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Factors Associated with the Need for Breastfeeding Information Among Women with Gestational Diabetes Mellitus: A Cross-sectional Study

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ABSTRACT (ENGLISH)

Purpose

Analyzing information based on individual needs can maximize the effectiveness of education, leading to changes in personal health behaviors. This cross-sectional descriptive survey study aimed to identify the characteristics of mothers who experienced gestational diabetes mellitus and correlate the factors associated with their information needs.

Methods

The participants were 298 women between the ages of 20 and 49 years who were pregnant and diagnosed with gestational diabetes at the time of the study, or who were diagnosed with gestational diabetes mellitus within five years after delivery. The average age of the participants was 34.28 years. After comparing participants' demographics, diabetes, and breastfeeding-related characteristics according to their need for information on breastfeeding, a multiple logistic regression analysis was performed.

Results

Factors associated with participants' need for information on breastfeeding were economic conditions, usual body mass index, current pregnancy, and experience of breastfeeding.

Conclusion

The findings can be used to implement programs that meet the needs of these women and help improve maternal and pediatric health and quality of life.

FULL TEXT

Introduction

In 2019, the International Diabetes Federation (IDF) estimated that 20.4 million pregnant women had hyperglycemia. In 83.6% of these cases, the underlying reason was gestational diabetes mellitus (GDM). The prevalence of GDM increases with age, resulting in a 37% occurrence in the 45–49 age group and a 50.1% occurrence in women under the age of 30 years [1]. In the 1990s, the prevalence of GDM in Korea ranged from 1.7% to 3.9%; however, a systematic review from 2000 to 2016 revealed that its prevalence in Korea increased to approximately 7.2% [2,3]. The risk of type 2 diabetes and obesity in both mothers and newborns increases if pregnant women with GDM do not receive timely treatment; thus, diabetes-related knowledge and management skills are essential for this population [4]. Of the various methods to decrease the risk of diabetes, breastfeeding has been found to be one of the most beneficial since it can also reduce the incidence of other diseases and improve women's health [5–7]. Being breastfed as a newborn also plays a role in adult life. Specifically, in a population-based birth cohort study of 3493 newborns in Pelotas, Brazil in 1982, breastfeeding was linked to an increase in intelligence quotient 30 years later,

which helped influence educational performance and income growth during adulthood [8].
However, there are a number of factors that lead to early breastfeeding cessation, including problems with breastfeeding at home, early return to work after childbirth (i.e., within three months), inadequate breastfeeding support, cesarean section delivery, low socioeconomic status, and increased body mass index (BMI) [9]. Only a few studies have investigated the need for information on breastfeeding or beliefs related to it among women with GDM, which is important since some diabetes medications taken by mothers can affect the children being breastfed [10]. Technological advancements, the abundance of available resources (i.e., information overload), and information targeting pregnant women do not always accurately reflect the needs of those with GDM [9]. Furthermore, anecdotal information by grandmothers has been found to negatively affect proper breastfeeding [11].
Knowledge, attitudes, and interest can influence the duration a mother breastfeeds; thus, education regarding the benefits and methods of breastfeeding is not only helpful but imperative [12,13]. Information based on an individual's needs that is provided in a timely manner can lead to changes in personal health behaviors [14]. The present study, therefore, aimed to identify the characteristics of mothers who experienced GDM and correlate their information needs. This information will serve as the basis for programs that can be potentially effective and aid mothers with GDM and their children lead healthy lives.

Materials and methods Participants

Potential participants were recruited through an online forum for pregnant women with diabetes in May 2020 and were required to provide information regarding their GDM diagnosis in the form. Participants were then selected based on their self-reports. The inclusion criteria were: (1) women aged 20–49 years who were (2) currently pregnant and diagnosed with GDM or (3) diagnosed with GDM within five years after delivery. Women who were diagnosed with GDM and had type 2 diabetes after delivery were excluded. The data were collected anonymously, and the questionnaire was identified by a serial number, placed in an anonymous envelope, and delivered to individual participants.
The sample size for logistic regression was calculated using G* Power, version 3.14. We considered an odds ratio (OR) of 1.62, Pr of 0.43, significance level of 0.05, alpha of 5%, and two-tailed test with 95% confidence interval (CI) based on self-efficacy. The minimum sample size was determined to be 248; accounting for a potential dropout rate of 20%, a total of 298 women were surveyed.

Variables Need for breastfeeding information

The need for breastfeeding information was assessed by one question: “Do you want to receive information about a breastfeeding program for mothers with GDM?” Participants were then divided into two groups based on their responses (yes or no).

Demographic characteristics

Demographic characteristics included age (26–30 years, 31–35 years, 36–40 years, and ≥41 years), educational level (high school or college/university and above), economic condition (low or above medium), employment status (employed or unemployed), weight (in kg), and height (in cm). Weight and height were used to calculate BMI, which was included in the final analysis. Current pregnancy was classified as “yes” if they were pregnant at the time of the survey and were diagnosed with GDM.

Diabetes-related and breastfeeding experience characteristics

For diabetes-related characteristics, participants provided information on previous illnesses other than diabetes (if any, the number of such diseases), current diabetes medication/s (if any, medication name/s, and type of management), and diabetes duration. The instrument used to assess GDM-related knowledge was developed based on the “Knowledge and Health Beliefs about Gestational Diabetes and Healthy Pregnancy's Breastfeeding Intention” [13]. This tool comprised 15 questions: four on GDM's definition, signs, and symptoms; four on GDM management; five on the adverse outcomes of GDM; and two concerning breastfeeding. The content validity was confirmed by two obstetric-gynecologists and two maternity nursing professors. Fifteen items with a content validity index of 0.8 or higher were extracted, and in a previous study, Kuder-Richardson 20 ranged from .75 to .77 [13,15]. Each question was answered as “Yes,” “No,” or “Don't know”; correct answers received 1 point while wrong answers or “Don't

know" responses earned 0 points. The knowledge score was converted to a percentile correct answer rate (%), with higher scores indicating greater knowledge. The Kuder-Richardson Formula 20 was .607. The breastfeeding experience was divided into full breastfeeding, mixed breastfeeding, and artificial breastfeeding.

