-018-1945-x

4. Hjorth E, Kreicbergs U, Sejersen T, Lövgren M. Parents' advice to healthcare professionals working with children who have spinal muscular atrophy. Eur J Paediatr Neurol. 2018;22(1):128–34. https://doi.org/10.1016/j.ejpn.2017.10.008

5. Kocova H, Dvorackova O, Vondracek P, Haberlova J. Health-related quality of life in children and adolescents with spinal muscular atrophy in the Czech Republic. Pediatr Neurol. 2014;50(6):591–4. https://doi.org/10.1016/j.pediatrneurol.2014.01.037

6. Yang BH, Mu PF, Wang WS. The experiences of families living with the anticipatory loss of a school-age child with spinal muscular atrophy - the parents' perspectives. J Clin Nurs. 2016;25(17-18):2648–57. https://doi.org/10.1111/jocn.13312

7. Kao WT, Tseng YH, Jong YJ, Chen TH. Emergency room visits and admission rates of children with neuromuscular disorders: a 10-year experience in a medical center in Taiwan. Pediatr Neonatol. 2019;60(4):405–10. https://doi.org/10.1016/j.pedneo.2018.09.008

8. Orem DE. Nursing concepts of practice. 6 ed. St. Missouri: Mosby Publications, Inc.; 2001.

9. McGraw S, Qian Y, Henne J, Jarecki J, Hobby K, Yeh W-S. A qualitative study of perceptions of meaningful change in spinal muscular atrophy. BMC Neurol. 2017;17(1):68. https://doi.org/10.1186/s12883-017-0853-y

10. Lamb C, Peden A. Understanding the experience of living with spinal muscular atrophy: a qualitative description. J Neurosci Nurs. 2008;40(4):250–6. https://doi.org/10.1097/01376517-200808000-00009

11. Mandy A, Sims T, Stew G, Onions D. Manual feeding device experiences of people with a neurodisability. Am J Occup Ther. 2018;72(3):7203345010. https://doi.org/10.5014/ajot.2018.025353

12. Bassola B, Sansone VA, Lusignani M. Being yourself and thinking about the future in people with motor neuron disease: a grounded theory of self-care processes. J Neurosci Nurs. 2018;50(3):138–43. https://doi.org/10.1097/JNN.0000000000000366

13. Gosar D, Košmrlj L, Musek PL, Meško T, Stropnik S, Krkoč V, et al. Adaptive skills and mental health in children and adolescents with neuromuscular diseases. Eur J Paediatr Neurol. 2021;30:134–43. https://doi.org/10.1016/j.ejpn.2020.10.008

14. Chung BHY, Wong VCN, Ip P. Spinal muscular atrophy: survival pattern and functional status. Pediatrics. 2004;114(5):e548–53. https://doi.org/10.1542/peds.2004-0668

15. Rivière J. Self-produced locomotion and spatial cognition: a new light from spinal muscular atrophy. Arch Pediatr : Organe Officiel de la Societe Francaise de Pediatrie. 2007;14(3):279–84. https://doi.org/10.1016/j.arcped.2006.10.011

16. Yang BH, Li YS. Application of therapeutic plays to the emotion handling of children with spinal muscular atrophy. Chang Gung Nurs. 2011;22(1):114–22. https://doi.org/10.6386/CGN.201103_22(1).0012. Chinese.

17. Hsu CL. A multiple case study for spinal muscular atrophy students to use assistive technology. Tainan: National University of Tainan; 2012 [cited 2019 Mar 5]. Available from: https://hdl.handle.net/11296/3rmprb

18. Lin PJ, Lin CT. Small fish can also drive the submarine: action research for powered wheelchair intervention for a student with profound and multiple disabilities. Bull Special Educ. 2013;38(2):99–125. https://doi.org/10.6172/bse.201307.3802005. Chinese.

19. Lin CW. Individualized design and development for the spinal muscular atrophy students in the university of using 3D printing pencil grip for functional performances. National Taiwan Normal University; 2019. https://doi.org/10.6345/ntnu202000027

20. Merleau-Ponty M. Phenomenology of perception. London and New York: Routledge Publications, Inc.; 2012.

21. Missel M, Jesper HP, Hendriksen C, Tewes M, Adamsen L. Regaining familiarity with own body after treatment for operable lung cancer - a qualitative longitudinal exploration. Eur J Canc Care (Engl). 2016;25(6):1076–90. https://doi.org/10.1111/ecc.12383

22. Yang HC, Mu PF, Chang TK, Curia M. Teenagers who coexist with cancer: chemotherapy body and self-integration. Canc Nurs. 2021;44(1):E1–12. https://doi.org/10.1097/ncc.0000000000000759

23. Bjorbaekmo W, Engelsrud G. I am almost like a fish: an investigation of how children with congenital heart disease experience and perform movement in daily life. Child Care Health Dev. 2008;34(6):781–8. https://doi.org/10.1111/j.1365-2214.2008.00851.x

24. Sokolowski R. Introduction to phenomenology. Taipei: Psy-Garden Publications, Inc.; 2008.

25. Giorgi A. The phenomenological movement and research in the human sciences. Nurs Sci Q. 2005;18(1):75e82. https://doi.org/10.1177/0894318404272112

26. Guba EG, Lincoln YS. Paradigmatic controversies, contradictions, and emerging confluences. In: Denzin NK, Lincoln YS, editors. The Sage handbook of qualitative research. Thousand Oaks, CA: Sage Publications Ltd; 2005. p. 191e215.

27. Lee MY, Mu PF, Tsay SF, Chou SS, Chen YC, Wong TT. Body image of children and adolescents with cancer: a metasynthesis on qualitative research findings. Nurs Health Sci. 2012;14(3):381–90. https://doi.org/10.1111/j.1442-2018.2012.00695.x

28. Cushman G, Stolz MG, Shih S, Listernick Z, Talmadge C, Gold BD, et al. Age, disease symptoms, and depression are associated with body image dissatisfaction in newly diagnosed pediatric inflammatory bowel disease. J Pediatr Gastroenterol Nutr. 2021;72(3):e57–62. https://doi.org/10.1097/MPG.0000000000002943

29. Russo L, Craig F, Ruggiero M, Mancuso C, Galluzzi R, Lorenzo A, et al. Exploring visual perspective taking and body awareness in children with autism spectrum disorder. Cognit Neuropsychiatr. 2018;23(4):254–65. https://doi.org/10.1080/13546805.2018.1486182

30. Yamaguchi M, Suzuki M. Independent living with Duchenne muscular dystrophy and home mechanical ventilation in areas of Japan with insufficient national welfare services. Int J Qual Stud Health Well-Being. 2013;8:20914. https://doi.org/10.3402/qhw.v8i0.20914

31. Haugdahl HS, Eide R, Alexandersen I, Paulsby TE, Stjern B, Lund SB, et al. From breaking point to breakthrough during the ICU stay: a qualitative study of family members' experiences of long-term intensive care patients' pathways towards survival. J Clin Nurs. 2018;27(19-20):3630–40. https://doi.org/10.1111/jocn.14523

32. Graham N, Mandy A, Clarke C, Morriss-Roberts C. Play experiences of children with a high level of physical disability. Am J Occup Ther. 2019;73(6). https://doi.org/10.5014/ajot.2019.032516, 7306205010p1-p10.

33. Wintels SC, Smits DW, van Wesel F, Verheijden J, Ketelaar M. How do adolescents with cerebral palsy participate? Learning from their personal experiences. Health Expect. 2018;21(6):1024–34. https://doi.org/10.1111/hex.12796

34. Wiemann CM, Graham SC, Garland BH, Hergenroeder AC, Raphael JL, Sanchez-Fournier BE, et al. Development of a group-based, peer-mentor intervention to promote disease self-management skills among youth with chronic medical conditions. J Pediatr Nurs. 2019;48:1–9. https://doi.org/10.1016/j.pedn.2019.05.013

35. Ahola Kohut S, Stinson J, Forgeron P, van Wyk M, Harris L, Luca S. A qualitative content analysis of peer mentoring video calls in adolescents with chronic illness. J Health Psychol. 2018;23(6):788–99. https://doi.org/10.1177/1359105316669877

Research Article

Current Status and Associated Factors of Annual Eye Examination Among People with Type 2 Diabetes Mellitus: Using the 7th National Health and Nutrition Examination Survey

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ABSTRACT

Purpose: To evaluate the level of annual eye examination (AEE) and identify the associated factors among people with diabetes mellitus (DM).
Methods: A secondary data analysis was conducted using data from the Korean National Health and Nutrition Examination Survey (2016–2018). A total of 1,465 people with DM (726 men and 739 women) aged ≥40 years were included. The data were analyzed using a complex sample analysis considering a combined sampling weight of 3 years.
Results: In total, 29.5% and 12.0% of men and 36.3% and 24.1% of women underwent AEE and EE at the time of diagnosis of DM, respectively. The AEE rate in men was significantly higher in those who were high school graduates and above (odds ratio [OR] = 1.98), current nonsmokers (OR = 1.82), had ≥10-year duration of DM (OR = 1.75), and use insulin (OR = 2.81), and with a normal body mass index (OR = 1.68). For women, the AEE rate was significantly higher in those aged 40–64 years (OR = 1.76) and with ≥10 years of DM (OR = 1.91).
Conclusion: The AEE rate among people with DM is unsatisfactory and needs to be improved. Health education on the importance of AEE and the application of a reminder or alarm system should be designed to promote AEE to the high-risk population showing lower levels of AEE, including those with a longer duration of DM.
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Introduction

Diabetes mellitus (DM) is a complex metabolic disorder characterized by a high blood glucose level and is recognized as a major health problem worldwide because of lifestyle changes and aging populations. In 2019, 9.3% (463 million) of the global population aged 20–79 years had DM, and the prevalence is estimated to increase to 10.9% (700 million) by 2045 [1]. In 2017, the prevalence of DM among adults aged ≥30 years in Korea reached 12.9% in men and 7.9% in women [2].

A prolonged period of hyperglycemia caused by DM increases the risk of cataract, glaucoma, refractive error, and age-related macular degeneration, in addition to eye complications such as diabetic retinopathy [3,4]. A systematic review and meta-analysis of 288 population-based studies from 1980 to 2014 showed that uncorrected refractive error, cataract, age-related macular degeneration, glaucoma, and diabetic retinopathy are the main causes of vision disorders and blindness [5], indicating that people with DM have a higher risk of visual impairment and blindness than those without. In 2015, approximately 2.6 million people were reported to suffer from moderate to severe visual impairment due to diabetic retinopathy, which was estimated to increase to 3.2 million by 2020 [5]. According to a combined analysis of studies from the United States, Europe, Asia, and Australia, the prevalence of overall diabetic retinopathy and vision-threatening diabetic retinopathy was 34.6% (92.6 million) and 10.2% (28.4 million), respectively, in 2010, and it is estimated to increase to 191 million by 2030 as the diabetic population increases [6].

Fortunately, eye complications in people with DM can be largely prevented by early diagnosis and appropriate treatment through

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adherence to regular eye examination guidelines for DM [7]. Some patients may not have subjective symptoms even at the vision-threatening stage, such as proliferative retinopathy or macular edema; thus, up to 94% of severe vision loss can be reduced by early detection and treatment of diabetic retinopathy through regular eye examination [8]. In particular, people with type 2 DM are recommended to undergo an eye examination at the time of diagnosis, as 21% of them have already had diabetic retinopathy at this point [9]. Accordingly, the American Diabetes Association (ADA) [10] and the American Association of Clinical Endocrinologists and American College of Endocrinology [11] recommend an initial dilated eye examination within 5 years after the onset of DM for people with type 1 DM, and at the time of diagnosis for those with type 2 DM; following which, examination should be repeated every 1 or 2 years for those with both no evidence of retinopathy and well-controlled blood glucose, otherwise annually or more. The Korean Diabetes Association [12] also presents the same guidelines for the timing of an initial eye examination and screening intervals as those of foreign expert groups [10,11] and also recommends a fundus examination, including the periphery of the retina, and a comprehensive eye examination.

The annual eye examination (AEE) rate of people with DM varies from 15.3% [13] to 71.5% [14] in foreign countries and from 26.7% [15] to 38.1% [16] in community-based surveys in Korea, which seems to be due to differences in time, study subjects, or methods. However, studies on the eye examination rate of people with DM in Korea were conducted at least 5 years ago, which does not reflect the current eye examination status, or their inclusion criteria of the subjects' age were different; therefore, it is difficult to directly compare the study findings. In particular, although people with type 2 DM are recommended to undergo an initial eye examination at the time of diagnosis, previous studies have reported on the eye examination rate within 1 year of diagnosis.

Studies have shown that better knowledge or education about DM [8,14], in addition to sociodemographic characteristics such as older age, longer DM duration, and insurance coverage [8,17], is associated with adherence to AEEs in foreign countries. In Korea, an education level of college graduates or above and a DM duration of ≥5 years were found to have a positive association with AEEs, but insurance coverage was not a significant factor because of the provision of national health insurance [16,18]. Age showed inconsistent results, including no significant association with adherence rates [16], lower nonadherence rates for those aged 65 years or older [18], and higher nonadherence rates for those aged 80 years or older [15]. Additionally, gender also showed inconsistent association across studies of people with DM in Korea, including higher adherence rates in women [16], or no significant difference between men and women [15,18], while it was not a significant factor in foreign countries [8,13,14,17]. Several community-based studies of the general population have reported that the prevalence of visual impairment and blindness [19] and the use of eye examinations [20] were higher in women, as was the fundus examination rate for people with diabetic retinopathy [21]. However, the differences in any aspect of adherence to AEEs between men and women have not been investigated. Therefore, it is necessary to identify factors related to adherence to AEEs by gender.