Data analysis

Survey data were processed with SPSS, version 24.0 (IBM Corp., Armonk, NY, USA). The differences in demographics, diabetes-related characteristics, and breastfeeding-related characteristics were analyzed using t-tests and chi-square tests. The correlates of breastfeeding information needs were analyzed through multiple logistic regression.

Ethical considerations

The participants understood the study's purpose, that participation was voluntary, and that the collected data would be used only for research purposes. All participants provided written informed consent. The study was approved by the concerned institutional review board (KBUIRB-202004-SB-003-01).

Results Demographic characteristics

The data of 298 women with GDM were analyzed. Among them, 123 (41%) had information needs, and there was no significant age difference between the groups with and without information needs (mean = 34.28 years). The difference between the two groups concerned economic condition; when the economic level was low, information needs were about 10% higher (χ^2 = 4.42, p = .036). Furthermore, the usual BMI in the group with information needs was 25.30 kg/m^2, indicating greater obesity (about 2 kg/m^2) compared to the group without information needs (t = −4.20, p χ^2 = 12.79, p Table 1).

Diabetes-related and breastfeeding experience characteristics

Table 2 presents the characteristics of diabetes and other diseases in terms of participants' information needs. The group with information needs had an average of 0.40 diseases other than diabetes, which was statistically higher than those without information needs, with an average of 0.26 (t = 7.23, p = .007). In other words, 36.6% of the participants with information needs had more than one disease, apart from diabetes. In the groups with and without information needs, the prevalence of use of diabetes medications was 30.1% and 26.3%, respectively, with insulin being the most commonly used drug (24.4% and 13.7%, respectively). However, differences between the groups in use of diabetes medication, duration of diabetes, GDM-related knowledge, and breastfeeding experience were not statistically significant (Table 2).

Factors affecting information needs in participants

To identify the factors influencing information needs in the participants, a logistic regression analysis was performed using demographic, diabetes-related, and pregnancy and breastfeeding experience characteristics as independent variables. The predictors were economic condition (OR = 2.60, 95% CI = 1.14–5.92), usual BMI (OR = 1.11, 95% CI = 1.03–1.20), current pregnancy (OR = 3.57, 95% CI = 1.14–11.11), and breastfeeding experience (OR = 2.38, 95% CI = 1.04–5.45). Thus, the group with a low economic level had 2.60 times higher information needs than the groups with middle or high economic levels; additionally, the higher the usual BMI, the greater the need for information (by 1.11 times). Furthermore, women who were pregnant at the time of the study had a 3.60 times greater need for breastfeeding information than those who were not. The need for breastfeeding information was 2.38 times greater among women who experienced mixed breastfeeding than among those who did not (Table 3).

Discussion

This study aimed to identify factors associated with breastfeeding information needs among pregnant women with GDM. In this study, about 41% of participants had information needs. This result is difficult to collate accurately due to a lack of prior studies on the information needs of mothers with GDM; however, in a previous study of 21 patients who experienced psychological impairment after ICU treatment, 75% of patients had information needs [16]. Among these ICU survivors, only 33% were satisfied with the information provided by the hospital; thus, it can be assumed that 42% still required more information. In another study, a Swedish survey of 542 patients with chronic obstructive pulmonary disease requiring ongoing self-care, reported that further information on self-care and diet was needed in 68% of moderate and 32% of severe grade patients [17]. Another study involving 458 patients diagnosed with

hematologic cancer reported a perceived need for information among 40–70% of the patients [18]. As compared to these studies, the participants in the current study had lower medical severity, but similar information needs. However, although the present study investigated the specific information needs of mothers with GDM, follow-up studies are needed to corroborate the information needs among this target population.

Factors associated with the need for breastfeeding information were low economic levels, increased BMI, current pregnancy status, and mixed breastfeeding experiences. Unlike in previous studies [3,8], GDM-related knowledge, complications, and diabetes drug use levels were not correlated with the need for breastfeeding information in the current study. Demographic data, pregnancy status, and breastfeeding experience were found to be more important than diabetes-related characteristics. Low economic levels and increased BMI have previously been known to influence early breastfeeding cessation in mothers with GDM [9]. Therefore, providing adequate breastfeeding information to mothers with GDM, especially among those with the aforementioned risk factors, can help prevent early breastfeeding cessation.

According to the 2018 National Health and Nutrition Survey, approximately 55% of women had breastfeeding experience of over one month; the average breastfeeding duration was about 17 months [19]. The present results indicate that 70.5% of the women who engaged in mixed and complete breastfeeding had a better breastfeeding experience than the domestic average. Furthermore, the group that engaged in mixed breastfeeding had higher information needs than the group that engaged exclusively in artificial feeding.

The first possible reason for these findings is that the participants may have had experiences with GDM and failed to complete breastfeeding for a previous child. In a study among 1323 healthy mothers investigating the reasons for the cessation of breastfeeding within one year, three main factors were found: that the baby began to bite, the baby lost interest in breast milk, and the mother was unable to produce enough milk [20]. To date, few studies have investigated whether there is a difference between breast milk in healthy women and in women with GDM; however, some research indicates that GDM causes elevated sodium levels in breast milk [21], which are associated with insufficient milk supply and malnutrition in infants [22]. Therefore, the possibility that GDM influences breastfeeding cannot be excluded. Moreover, insufficient breast milk production is a concern not only for the mother but also for healthcare providers [23,24]. Hence, prenatal education on topics such as breast massage and maternal health status is necessary to increase breast milk production.