Inappropriate health behaviors such as smoking [12], alcohol consumption [22], insufficient physical activity [23], long duration of DM, poor blood glucose control, or underlying diseases such as hypertension or dyslipidemia [12], which can lead to microvascular damage, increase the risk of eye complications, and more rigorous eye care management is required. However, previous studies have only evaluated some of these factors, and it has not yet been determined whether people at high risk of eye disease have better compliance with AEE guidelines. Furthermore, smoking

[14,15,18,24], insulin use [14,16,25], glycosylated hemoglobin (A1C) levels [14,24,25], hypertension, and other underlying diseases [15,18,24] were not found to be consistently associated with adherence to eye examination guidelines. Therefore, the purpose of this study was to investigate the current status of eye examinations in people with DM and the factors affecting adherence to eye examination guidelines by gender, using data from the most recent Korean National Health and Nutrition Examination Survey (KNHANES) (2016—2018).

Methods

Design and study participants

This is a secondary data analysis using data from the KNHANES conducted by the Korea Centers for Disease Control and Prevention. The KNHANES is an ongoing nationwide cross-sectional survey that has been conducted every year since 1998 to assess the health and nutritional status of civilians residing in Korea. Data are collected through three component surveys, that is, health interview, health examination, and nutrition survey. The most recent KNHANES VII (2016—2018) has been completed [26,27]. In the KNHANES VII, to select the survey subjects, geographically defined sampling units were extracted through a two-stage clustered probability design, and target households were selected through confirmation of their members. As a result, 13,248 households were extracted from 576 sampling units over a 3-year period. All the members of the extracted households aged ≥1 year (31,689 persons) were selected as the survey subjects; among whom, 24,269 (76.6%) participated in the survey [27].

The subjects of this study were selected among the KNHANES VII participants who fulfilled the following inclusion criteria: those with weighted data for complex sample analysis, aged ≥40 years [18], diagnosed with DM after the age of 20 years, and who had no missing or unknown data for the explanatory variables. The presence of DM was determined as self-reported "Yes" to the question "Have you ever been diagnosed with DM by a physician?" in the "Morbidity" section. As the KNHANES does not investigate the types of DM, a distinction was made for those diagnosed with DM after the age of 20 years to select only those with type 2 DM. Among the 24,269 participants in the KNHANES VII, 1,465 participants (726 men and 739 women) fulfilled all the aforementioned inclusion criteria (Figure 1).

Definition and variables

Adherence to the eye examination guidelines was the outcome variable of this study. Accordingly, subjects were classified as "adherent" if they answered "Yes" to the question of "Have you
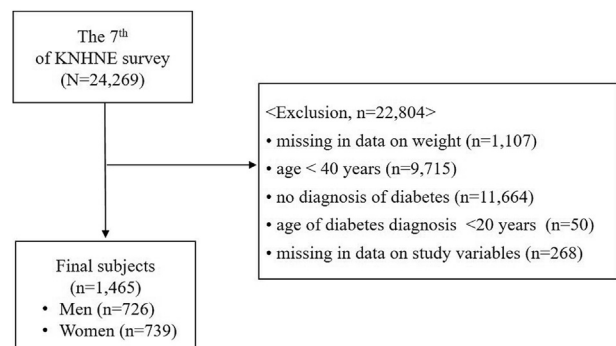

Figure 1. Flowchart of the selection of study participants.

undergone eye examination (fundoscopy) to check for eye complications caused by DM during the last year?" Those who answered "No" were classified as "not adherent," and those who answered "Do not know" were classified as "missing or unknown" and were excluded. Meanwhile, as the KNHANES does not investigate whether the participants with DM had their eye examination at the time of diagnosis, <1 year of a difference between the age at the time of survey and the age at the time of DM diagnosis was defined as adherence to eye examination guidelines at the time of DM diagnosis. Eighty-two subjects, comprising 35 men and 47 women, were found to have undergone eye examinations at the time of DM diagnosis.

Explanatory variables were composed of sociodemographic and DM-related characteristics and health-related characteristics, which were reported as factors affecting adherence to eye examination guidelines in one or more previous studies [8,14,16–18,25,28] or factors increasing the risk of eye complications [12,22,23]. Sociodemographic characteristics included gender, age, education level, and household income and were reclassified according to the purpose of this study. For example, age was divided into two categories of "40–64 years old" and "≥65 years old," while education level was divided into "lower than high school graduation" and "high school graduation or higher." The household income, classified as quartiles (high, high middle, low middle, low) were reclassified into three categories of "high," "middle," and "low."

DM-related characteristics included duration of DM, insulin use, glycated hemoglobin (A1C), and presence of a family (father, mother, or siblings) history of DM. Laboratory data were used for A1C, and the results were categorized based on 6.5% of the diagnostic criteria for DM of the ADA [29] and the Korean Diabetes Association [12].

Health-related characteristics comprised eight items, including health examination within the last 2 years, current smoker, current drinker, physical activity, body mass index (BMI), and presence of comorbid diseases such as hypertension, dyslipidemia, and cardiovascular disease. Current smoker was defined as the subject responded with currently smoking "everyday" or "sometimes." Current drinker was defined as the subject had drunk more than once a month during the last year. Physical activity was defined as the subject had engaged in mid-intensity physical activities for >2.5 hours, high-intensity physical activities for >1.25 hours in a week, or a mixture of the mid- and high-intensity physical activities. The BMI was computed using the formula "weight (kg)/height^2 (m^2) and classified in accordance with the BMI criteria for Asia-Pacific Region of WHO [30] and the Korean Society for the Study of Obesity [31]: 18.5 kg/m^2, underweight; 18.5–22.9 kg/m^2, normal; 23–24.9 kg/m^2, overweight; and >25 kg/m^2, obese. Among the four categories, "underweight" and "normal" were reclassified into "22.9 kg/m^2 or less" because of a low frequency (n = 14) of the underweight category. Hypertension, dyslipidemia, and cardiovascular disease were defined as the subjects had been diagnosed with the diseases by a physician, and cardiovascular disease included any of stroke, myocardial infarction, or angina.

Data collection

Before data collection, the institutional review board of Pusan National University approved the study (Approval no. PNU IRB/ 2019_112_HR). The raw data of the KNHANES VII (2016–2018), which deleted personal identification and sensitive information, and user guidelines for the data were provided and used by accessing the KNHANES website of the Korean Centers for Disease Control and Prevention (https://knhanes.cdc.go.kr).

Data analysis

Data were analyzed using the SPSS WIN 23.0 Program. Complex sample analysis incorporating the combined sampling weight of 3 years, strata, and cluster was performed in accordance with the KNHANES VII data analysis manual [27]. The significance level of the two-tailed statistical test was set at .05. The eye examination rate was computed in terms of percentages and standard errors. To confirm the correlation between the explanatory variables and adherence to eye examination guidelines, eye examination rates and standard errors for each category of explanatory variables were computed, and odds ratios (ORs) and 95% confidence intervals were computed using a simple logistic regression analysis.

To identify adherence to eye examination guideline–related factors, stepwise multiple logistic regression analysis was performed using the explanatory variables confirmed as significant in the simple logistic regression analysis, and ORs and 95% confidence intervals were computed. Meanwhile, as a result of a correlation analysis among the explanatory variables before the multiple logistic regression analysis, the coefficients of determination were <.80 [32], thereby confirming the absence of multicollinearity.

Results

Characteristics of study subjects

The characteristics of the study subjects are listed in Table 1. The average age of the total 1465 subjects was 64.11 years, 44.3% had an education level of high school graduate or higher, and 48.3% had a household income corresponding to the "middle" category. The average duration of DM was 9.22 years, with 7.3% injecting insulin, 26.6% with an A1C < 6.5%, and 55.6% had a family history of DM. Within the last 2 years, 73.3% had health examinations, 17.5% were currently smoking, and 44.9% were currently drinking. The percentage of physical activity was 34.7%, and the average BMI was 25.11 kg/m^2. The presence of hypertension and dyslipidemia as comorbid diseases were 62.5% and 53.1%, respectively.

According to gender, there were significant differences in age, education level, household income, health examination within the last 2 years, current smoking rate, current drinking rate, dyslipidemia, and cardiovascular disease prevalence. The average age of men was lower than that of women ($p < .001$). Moreover, men had a higher proportion of educational level of high school graduate or higher ($p < .001$), household income corresponding to the "high" category ($p < .001$), health examination within the last 2 years ($p = .001$), current smoker ($p < .001$), current drinker ($p < .001$), and higher prevalence of dyslipidemia ($p = .002$) and cardiovascular disease ($p = .024$) than women.

Rate of adherence to eye examination guidelines

The overall adherence rate to AEE was 32.7%, which was 1.36 times ($p = .022$) higher in women (36.3%) than in men (29.5%). The eye examination rate when the elapsed time after diagnosis of DM was <1 year, that is, the adherence rate to eye examination at the time of DM diagnosis, was 18.7%, and there was no significant difference between men (12.0%) and women (24.1%) ($p = .247$) (Figure 2).

Factors associated with adherence to annual eye examination

Table 2 shows the results of the analyses of factors associated with adherence to AEEs in men. Adherence to AEE in men was significantly associated with education level, current smoking, BMI, duration of DM, and insulin use. Subjects with an education level of

Table 1 *Characteristics of Study Participants.*

Characteristics		Total (n = 1465) n (%)	Men (n = 726) n (%)	Women (n = 739) n (%)	X^2	p
Demographics						
Age (yr)	40—64	594 (51.2)	331 (59.7)	263 (41.7)	47.02	<.001
	≥65	871 (48.8)	395 (40.3)	476 (58.3)		
	Mean ± SE	64.11 ± 0.34	62.02 ± 0.46	66.45 ± 0.47		
Education	<High school	901 (55.7)	346 (42.3)	555 (70.8)	120.16	<.001
	≥High school	564 (44.3)	380 (57.7)	184 (29.2)		
Household income	Low	549 (32.5)	226 (26.0)	323 (39.6)	37.41	<.001
	Middle	686 (48.3)	358 (50.7)	328 (45.9)		
	High	230 (19.2)	142 (23.3)	88 (14.5)		
DM related						
Duration of DM (yr)	<10.0	816 (59.3)	402 (59.3)	414 (59.2)	0.00	.971
	≥10.0	649 (40.7)	324 (40.7)	325 (40.8)		
	Mean ± SE	9.22 ± 0.26	9.04 ± 0.34	9.43 ± 0.38		
Insulin use		116 (7.3)	50 (6.4)	66 (8.3)	2.07	.199
A1C (%)	<6.5	399 (26.6)	201 (26.7)	198 (26.5)	0.01	.914
	≥6.5	1066 (73.4)	525 (73.3)	541 (73.5)		
	Mean ± SE	7.23 ± 0.04	7.25 ± 0.05	7.20 ± 0.05		
Family history of DM		812 (55.6)	383 (53.4)	429 (58.1)	3.29	.124
Health related						
Health examination in last 2 yrs		1062 (73.3)	561 (78.3)	501 (67.7)	21.08	.001
Current smoker		236 (17.5)	212 (29.8)	24 (3.6)	173.25	<.001
Current drinker		602 (44.9)	450 (65.1)	152 (22.2)	271.92	<.001
Aerobic physical activity		469 (34.7)	261 (38.3)	208 (30.7)	9.19	.013
Body mass index (kg/m²)	<22.9	393 (26.2)	203 (27.8)	190 (24.5)	5.08	.177
	23.0—24.9	367 (25.4)	191 (26.6)	176 (26.3)		
	≥25.0	705 (48.3)	332 (45.6)	373 (51.4)		
	Mean ± SE	25.11 ± 0.10	24.87 ± 0.14	25.38 ± 0.15		
Comorbidity	Hypertension	958 (62.5)	456 (60.2)	502 (65.1)	3.76	.102
	Dyslipidemia	759 (53.1)	329 (48.5)	430 (58.3)	14.23	.002
	CVD	227 (14.6)	132 (16.6)	95 (12.3)	5.53	.024

Note. CVD = cardiovascular disease; DM = diabetes mellitus; SE = standard error.
Data are unweighted number and weighted proportions.

high school graduate or higher (OR = 1.98, *p* = .001), currently not smoking (OR = 1.82, *p* = .009), BMI < 22.9 (OR = 1.68, *p* = .032), duration of DM of 10 years or longer (OR = 1.75, *p* = .007), and insulin use (OR = 2.81, *p* = .003) had higher rates of AEE than those who did not correspond to these factors. Adherence to AEE in women was significantly associated with age and duration of DM, and subjects aged 40—64 years (OR = 1.76, *p* = .008) and those with a DM duration of 10 years or longer (OR = 1.91, *p* = .001) had a higher rate of AEE than those who did not correspond to these factors (Table 3).

Discussion

The present study investigated the rate of adherence to AEE guidelines among people with DM aged ≥40 years using the KNHANES VII (2016—2018) data. It was found that approximately one-third of people with DM in Korea underwent eye examinations within a year of diagnosis, which was decreased from the 36.9% reported in a previous study of the KNHANES IV (2007—2009) data conducted 10 years ago [18]. Although both studies were conducted on the same target population, that is, people with DM aged ≥40 years, the AEE rate may have actually decreased, or information bias may have occurred because of reliance on self-reported adherence to eye examination. However, the eye examination rate confirmed in this study was substantially lower than the examination rate of 59.7% in people with DM aged ≥40 years using data from the National Health and Nutrition Examination Survey of the U.S. [7]. The AEE rate of women was approximately 1.4 times higher than that of men, which was consistent with the results of a literature review by Fathy et al. [33] and previous studies conducted in Korea [16,20]. This is a preferable result, considering that the prevalence of visual impairment and blindness caused by diabetic retinopathy or cataracts is higher in women [5,19]. However, the eye examination rate in women was also low, at an average of

36.3%. In this study, as a result of additional analysis of the AEE rate during 2016—2018, although the eye examination rate continued to increase by 29.5% in 2016, 34.0% in 2017, and 34.7% in 2018 (Supplementary Table 1), these rates were still very low. In particular, given that these analyses were performed on people with type 2 DM, various efforts to improve the eye examination rate while continuously monitoring the disease are required.