The second possible reason for the findings is that mothers who already have GDM are aware that breastfeeding has many benefits, but the information given to them while they breastfeed may not be what they need or want. Many studies have focused on motivating breastfeeding mothers by investigating the factors that affect the presence or absence of breastfeeding [9,25]. However, there is a lack of research on breastfeeding-related problems among mothers with GDM and their solutions. Throughout the breastfeeding period, it is necessary to ensure that mothers with GDM can have their doubts clarified by experts, receive corrective feedback, and benefit from supportive programs.

In 2015, a qualitative study of 14 African American mothers found that most were using at least one mobile application to obtain breastfeeding information through social media [26], confirming that pregnant women have a high need for information. Therefore, providing information using social media or mobile applications can help those who are currently pregnant and who will be breastfeeding in the near future, to communicate with experts on related topics.

Despite its strengths, this study has the following limitations. First, although social support, such as support from family members, is very important for continued breastfeeding [9,12], this study did not confirm whether it is associated with information needs. Second, in conducting an online survey, we did not consider potential differences in the information needs of mothers with GDM who do not have access to the internet. Third, interactions between variables, such as economic level and BMI, were not confirmed. Finally, research on the information needs of women with GDM is currently limited. Therefore, knowledge on women who refuse to receive breastfeeding information is scarce. This study also did not investigate why these women did not want to receive this information. Further, a qualitative study on the experience of breastfeeding preparation in women with GDM is necessary. In

addition, according to previous studies, mothers with GDM who have high self-efficacy are more likely to breastfeed [15]. Therefore, it would be helpful for health care providers to offer information programs to increase self-efficacy.

Conclusions

We identified the correlates of breastfeeding information needs among women with GDM. Healthcare providers should offer information needs–based programs to increase breastfeeding self-efficacy among women with GDM.

Funding

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Conflict of interest

The authors declare that they have no competing interests.

Acknowledgments

S. P., I. S., and D. M. conceived and designed the study, performed the data analysis, and wrote the manuscript. All authors have read and approved the final manuscript.

Variables	Total	Need for information	Difference	(N = 298)
Yes (n = 123)	No (n = 175)	n (%)/M±SD	n (%)/M±SD	n (%)/M±SD
χ^2 or t (p)	Age (years)	34.28 ± 3.73	34.17 ± 3.62	34.35 ± 23.37
0.40 (.686)	26–30	54 (18.1)	22 (17.9)	32 (18.3)
	31–35	136 (45.6)	60 (48.8)	76 (43.4)
	36–40	93 (31.2)	37 (30.1)	56 (32.0)
	≥41	15 (5.1)	4 (3.2)	11 (6.3)
	Educational level			
2.61 (.106)	High school	65 (21.8)	33 (26.8)	32 (18.3)
	≥College/university	233 (78.2)	90 (73.2)	143 (81.7)
	Economic condition			
4.42 (.036)	Low	44 (14.8)	25 (20.3)	19 (10.9)
	≥Medium	254 (85.2)	98 (79.7)	156 (89.1)

	Employment status			
1.12 (.735)	Employed	131 (44.0)	56 (45.5)	75 (42.9)
	Unemployed	167 (56.0)	67 (54.5)	100 (57.1)
	Usual BMI (kg/m^2)	24.19 ± 3.96	25.32 ± 3.89	23.37 ± 3.82
−4.20 (<.001)	Current pregnancy			
12.79 (<.001)	Yes	53 (17.8)	34 (27.6)	19 (10.9)
	No	245 (82.2)	89 (72.4)	156 (89.1)

Variables	Total	Need for information	Difference	(N = 298)
Yes (n = 123)	No (n = 175)	n (%)/M±SD	n (%)/M±SD	n (%)/M±SD
χ^2 or t (p)	Previous illness (except DM)	0.32 ± 0.54	0.40 ± 0.55	0.26 ± 0.52
7.23 (.007)	No	215 (72.1)	78 (63.4)	137 (78.3)
	Yes	83 (27.9)	45 (36.6)	38 (21.7)
	1	72 (24.2)	41 (33.3)	31 (17.7)
	≥2	11 (3.7)	4 (3.3)	7 (4.0)
	Diabetes medication			
0.35 (.556)	No	215 (72.1)	86 (69.9)	129 (73.7)
	Diet and exercise	213 (71.5)	85 (69.1)	128 (73.1)
	Observation	2 (0.6)	1 (0.8)	1 (0.6)

	Yes	83 (27.9)	37 (30.1)	46 (26.3)
	Insulin + OHA	12 (4.1)	2 (1.6)	10 (5.7)
	Insulin only	17 (5.7)	30 (24.4)	24 (13.7)
	OHA only	54 (18.1)	5 (4.1)	12 (6.9)
	Disease period (months)	28.13 ± 21.96	27.67 ± 25.61	28.47 ± 19.03
0.31 (.758)	GDM-related knowledge	11.38 ± 2.51	11.28 ± 2.20	11.44 ± 2.72
0.55 (.586)	Experience of breastfeeding (n = 254)*			
2.20 (.333)	Artificial feeding	44 (14.8)	14 (11.4)	30 (17.1)
	Mixed breastfeeding	145 (48.7)	63 (51.2)	82 (46.9)
	Complete breastfeeding	65 (21.8)	24 (19.5)	41 (23.4)

Variable	Odds ratio	95% CI	p-value
Age (years) (ref: 26–30)			
31–35	1.12	0.48–2.64	.790
36–40	0.87	0.35–2.15	.762
≥41	0.44	0.10–1.99	.287
Educational level (Ref: ≥College/University)			
High school	1.20	0.56–2.57	.633
Economic condition (Ref: ≥Medium)			

Low	2.60	1.14–5.92	.023
Employment status (Ref: Unemployed)			
Yes	1.18	0.67–2.08	.578
Usual BMI	1.11	1.03–1.20	.007
Previous illness (Ref: No)			
1	1.70	0.88–3.30	.115
≥2	0.64	0.13–3.25	.591
Diabetes medication (Ref: No)			
Yes	1.15	0.61–2.17	.671
Disease period (Months)	1.00	0.99–1.01	.976
GDM-related knowledge	0.99	0.88–1.11	.811
Current pregnancy (Ref: No)			
Yes	3.57	1.14–11.11	.028
Experience of breastfeeding (Ref: Artificial)			
Mixed	2.38	1.04–5.45	.041
Complete	1.80	0.70–4.58	.222

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Effects of Home-and-Workplace Combined Exercise for Patients with Ankylosing Spondylitis

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ABSTRACT (ENGLISH)

Purpose

The purpose of this study was to investigate the effects of home-and-workplace combined exercise on physical function, depression, and work-related disability in patients with ankylosing spondylitis.

Methods

This study adopted a non-randomized quasi-experimental design. Fifty-two patients were recruited: home-and-workplace combined exercise (n = 17), home exercise (n = 18), and control group (n = 17).

Results

The home-and-workplace combined exercise group showed improvement in spinal mobility and pulmonary function and significantly lower absenteeism and overwork impact than the home-exercise group and control group. The home-and-workplace combined exercise and home exercise groups showed a higher level of activity improvement than the control group.

Conclusion

home-and-workplace combined exercise can be recommended to patients with ankylosing spondylitis to enhance their physical function, including spinal mobility and pulmonary function, and reduce work-related disability.

FULL TEXT

DETAILS

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The Work Experience of Newly Recruited Male Nurses during COVID-19: A Qualitative Study

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ABSTRACT (ENGLISH)

Purpose

This study was to investigate the work experience of newly recruited male nurses during the COVID-19 pandemic.

Methods

With a phenomenological approach, this qualitative study was adopted semistructured interviews by phone or video calls. A total of 9 male nurses newly recruited for the COVID-19 wards in Chinese hospitals were interviewed for this study. And Colaizzi's method was applied for evaluation in the data analysis.

Results

Based on our findings, three themes were extracted. First, the newly recruited male nurses showed negative emotions at the beginning of COVID-19 epidemic, which was caused by changes in working conditions and content, but also prompted the nurses to change the way of coping with the crisis. Second, they gradually mastered the working skills and psychological training to cope with COVID-19 and developed a positive attitude toward life and a high sense of professional responsibility. Finally, we learned about their needs to respond to public health emergencies such as the COVID-19 pandemic.

Conclusion

COVID-19 is a disaster for all of humanity. The newly recruited male nurses are an important force in emergency rescue. Although they suffered from short-term negative emotions, they quickly adapted to the crisis. In order to better prepare for future emergencies, the disaster response capacity of newly recruited male nurses needs to be further improved. In addition, newly recruited male nurses have a strong demand for timely and personalized career development guidance.

FULL TEXT

Introduction

According to the World Health Organization (WHO), the coronavirus disease 2019 (COVID-19) has been identified as a disease caused by a novel coronavirus [1,2], and the first case was reported in Wuhan, China on December 12, 2019 [3]. As of May 1, 2021, there were 150,989,419 confirmed cases of COVID-19 worldwide, including 3,173,576 deaths [4]. And male nurses were considered essential for the care and treatment of COVID-19 patients in response to such a serious public health event. In the face of emergencies, male nurses had strong adaptability and antipressure ability [5], strong physical quality, decisive character, and can undertake heavy physical work to relieve patients' tension and anxiety [6,7]. These qualities could make male nurses indispensable in the healthcare workplace, especially when dealing with medical emergencies [8].

In the early stage of clinical work, these new male nurses were full of curiosity and had a strong thirst for knowledge when they encountered new knowledge or problems at work. In addition, they had strong plasticity and adaptability and often showed high enthusiasm for their work [5]. However, in Asian culture, due to insufficient training, lack of clinical experience, weak safety awareness, and social prejudice [9,10], they were often vulnerable to physical and mental trauma [11–13].

The COVID-19 pandemic with high rates of infection, which leads to heavy work, has put pressure on inexperienced nurses in particular. And nurses, as a line of defense for healthcare, should be considered as people who also need support and attention. Previous studies on male nurses' response to public emergencies were mostly quantitative studies [14,15], which often failed to reflect the psychological experience of new male nurses in the outbreak of infectious diseases.

There have been quantitative studies examining nurses' response to public crisis events. However, most of them were evaluation studies designed to investigate the effects of educational interventions in simulated environments on crisis event prevention, response, and post-disaster management. While these studies may be helpful in

identifying key factors in crisis response, they could not provide detailed information about the nurses' experience [16]. As recently observed, quantitative studies often failed to assess the perspectives, intentions, and role awareness of nurses in response to the COVID-19 pandemic [17]. At the same time, the influence of environment, law, and organizational culture on nurses' crisis response ability could not be fully clarified [18]. And qualitative research was considered necessary to advance the understanding of care and public health emergencies. As a commonly used qualitative research method, Colaizzi's phenomenological approach mainly focuses on the experience and feelings of participants and finds common patterns among the research subjects rather than individual characteristics. Therefore, it ensures the authenticity of participants' experience and follows scientific standards, which has been verified in various qualitative nursing studies [19].