Meanwhile, the ADA [10] and the Korean Diabetes Association [12] recommend that people with type 2 DM undergo dilated eye examination at the time of DM diagnosis, as it is presumed that a considerable period of time has passed before the diagnosis. In this study, 18.7% of the subjects (one out of eight men and one out of four women) had an eye examination <1 year from the time of diagnosis of DM. This supports the results of a joint study conducted in 2017 by the Korean Ophthalmological Society and the Korea Centers for Disease Control and Prevention [21], in which the fundus examination rate among people with DM aged ≥40 years in Korea was only 23.5% (men: 20.5%, women: 27.4%). It can therefore be concluded that most people with type 2 DM in Korea do not have the opportunity to detect eye complications caused by DM in the early stages. Nonetheless, few studies have reported eye examination rates at the time of diagnosis of type 2 DM, both in Korea and abroad. In studies that assessed adherence to the ADA guidelines in the U.S. [13,14], only eye examination rates within 1—2 years have been reported. Accordingly, there is a demand for repetitive studies on the eye examination rate at the time of DM diagnosis in the future.

The duration of DM was related to adherence to AEE guidelines in both men and women, and education level, current smoking status, BMI, and insulin use in men and age in women were associated factors in the present study. The duration of DM and insulin use are DM-related factors that have been commonly considered in relation to eye examination, and the results of the present study are consistent with previous studies reporting that the eye examination rate was higher in those with a longer duration of DM or those
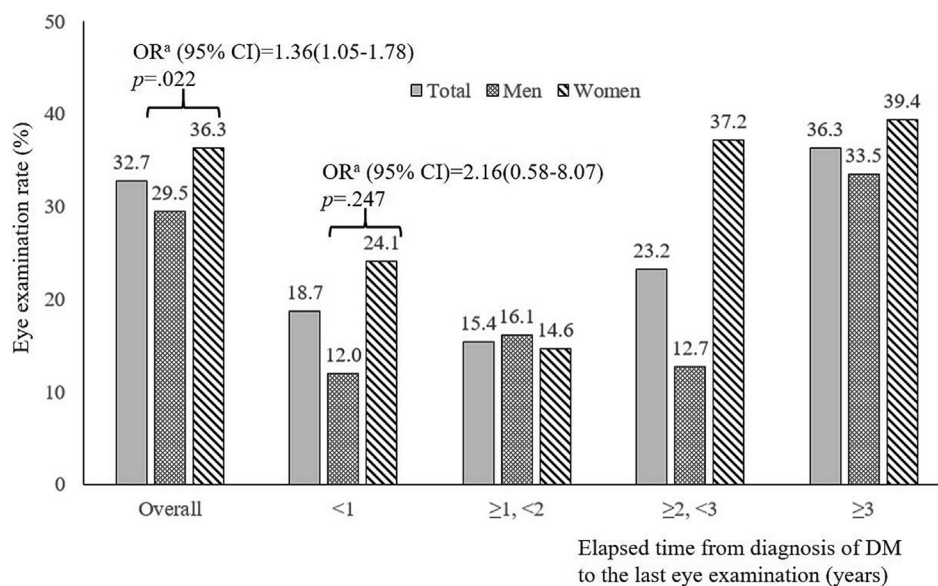
Figure 2. Annual eye examination rate of study participants.
Note. CI = confidence interval; DM = diabetes mellitus; OR = odds ratio. [a]The reference category is men.

who were taking insulin [8,25]. The reason for these results can be explained by previous studies in which the eye examination rate was lower in those who considered their health to be good [18] or in those with few comorbid diseases [14], while it was higher in those with some visual impairment and retinopathy [25]. That is, the eye examination rate is considered to be low if there is no awareness of the eye complications caused by DM but increases as complications begin to manifest; it is particularly important to educate people with type 2 DM to sufficiently recognize the risk of eye complications from the time of diagnosis.

Among men, the eye examination rate was higher in those with higher education, nonsmokers, and a normal BMI. Education level is a factor anticipated to impart an affirmative effect on the acquisition of knowledge and understanding of DM education. As such, in a study by An et al. [14], it was reported that the adherence rate to eye examination guidelines decreased significantly when the education level was low. Moreover, in Korea, studies conducted approximately 10 years ago reported that the eye examination rate of highly educated subjects was significantly higher [16,18], which was consistent with the results of this study. Previous studies on the association between smoking and adherence to eye examination guidelines vary by region and ethnicity. In a study conducted in Southern California, the U.S., the proportion of Caucasians among the subjects was 52.9%, and the eye examination rate of smokers was significantly lower than that of nonsmokers [14]. In contrast, in a study conducted in Alabama, the U.S., African Americans accounted for 84.5% of the subjects, and there was no significant difference between current smokers and nonsmokers [34]. In Korea, studies are mostly conducted using community-based survey data with representative samples of each region, which makes it difficult to identify regional differences between smokers and nonsmokers. Nevertheless, it has been reported that the rate of eye care service use was higher in urban residents among the general population aged ≥12 years [20], and the nonadherence rate to eye examination guidelines was 1.7 times higher in rural residents among people with DM aged ≥40 years [18]. Given these findings, it is necessary to identify whether there are differences in health behaviors, including smoking, between urban and rural areas, and how these differences affect adherence to eye examination guidelines, according to the characteristics of the residents in each area.

Meanwhile, subjects with normal BMI showed a 1.68 times higher eye examination rate than those with obesity (25 kg/m^2) in the present study. Studies on the association between obesity and adherence to eye examination guidelines are limited. However, in a retrospective cohort study conducted in the U.S. [14], the eye examination rate was higher in subjects with a BMI of ≥25 kg/m^2, which is contradictory to the results of this study. Accordingly, repeated studies on the association between obesity and adherence to eye examinations are needed.

Age was associated with adherence to eye examination among women, and the eye examination rate was 1.76 times higher in subjects aged 40–64 years than in those aged ≥65 years. This was contrary to the results of previous studies that reported higher eye examination rates in the elderly [18,25,34] and lower rates in younger patients [8,28]. It is thought that patients aged 40–64 years have a higher education level and greater accessibility to information than those aged ≥65 years, which makes it easier to acquire DM-related knowledge and take a more assertive attitude toward disease management by better recognizing their blood glucose levels. In addition, among women, age appears to be more associated with adherence to eye examination guidelines than education level or smoking status because socioeconomic factors, such as education level and income, and the overall smoking rate of women are lower than those of men in the elderly.

In summary, the adherence rate to eye examination guidelines is lower in those in the early stage of DM, those who consider themselves to be in good health or have no perceivable symptoms related to vision, those with a lack of understanding of the disease, and those with an unhealthy lifestyle such as smoking and obesity. Therefore, nurses are advised to classify people with DM who have such risk factors as a high-risk group and help them become aware of, and better understand, the disease through educational programs tailored to each person's needs. By implementing these changes, it will be possible to improve adherence to eye examination guidelines and further prevent and detect eye complications in the early stages.