In this study, Researchers aimed to understand the work experience of newly recruited male nurses during the COVID-19 pandemic through a well-designed interview and to further reveal the problems and challenges they might encounter in the process of their work. In addition, the identified experience could broaden the information available in the current literature on how nurses respond to public crisis events [20]. Therefore, by exploring the real experience of male nurses in coping with COVID-19, as well as the challenges and problems they faced, this study could provide information for further improving the comprehensive nursing management strategy and enhancing the ability of male nurses to cope with public health emergencies such as COVID-19.

Methods Study design

This is a qualitative exploratory descriptive study, conducted using semistructured interviews, based on phenomenological research methods and Colaizzi's seven-step method. The interview explored the experience of newly recruited male nurses during the COVID-19 pandemic. This study is consistent with the unified standard of qualitative survey [21].

Setting and participants

The study started in March and recruited nursing staff who participated in the fight against COVID-19 in tertiary hospitals in Wuhan and Zhengzhou from January to February 2020. These hospitals were chosen because of their commitment to treating patients with COVID-19. Voluntary participation in this study was carried out by the method of objective sampling. Demographic information included age, educational level, years of nursing experience, and marital status. In order to determine the number of nurses in the sample, data saturation was considered in the qualitative study. A total of 9 nurses were determined to be required to achieve data saturation. The average age of these 9 interviewees was 25 ± 2.0 years old, all of them had a bachelor's degree, and the average time of participating in anti-epidemic work was 17.5 ± 3.1 days.

Ethical consideration

When collecting and storing participant information, researchers paid close attention to confidentiality principles. Therefore, all personnel information was anonymized by using codes (N1, N2 …) during the transcription process. Transcribed text was then fed back to the participants for their approval. Audio recordings, videos, and other interview materials were stored on a password-protected computer. At the end of the study, all acquired data would be deleted. This study was approved by the Ethics Committee of Zhengzhou University (Approval no. 2020-18).

Data collection

Previous relevant reports were studied in this study to formulate an interview outline [22]. The questions were reviewed by a nursing team (including two professors and a research fellow) with expertise in qualitative methodology. In order to adjust the interview outline and complete the interview guidance, three male nurses were selected for pre-interview, followed by a comprehensive survey using the improved interview guidance. The final interview guide consisted of five open-ended questions to explore various aspects of the nurses' experiences in isolation wards: (a) What came to your mind when you learned that you would be working in the COVID-19 patient isolation ward? (b) What has been your previous experience in caring for COVID-19 patients? (c) In your opinion, what are the advantages and disadvantages of male nurses in fighting the epidemic? (d) How do you view your career after this experience? (e) As a newly recruited male nurse, what do you expect from hospital training?

The interview started after the participants were informed of the purpose and significance of the study. Since these

interviewees were mostly college classmates or friends of the researcher, the two sides maintained a good trust relationship, which laid the foundation for the smooth conduct of the interview. The interviewer has a master's degree in nursing and experiences in qualitative interview and psychological counseling. Additionally, the interviewer has obtained a Third-Level Psychological Consultant Certificate issued by the Ministry of Human Resources and Social Security of China. Hence, the researcher was qualified to conduct this study independently.
Considering the government's initiative in reducing the risk of infection, the interviews were conducted via video communication (using WeChat program). All interviews were recorded with the consent of the interviewees. Information was recorded simultaneously during the one-on-one interview. Through WeChat video interview, interviewers could clearly see the interviewees' facial expressions and body movements during the interview. Interviewers mainly listened to what the participants were talking about while paying attention to their movements, facial expressions and body language. Each interview lasted about 20 to 40 minutes.

Data analysis

Colaizzi's seven-step analysis was used to analyze the interview data: (1) transcribing recorded interviews verbatim into text and reading the participants' descriptions multiple times; (2) extracting significant statements from each description; (3) formulating meanings from those significant statements; (4) organizing those formulated meanings into themes; (5) integrating the results of the data; analysis into a description of the phenomenon under study; (6) returning the results to the participants for validation; and (7) incorporating any new, relevant data into the fundamental structure of the phenomenon [23]. The interview recordings were transcribed within 24 hours after the interview. The transcripts had been carefully checked and reviewed. Previous study from Lincoln and Guba [24] suggested that member checking was essential to ensure the credibility of qualitative data. In this study, the researchers gave feedback on emerging explanations, then reached a consensus within the group, and finally formed written materials. Finally, the written materials were emailed to the interviewees for verification. In this study, the interviewees had no disagreement about the completeness and accuracy of the written materials. After a careful reading of the transcript, the key information was highlighted and then properly encoded and subject optimized (Table 1).

Findings

This study conceptualized the attitudes and perspectives of newly recruited male nurses in dealing with COVID-19 based on their work experience. Three themes and several subthemes emerged from the analysis, which are described as below in detail.

I. Impact of the epidemic

COVID-19 is a disaster that threatens people's health and safety, leaving people in fear. Newly recruited male nurses also have negative emotions in the early stages. In order to mitigate the detrimental effects, newly recruited male nurses have to adopt coping strategies to reduce the impact of negative experiences.