Strength and limitation

The present study reported the recent status of adherence to eye examination guidelines among people with DM in Korea by using

Table 2 *Factors Associated with Annual Eye Examination in Men (N = 726).*

Characteristics		AEE rate mean ± SE	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)	p
Age (yrs)	40−64	30.9 ± 2.9	1.18 (0.80−1.75)	.401		
	≥65	27.4 ± 2.8	1			
Education level	<High school	24.0 ± 2.7	1		1	
	≥High school	33.5 ± 2.9	1.59 (1.09−2.34)	.018	1.98 (1.33−2.94)	.001
Household income	Low	25.3 ± 3.6	0.80 (0.47−1.38)	.430		
	Middle	31.5 ± 3.0	1.09 (0.66−1.80)	.747		
	High	29.7 ± 4.4	1			
Duration of DM (yrs)	<10.0	23.8 ± 2.5	1		1	
	≥10.0	37.7 ± 3.4	1.93 (1.31−2.86)	.001	1.75 (1.17−2.62)	.007
Insulin use	Yes	51.3 ± 8.0	2.71 (1.41−5.21)	.003	2.81 (1.43−5.49)	.003
	No	28.0 ± 2.1	1		1	
A1C (%)	<6.5	26.9 ± 3.6	1			
	≥6.5	30.4 ± 2.5	1.19 (0.77−1.82)	.437		
Presence of family history of DM	Yes	29.7 ± 2.8	0.97 (0.66−1.43)	.891		
	No	29.2 ± 3.0	1			
Health examination in last 2 yrs	Yes	30.4 ± 2.3	1.25 (0.78−2.03)	.354		
	No	25.9 ± 4.3	1			
Current smoker	Yes	21.2 ± 3.3	1		1	
	No	32.9 ± 2.5	1.82 (1.18−2.82)	.007	1.82 (1.16−2.86)	.009
Current drinker	Yes	27.2 ± 2.4	1			
	No	33.6 ± 3.5	1.35 (0.93−1.96)	.109		
Physical activity	Yes	33.5 ± 3.5	1			
	No	26.9 ± 2.5	0.73 (0.49−1.08)	.118		
Body mass index (kg/m²)	<22.9	36.8 ± 4.1	1.73 (1.10−2.73)	.019	1.68 (1.05−2.71)	.032
	23.0−24.9	29.1 ± 4.0	1.22 (0.77−1.93)	.408	1.30 (0.82−2.06)	.270
	≥25.0	25.2 ± 2.7	1		1	
Hypertension	Yes	27.8 ± 2.6	1			
	No	32.0 ± 3.5	1.22 (0.81−1.85)	.338		
Dyslipidemia	Yes	29.5 ± 3.0	1			
	No	29.4 ± 2.9	1.00 (0.67−1.49)	.987		
CVD	Yes	35.5 ± 5.2	1.40 (0.86−2.26)	.175		
	No	28.3 ± 2.2	1			

Note. AEE = annual eye examination; CI = confidence interval; CVD = cardiovascular disease; DM = diabetes mellitus; OR = odds ratio; SE = standard error; yr = years.

Table 3 *Factors Associated with Annual Eye Examination in Women (N = 739).*

Characteristics		AEE rate mean ± SE	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)	p
Age (yrs)	40−64	44.2 ± 3.4	1.80 (1.25−2.58)	.001	1.76 (1.16−2.66)	.008
	≥65	30.6 ± 2.6	1		1	
Education level	<High school	34.9 ± 2.5	1			
	≥High school	39.4 ± 4.1	1.21 (0.81−1.82)	.353		
Household income	Low	28.0 ± 3.1	0.46 (0.26−0.84)	.011	0.54 (0.28−1.04)	.066
	Middle	40.4 ± 3.0	0.81 (0.46−1.42)	.452	0.85 (0.47−1.52)	.578
	High	45.7 ± 6.3	1		1	
Duration of DM (yrs)	<10.0	32.0 ± 2.6	1		1	
	≥10.0	42.5 ± 3.2	1.57 (1.12−2.21)	.009	1.91 (1.32−2.78)	.001
Insulin use	Yes	51.6 ± 7.3	2.00 (1.11−3.60)	.022	0.62 (0.33−1.16)	.137
	No	34.9 ± 2.2	1		1	
A1C (%)	<6.5	38.3 ± 4.1	1			
	≥6.5	35.5 ± 2.4	0.89 (0.61−1.30)	.541		
Presence of family history of DM	Yes	36.2 ± 2.8	1.01 (0.69−1.46)	.974		
	No	36.3 ± 3.4	1			
Health examination in last 2 yrs	Yes	38.7 ± 2.6	0.72 (0.48−1.07)	.105		
	No	31.2 ± 3.7	1			
Current smoker	Yes	34.0 ± 12.3	1			
	No	36.3 ± 2.2	0.90 (0.30−2.71)	.855		
Current drinker	Yes	41.0 ± 4.5	1			
	No	34.9 ± 2.3	0.77 (0.51−1.16)	.206		
Physical activity	Yes	37.1 ± 3.8	1			
	No	35.9 ± 2.6	0.95 (0.65−1.38)	.773		
Body mass index (kg/m²)	<22.9	36.6 ± 4.0	0.99 (0.64−1.53)	.964		
	23.0−24.9	34.6 ± 4.1	0.91 (0.59−1.38)	.642		
	≥25.0	36.9 ± 3.0	1			
Hypertension	Yes	33.7 ± 2.6	1			
	No	40.9 ± 3.7	1.36 (0.93−1.98)	.108		
Dyslipidemia	Yes	38.1 ± 2.6	1			
	No	33.7 ± 3.4	0.82 (0.57−1.18)	.294		
CVD	Yes	29.6 ± 5.6	0.71 (0.41−1.24)	.230		
	No	37.2 ± 2.3	1			

Note. AEE = annual eye examination; CI = confidence interval; CVD = cardiovascular disease; DM = diabetes mellitus; OR = odds ratio; SE = standard error; yrs = years.

the most recent KNHANES VII (2016−2018) data [26,27] which represent the health and nutritional status of civilians residing in Korea. In particular, we reported the eye examination rate at the time of diagnosis of type 2 DM, which has been rarely studied. To identify the eye examination rate at the time of DM diagnosis, an additional eye examination rate was computed when the age difference between the time of survey and the time of DM diagnosis was <1 year. In addition, the study results can help to screen high-risk groups according to gender and seek improvement strategies by identifying factors associated with adherence after classifying groups by gender.

However, the following limitations should be acknowledged when interpreting the study results. First, the eye examination rate may have been overestimated or underestimated depending on whether or not undergoing the examination was determined by self-reporting. Indeed, it may have been overestimated if some participants of the survey responded in a way that they deemed to be more socially desirable (that is, having undergone examination) or if he or she incorrectly responded as having undergone eye examination to screen for DM complications even though he or she visited the ophthalmologist for other reasons. In contrast, underestimation is also possible when some participants responded that they did not undergo eye examination because they visited the ophthalmologist for other reasons, although the ophthalmologist may have in fact conducted comprehensive eye examinations, including screening for DM complications. To confirm this problem, an additional analysis was performed on the eye examination rate of 899 subjects, excluding those who visited the ophthalmologist because of eye diseases. The results were similar to those for all subjects (32.7% in total, 29.9% in men, 36.7% in women); therefore, this limitation was unlikely to have significantly affected the results (Supplementary Table 1). Second, although the KNHANES VII participants were asked whether they underwent eye examination (fundoscopy) to check for eye complications caused by DM, an error may have occurred because the question did not specifically ask whether they underwent a dilated eye examination, which allows for assessment of the entire retina. Third, as the KNHANES does not consider the types of DM, DM diagnosed after the age of 20 years was defined as type-2 DM, and eye examination rate was computed in this study. However, if individuals with type 1 DM were included, the examination rate at the time of DM diagnosis could have been underestimated given that people with type 1 DM are recommended to undergo eye examination within 5 years from the time of DM diagnosis. Fourth, as the KNHANES does not investigate whether patients undergo eye examination at the time of DM diagnosis, the approximate eye examination rate at the time of DM diagnosis was determined by computing the difference between the age at the time of survey and the age at the time of DM diagnosis in this study; therefore, there could be information bias. Fifth, for adherence to eye examination, KNHANES data were collected through a single measurement. Therefore, it was not possible to identify adherence to regular eye examination guidelines, and long-term follow-up studies are needed. In addition, the data using self-reported questionnaire are vulnerable to information bias including memory bias and social desirability bias. The question whether an eye examination was performed last year was asked (one year ago), so the memory bias is expected to be small. Meanwhile, the relationship between health behaviors and social desirability bias have not shown consistent results depending on the studies: positive relation [35,36] and no relation [37−39]. Therefore, self-reported adherence to eye examination in this study may or may not represent valid adherence, and further studies are recommended to identify the effect of social desirability bias on the adherence to eye examination among DM patients. Finally, this study analyzed the factors associated with adherence to eye examination focusing on sociodemographic and DM-related characteristics, but cognitive or environmental factors that affect the eye examination practice of people with DM were not identified.

Clinical implication

People with DM have a higher risk of visual impairment and blindness than those without. Accordingly, regular eye examination and early treatment when needed can help improve the quality of life and prevent these eye complications. However, the eye examination rates during the last year and at the time of DM diagnosis among people with type 2 DM aged ≥40 years were very low in this study. The results showed that the adherence rate to eye examination guidelines is still not improving, although the number of people with DM continues to increase in Korea. Therefore, careful attention and interventions must be paid to high-risk groups with nonadherence to eye examination guidelines, along with periodic eye examination rate monitoring for all people with DM. In particular, given that the eye examination rate was low when the duration of DM was short in both men and women, efforts are required to provide education on the prevention and management of diabetic complications, including eye examination guidelines, and to periodically monitor adherence to the guidelines, particularly for newly diagnosed people with DM who may still have low awareness of the risk of diabetic eye complications.

Conclusions

This study showed that approximately one-third of people with DM aged ≥40 years in Korea underwent eye examination last year, with an eye examination rate at the time of DM diagnosis of only 18.7%, thereby requiring improvement of adherence to eye examination guidelines. Those who had been diagnosed with DM < 10 years ago were found to be a high-risk group with a low eye examination rate, which was particularly true for men with an education level of lower than high school graduation, currently smoking, obese, or using insulin and for women aged ≥65 years. Accordingly, intensive management, such as education on the importance of eye examination and providing alarms or reminders to facilitate adherence to eye examination guidelines, are needed for the high-risk group. Further long-term follow-up studies are needed to investigate the rate of adherence to eye examination guidelines, both at the time of DM diagnosis and annually thereafter, and cognitive or environmental factors that affect adherence to the guidelines, to develop intervention programs to facilitate eye examination.

Conflict of interest

The authors declare no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anr.2021.07.003.