Early negative experiences

The COVID-19 outbreak was sudden and highly infectious, with a large number of people infected initially. Under the condition of insufficient medical staff and lack of medical resources, the newly hired male nurses need to wear protective gear to carry out a lot of treatment work. On the other hand, the newly recruited male nurses need to work longer hours in order to address the shortage of medical staff. The physical discomfort caused by the closed protective equipment and the extended work load therefore caused the nurses to have serious physical and psychological fatigue.*Hospital was crowded with early patients. We had to distinguish between the infected and the uninfected (patients) and adopt different treatment methods. One has to do several things at once. We were on the go from morning till night. (Nurse 4)*

The overwhelming number of untreated patients in hospital has also increased the mental fatigue of newly recruited male nurses.*Sometimes at the end of a busy day, we could find that we had even more patients than when we took over. Faced with these circumstances and my mental exhaustion, I really thought my work was futile and probably hopeless. (Nurse 7)*

In addition, witnessing how patients were infected, and in some cases the inevitable death, made newly recruited

male nurses worry about their health and safety, as well as their families, increasing their psychological burden and fear of death.*The condition of a severely infected patient was both complicated and serious. Although as a nurse with expertise in respiratory diseases, I felt that my knowledge and experience were insufficient at this time. The rapid change of (patient)'s condition made me unable to determine whether I was doing the right thing and sometimes suspects that I really was not. (Nurse 3)I saw news reports about thousands of medical staffs being infected, which made me worry about my health. At first, infected people were not treated successfully. I could adjust my emotions quickly, but many people die every day and the grief recurs without waiting for you to return. The rescue treatment was good but there was no good result. No mood to eat anything. (Nurse 5)*

Temporary response strategy

In order to alleviate the negative experience caused by the clinical management of COVID-19, the newly recruited male nurses adopted an abstinence attitude, refused to pay attention to their own experiences and avoided expressing their feelings and emotions.*I will play my favorite online games after work, which can relieve my pressure and no longer think about my work experience. (Nurse 1)*

Some psychological cues could help nurses strengthen their mental resilience and stress capacity.*I often tell myself that I am doing a great thing, so I will try to protect myself and save others. It is necessary and meaningful. (Nurse 7)*

II. Gain experience and growth in the fight against the epidemic

With the great achievement in the fight against COVID-19, the newly recruited male nurses obtained a positive outlook on life. The healing and rehabilitation of patients also make them feel the greatness of professionalism, and at the same time improve their professional recognition and enhance their sense of responsibility.

Positive life perception

There is no denying that newly recruited male nurses play an important role in the care of COVID-19 patients. The support and warmth they receive from society and family reassures them and in turn expresses gratitude to those who support them.*The whole society is praising us and supporting us. The whole country is our backing. We only need to treat patients wholeheartedly. (Nurse 6)*

Improve professional recognition and enhance work responsibility

In the early days of the COVID-19 outbreak, there was a shortage of medical supplies, which quickly overwhelmed Wuhan's medical system. The rescue conditions in hospitals were rapidly exhausted, and nurses were faced with high workload and psychological pressure. In this case, the newly recruited male nurses had outstanding physical and psychological advantages in this rescue work.*After the outbreak of the epidemic, I found that being a nurse could save many lives in the first place. Especially, the gratitude of patients for my treatment made me proud of my profession and feel that everything was worthwhile. (Nurse 6)I am proud to be able to come forward when our country and people are in distress. I feel that I have done a great thing. In this particular moment, I feel like a hero. (Nurse 8)*

The newly recruited male nurses felt the appreciation and care from the whole society and were grateful for it.*We were from different departments. At the beginning, I was worried about getting along with everyone, but everyone was enthusiastic, helped each other at work, and cared for each other. I felt warm in the team, and everyone was working together to fight against the disease. (Nurse 3)*

III. Need for nurses in the epidemic

Through the fight against COVID-19, newly recruited male nurses have found themselves lacking in professional knowledge and are eager for psychosocial support and professional guidance in their career development.

Need for more emergency knowledge training

Newly recruited male nurses find themselves lacking in treating COVID-19 patients and wish to improve their knowledge and skills in the future.*Managers should strengthen the training of emergency rescue content in order to respond to unexpected accidents in the future. (Nurse 2)Improve my expertise and master more advanced professional operations. (Nurse 6)*

Need for psychosocial support

The COVID-19 outbreak had led to a rapid increase in the number of infections, and new male nurses faced greater

work pressure and psychological burden. Therefore, the way to alleviate this situation was to give them the material and psychological spiritual support they need from all walks of life.*We don't know how to deal with it …I think it would be easier if there are psychologists who can provide psychological counseling …We do need some kind of support from family members or social groups because we are facing high risks. (Nurse 2)*

Hope to get professional care

During the COVID-19 pandemic, society discovered that nurses were prone to burnout from overloaded care. In times like this, however, newly recruited male nurses expressed that social support has been a powerful source of motivation.*Everyone should abandon the traditional ideas in the future, respect us in the hospital and do not discriminate against male nurses. (Nurse 4)*

Discussion

Under the threat of the epidemic, people often feel afraid of their own health and helpless psychologically due to lack of knowledge, which only leads to the aggravation of negative emotions such as fear, exhaustion, and anxiety. COVID-19 is clearly a serious disease of international concern. It was more infectious than SARS, and more people were infected and killed than SARS [25,26]. Like others, newly recruited male nurses were concerned about their lives, health, and job safety in the face of a COVID-19 pandemic. Studies have shown [19] a sharp increase in the number of infections due to the COVID-19 outbreak, a 1.5-2 times increase in nurses' normal working hours and workload, and widespread fatigue. However, in the interview, it was found that the main reason for the fatigue of newly recruited male nurses was not the extension of working hours or the increase of workload, but the change in working conditions and content. Because this is a highly contagious disease, all treatment takes place in isolation wards. Frontline nurses without infectious disease expertise faced many challenges in adapting to a new work environment [27]. In addition, the management of COVID-19 patients needs to be both comprehensive and specific. Many newly recruited male nurses have little clinical experience in infectious intensive care [28]. When the health department is not prepared to deal with outbreaks of infectious diseases, there is an urgent shortage of medical staff. Therefore, there is an urgent need to train and educate newly recruited nurses. The rapid change in work content has also caused newly recruited male nurses to become more stressed and anxious on the job. We found that newly recruited male nurses showed significant anxiety during their first week on the job when they first entered the isolation ward. As working hours lengthen, most nurses experience an increase in fatigue and awareness of their own safety. Therefore, in the early stage of the epidemic, it is particularly important to carry out early psychological intervention for nurses. This could include immediate stress assessment and professional, continuous psychological interventions [29,30] to promote emotional relief and improve the mental health of nurses [31]. In addition, an early support system should be established for newly recruited male nurses working in isolation wards for a long time to ensure adequate supplies and reasonable staffing. Managers should also introduce flexible shift schedules and fixed allocations based on infections, illness, workload, and the number of nursing staff in order to provide a productive working environment for newly recruited male nurses. They should also ensure that nurses have enough time to recuperate to improve the quality of medical care [32].