References

1. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: results from the International Diabetes Federation Diabetes Atlas, 9th ed. Diabetes Res Clin Pract. 2019;157:107843. https://doi.org/10.1016/j.diabres.2019.107843
2. Korea Centers for Disease Control & Prevention (KCDC). Korea Health Statistics 2017: Korean National Health and Nutrition Examination Survey (KNHANES VII-3). [Internet] Osong: KCDC; 2019 [cited 2021 Jan 1]. Available from: https://knhanes.kdca.go.kr/knhanes/sub04/sub04_04_01.do
3. Zhou W, Wang W, Huang W, Zhang X. Diabetes mellitus as a risk factor for open-angle glaucoma: a systematic review and meta-analysis. PLoS One. 2014;9(8):e102972. https://doi.org/10.1371/journal.pone.0102972
4. Khan A, Petropoulos IN, Ponirakis G, Malik RA. Visual complications in diabetes mellitus: beyond retinopathy. Diabet Med. 2017;34(4):478–84. https://doi.org/10.1111/dme.13296
5. Flaxman SR, Bourne RRA, Resnikoff S, Ackland P, Braithwaite T, Cicinelli MV, et al. Global causes of blindness and distance vision impairment 1990-2020: a systematic review and meta-analysis. Lancet Global Health. 2017;5(12): e1221–34. https://doi.org/10.1016/S2214-109X(17)30393-5
6. Zheng Y, He M, Congdon N. The worldwide epidemic of diabetic retinopathy. Indian J Ophthalmol. 2012;60(5):428–31. https://doi.org/10.4103/0301-4738.100542
7. Bressler NM, Varma R, Doan QV, Gleeson M, Danese M, Bower JK, et al. Underuse of the health care system by persons with diabetes mellitus and diabetic macular edema in the United States. JAMA Ophthalmol. 2014;132(2): 168–73. https://doi.org/10.1001/jamaophthalmol.2013.6426
8. Schoenfeld ER, Greene JM, Wu SY, Leske MC. Patterns of adherence to diabetes vision care guidelines: baseline findings from the diabetic retinopathy awareness program. Ophthalmology. 2001;108(3):563–71. https://doi.org/10.1016/S0161-6420(00)00600-X
9. Fong DS, Aiello LP, Ferris 3rd FL, Klein R. Diabetic retinopathy. Diabetes Care. 2004;27(10):2540–53. https://doi.org/10.2337/diacare.27.10.2540
10. American Diabetes Association. Standards of medical care in diabetes—2020 abridged for primary care providers. Clin Diabetes. 2020;38(1):10–38. https://doi.org/10.2337/cd20-as01
11. Handelsman Y, Bloomgarden ZT, Grunberger G, Umpierrez G, Zimmerman RS, Bailey TS, et al. American Association of Clinical Endocrinologists and American College of Endocrinology − clinical practice guidelines for developing a diabetes mellitus comprehensive care plan − 2015. Endocr Pract. 2015;21Suppl 1(Suppl 1):1–87. https://doi.org/10.4158/EP15672.GL
12. Korean Diabetes Association (KDA). Clinical practice guideline for diabetes. 7th ed. Seoul: KDA; 2021. p. 214–5.
13. Benoit SR, Swenor B, Geiss LS, Gregg EW, Saaddine JB. Eye care utilization among insured people with diabetes in the U.S., 2010-2014. Diabetes Care. 2019;42(3):427–33. https://doi.org/10.2337/dc18-0828
14. An JJ, Niu F, Turpcu A, Rajput Y, Cheetham TC. Adherence to the American Diabetes Association retinal screening guidelines for population with diabetes in the United States. Ophthalmic Epidemiol. 2018;25(3):257–65. https://doi.org/10.1080/09286586.2018.1424344
15. Han SH, Park YS, Kim JH, Lee I. Factors associated with screening for diabetic retinopathy in elderly diabetic patients: the sixth Korea National Health and Nutrition Examination Survey. Kor J Fam Pract. 2019;9(4):353–8. https://doi.org/10.21215/kjfp.2019.9.4.353. Korean.
16. Shin KH, Chi MJ. Fundus examination rate in diabetics and the public health factors associated with fundus examination rate. J Kor Ophthalmol Soc. 2009;50(9):1319–25. https://doi.org/10.3341/jkos.2009.50.9.1319. Korean.
17. Doucette ED, Salas J, Wang J, Scherrer JF. Insurance coverage and diabetes quality indicators among patients with diabetes in the US general population. Prim Care Diabetes. 2017;11(6):515–21. https://doi.org/10.1016/j.pcd.2017.05.007.
18. Lim HT, Choi KS. Factors associated with screening for diabetic retinopathy in diabetic patients aged ≥ 40 years using the KNHANES IV. J Kor Ophthalmol Soc. 2012;53(4):516–21. https://doi.org/10.3341/jkos.2012.53.4.516. Korean.
19. Park SH, Lee JS, Heo H, Suh YW, Kim SH, Lim KH, et al. A nationwide population-based study of low vision and blindness in South Korea. Invest Ophthalmol Vis Sci. 2015;56:484–93. https://doi.org/10.1167/iovs.14-14909
20. Park YS, Heo H, Ye BJ, Suh YW, Kim SH, Park SH, et al. Epidemiologic survey Committee of the Korean Ophthalmological Society. Prevalence and factors associated with the use of eye care services in South Korea: Korea national health and nutrition examination survey 2010-2012. Kor J Ophthalmol. 2017;31(1):58–70. https://doi.org/10.3341/kjo.2017.31.1.58
21. Woo GJ, Kim YJ, Oh KW. Prevalence, awareness and treatment rates of eye disease: Korea national health and nutrition examination survey. Publ Health Wkly Rep. 2019;12(22):717–21.
22. Lee CC, Stolk RP, Adler AI, Patel A, Chalmers J, Neal B, et al. Association between alcohol consumption and diabetic retinopathy and visual acuity-the AdRem Study. Diabet Med. 2010;27(10):1130–7. https://doi.org/10.1111/j.1464-5491.2010.03080.x
23. Praidou A, Harris M, Niakas D, Labiris G. Physical activity and its correlation to diabetic retinopathy. J Diabet Complicat. 2017;31(2):456–61. https://doi.org/10.1016/j.jdiacomp.2016.06.027
24. Yang SK, Lee EJ, Song YH, Kim JE, Choi IY, Lee D. Does the severity of type 2 diabetes affect yearly diabetic retinal examination?: A cross sectional analysis of the Korea National Health and Nutrition Examination Survey 2013-2015. Kor J Fam Pract. 2018;8:793–8. https://doi.org/10.21215/kjfp.2018.8.5.793. Korean.
25. Saadine JB, Fong DS, Yao J. Factors associated with follow-up eye examinations among persons with diabetes. Retina. 2008;28(2):195–200. https://doi.org/10.1097/IAE.0b013e318115169a
26. Kweon S, Kim Y, Jang MJ, Kim Y, Kim K, Choi S, et al. Data resource profile: the Korea national health and nutrition examination survey (KNHANES). Int J Epidemiol. 2014;43(1):69–77. https://doi.org/10.1093/ije/dyt228
27. Korea Centers for Disease Control & Prevention (KCDC). Manual for Using Data of Korean National Health and Nutrition Examination Survey: (KNHANES VII-2016-2018). Osong: KCDA; 2020. p. 3–14.
28. Maclennan PA, McGwin Jr G, Heckemeyer C, Lolley VR, Hullett S, Saaddine J, et al. Eye care use among a high-risk diabetic population seen in a public hospital's clinics. JAMA Ophthalmol. 2014;132(2):162–7. https://doi.org/10.1001/jamaophthalmol.2013.6046
29. American Diabetes Association. 2. Classification and diagnosis of diabetes: standards of medical care in diabetes-2018. Diabetes Care. 2018;41(Suppl 1): S13–27. https://doi.org/10.2337/dc18-S002
30. Pan WH, Yeh WT. How to define obesity? Evidence-based multiple action points for public awareness, screening, and treatment: an extension of Asian-Pacific recommendations. Asia Pac J Clin Nutr. 2008;17(3):370–4. https://doi.org/10.6133/apjcn.2008.17.3.02
31. Korean Society for the Study of Obesity (KSSO). Clinical guideline for obesity treatment. Seoul: KSSO; 2014. p. 24–5.
32. Kim JH. Multicollinearity and misleading statistical results. Kor J Anesthesiol. 2019;72(6):558–69. https://doi.org/10.4097/kja.19087
33. Fathy C, Patel S, Sternberg Jr P, Kohanim S. Disparities in adherence to screening guidelines for diabetic retinopathy in the United States: a comprehensive review and guide for future directions. Semin Ophthalmol. 2016;31(4): 364–77. https://doi.org/10.3109/08820538.2016.1154170
34. Keenum Z, McGwin Jr G, Witherspoon CD, Haller JA, Clark ME, Owsley C. Patients' adherence to recommended follow-up eye care after diabetic retinopathy screening in a publicly funded county clinic and factors associated with follow-up eye care use. JAMA Ophthalmol. 2016;134(11):1221–8. https://doi.org/10.1001/jamaophthalmol.2016.3081
35. Adams SA, Matthews CE, Ebbeling CB, Moore CG, Cunningham JE, Fulton J, et al. The effect of social desirability and social approval on self-reports of physical activity. Am J Epidemiol. 2005;161(4):389–98. https://doi.org/10.1093/aje/kwi054
36. McCullagh MC, Rosemberg MA. Social desirability bias in self-reporting of hearing protector use among farm operators. Ann Occup Hyg. 2015;59(9): 1200–7. https://doi.org/10.1093/annhyg/mev046
37. Persoskie A, Nelson WL. Just blowing smoke? Social desirability and reporting of intentions to quit smoking. Nicotine Tob Res. 2013;15(12):2088–93. https://doi.org/10.1093/ntr/ntt101
38. Kypri K, Wilson A, Attia J, Sheeran P, Miller P, McCambridge J. Social desirability bias in the reporting of alcohol consumption: a randomized trial. J Stud Alcohol Drugs. 2016;77(3):526–31. https://doi.org/10.15288/jsad.2016.77.526
39. Vernon SW, Abotchie PN, McQueen A, White A, Eberth JM, Coan SP. Is the accuracy of self-reported colorectal cancer screening associated with social desirability? Canc Epidemiol Biomarkers Prev. 2012;21(1):61–5. https://doi.org/10.1158/1055-9965.EPI-11-0552