Previous studies, such as those conducted during SARS, have found that infectious diseases have brought great pain to medical staff, affecting more nurses than doctors [33]. This is due to the nature of their work and their long-term close contact with infected patients. In addition, due to the shortage of staff, nurses also have to handle some of the daily work of the hospital. Therefore, it is interesting to see how nurses respond to the challenges of care and treatment during the COVID-19 outbreak. In the face of a variety of challenges, the newly recruited male nurses have shown great strength and resilience. They actively seek multiple support systems and self-regulation skills to relieve stress because they know that in order to save more lives and protect themselves, they need to take care of themselves and focus on their responsibilities. In terms of psychology, they often gave themselves positive psychological affirmation, defining fighting COVID-19 as a process that supports positive experiences and growth, which was consistent with Sun's findings [19]. Male nurses tend to adopt a certain abstinence attitude, refuse to pay close attention to their own experiences and further avoid expressing their feelings and emotions. For example, they will play online games, watch movies, and listen to music to adjust the unhappy mood at work. Similar to previous

studies [19,34], some nurses record their emotions and cognition through electronic diaries or letters, and interact closely with the outside world to obtain social and family information and psychosocial support. Unlike previous research results, newly recruited male nurses did not mind paying attention to the news about COVID-19. They just do not want to recall their experiences in the ward but are still keen on social report on COVID-19. This may be because they come from different regions, hoping to get more information about their hometowns.

Like other medical staffs, male nurses had negative experiences in the early stage of the COVID-19 fight, but they were able to quickly adjust and adapt to working in the isolation zone and continued to develop positive emotions during their work. Overall, respondents were more optimistic and could feel their own peace of mind. They were proud to participate in the epidemic prevention and control work and were full of confidence and expectations for the future work. Newly recruited male nurses have several reasons to be particularly optimistic: (a) they are enthusiastic about their work and are willing to accept challenging things; (b) they believe that participating in the fight against the epidemic has given them a sense of self-worth and accomplishment; (c) team support, social care, and compliments from patients can alleviate their mental stress of patients and reduce the impact of some negative emotions; and (d) in terms of crisis management, men are more likely to choose to tackle impersonal problems that cause specific difficulties and are less likely to focus on emotional issues.Therefore, when dealing with stress, they rarely use emotion-centric coping methods [35].

COVID-19 has been a disaster, creating huge challenges for newly recruited male nurses. However, despite the stress of the epidemic, they had to use their medical and psychological knowledge to make psychological adjustments. At the same time, they were in emergency rescue and infectious disease prevention. The physical and mental recovery and control of the injured after the disaster also gave them good experience in responding to public health crises in the future. Based on our findings, we were able to determine that the majority of newly recruited male nurses grew psychologically and cognitively under stress. They actively reflected on their cognitive thinking and found positive forces, such as greater respect for health and life, increased professional identity and responsibility, and gratitude for social and family support, which was consistent with the findings of Shih *et al.* [36]. Notably, the newly recruited male nurses showed positive altruism and greater solidarity in the face of disaster. The sense of responsibility that comes with a career encouraged them to take an active part in related work, which improved their professionalism and self-esteem [37]. In addition, the collaborative work of nurses from different regions and positions also enabled newly recruited male nurses to participate in a multidisciplinary teamwork. Therefore, during the COVID-19 epidemic, actively guiding and inspiring newly recruited male nurses to realize their own growth, adjusting cognitive evaluation, guiding positive coping styles, and stimulating positive emotions might play a positive role in psychological adaptation and career development.

Our findings indicated that newly recruited male nurses responding to the COVID-19 pandemic need more training in emergency preparedness, psychosocial support, and specialized care. Respondents showed that although they had received training on disaster knowledge during their employment, they mainly focused on emergency drills such as earthquakes and fire. These trainings mainly include first aid techniques, trauma treatment and injury, disposal, and classification of the wounded [38]. However, in the prevention and control of infectious diseases, the newly hired male nurses are still inadequate, such as lack of experience in response. Based on these findings, newly hired male nurses should also play a more important role in the leadership, such as resource allocation, patient transport, and health support for survivors and vulnerable groups [39]. In the future, leaders should pay attention to the construction of the disaster relief team, improve the relevant rules and regulations, and ensure the team construction and talent reserve [40].

Previous studies have shown that [41] lack of psychosocial support is a significant risk factor for negative psychological experiences in all types of disasters. At the same time, positive emotions are related to the support of patients, family members, team members, government, and the whole society. Therefore, psychosocial support is also anessential resource for newly recruited male nurses to fight the epidemic. This study also identified that good psychological adaptability and sufficient social support could ensure that newly hired male nurses could quickly acquire the mental recovery ability under severe stress. Therefore, encouraging various social supports and

strengthening the psychological treatment of nurses fighting COVID-19 in the initial phase of the COVID-19 response is critical to ensure the mental health of newly hired male nurses in the aftermath of disasters.

Although we found a further increase in the professional identity and responsibility of newly hired male nurses to participate in the COVID-19 outbreak, there were still many who were not involved in the treatment of COVID-19 patients and might require more professional guidance and care. Men were relatively underrepresented at different levels of employment in most countries, and male nurses were in a minority category [42]. Male nurses with less than 4 years of work experience have a higher turnover rate [43], which is not conducive to maintaining the diversity of the nursing team.

Male nurses tend to be enthusiastic at the beginning of their work and have high expectations for the development of their nursing career, but often their positions do not match their own conditions, which can only lead to major setbacks for male nurses [44]. The training of male nurses mainly includes professional training, continuing education, further training, promotion teaching, and scientific research [45]. During the interview, respondents mostly wish to receive more professional and scientific research training. According to the professional ability demand of male nurses, specialized training groups such as pressure ulcer care group and nutrition care group should be set up. Group training should be conducted once a week; furthermore, long-term planning arrangements should be made. Moreover, managers need to take full account of gender differences in the profession and make use of "person-job matching" [46], which could help them make full use of their own advantages and meet their career expectations according to their personal situation, professional ability, and personality characteristics of male nurses.

At present, nursing is still a highly gendered occupation. It is deeply influenced by traditional gender discrimination, regional development level, and other factors. In some regions, especially in developing countries, nursing recognition is low, nurses generally have a low social status, and men's participation in nursing is often disingenuously accepted [47]. Respondents believe that improving their social status is of far-reaching significance for future career development. Therefore, it is suggested that nursing managers and educators should carry out the concept of "gender neutrality" in nursing work, so as to promote the dedication of male nurses, establish the image of male nurses in society in the new era, and change the public prejudice against male nurses. At the same time, gender-sensitive nursing policy should be made consciously, so that gender-sensitive nursing policy should run through the whole education, practice, supervision, and leadership functions.

Although the newly recruited male nurses were well adapted to this incident, we could not ignore the physical and mental damage they suffered. We called on the family members and the community to provide full support and care to the male nurses in their prevention work. Psychologists should play a greater role in the diagnosis and treatment of male nurses who had completed rescue work.

Limitations

This study has limitations. Our study examined the working experiences of newly recruited male nurses working in major hospitals in several Chinese cities, including the previous epicenter Wuhan city. As a result, we still lack information about male nurses working in other countries and in different cultural contexts. Besides, our findings were based on data from participants who had shared educational experience at undergraduate institutions. Thus, it is necessary to expand the sample size and further study in combination with the investigation.

Conclusion

The COVID-19 outbreak has become a disaster that affects all of humanity. Compared with female nurses, male nurses were more adaptable to COVID-19 (able to make rapid psychological and cognitive adjustments to improve vocational skills and career planning level), but negative emotions were evident in the short term. Therefore, the integration of appropriate medical resources and social support and the establishment of supporting systems are crucial to alleviate the severe physical and mental stress of new male nurses in dealing with COVID-19 in its early stages. Based on these results, nursing managers should further strengthen the disaster rescue ability of newly recruited male nurses and make timely career development guidance to promote the career growth of new male nurses.

Conflict of interest

The authors declared no conflict of interest.

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Quotations	Theme	Subtheme
•One person had to do several tasks at the same time. We were busy from morning till night, without rest. I really thought my work was futile and there might be no hope.	I. Impact of the epidemic	Early negative experiences
•I will play my favorite online games after work, which can relieve me of stress and no longer think about the work experience.	Temporary response strategy	
•I found being a nurse can save many lives in the first place, especially patient's gratitude to me for treating them makes me proud of my profession and feels that everything is worth it.	II. Gain experience and growth in the fight against the epidemic	Positive life perception
•I am proud to be able to come forward when our country and people are in distress. I feel that I have done a great thing. In this particular moment, I feel like a hero.	Improve professional recognition and enhance work responsibility	
•Managers should strengthen the training of emergency rescue content so that we can respond to unexpected accidents in the future.	III. Need for nurses in the epidemic	Need for more emergency knowledge training
•We don't know the coping strategies...I think it would be easier if there are psychologists who can provide psychological counselling...	Need for psychosocial supports	•Everyone should abandon traditional ideas in the future, respect us in the hospital and not discriminate against male nurse.

DETAILS

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Behavioral Responses of Pregnant Women to the Early Stage of COVID-19 Pandemic in the Network Era in China: Online Questionnaire Study

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ABSTRACT (ENGLISH)

Purpose
The aim of this study was to examine the behavioral responses of pregnant women during the early stage of Coronavirus Disease 2019 (COVID-19) outbreak.
Methods
We recruited 1,099 women to complete an online questionnaire survey from February 10 to February 25, 2020. The subjects were divided into two groups (the pregnant women group and the control group).
Results
Concerns about infection: most of the participants watched the COVID-19 news at least once a day. Protective behaviors: the utilization rate of pregnant women (often using various measures) was higher than that of nonpregnant women. Exercise: 30.6% of the pregnant women continued to exercise at home, whereas in the control group, this percentage was 8.4%. Spouse relationship: 38.8% of the subjects' relationship improved, whereas only 2.3% thought the relationship was getting worse.
Conclusion
Pregnant women had some unique behavioral responses different from that of nonpregnant women. It is important to understand the behavioral responses of pregnant women in this network era.

FULL TEXT

Introduction

Coronavirus disease (COVID-19) has spread quickly and evolved into a pandemic since December 2019 when it first emerged in Wuhan, China [1]. The World Health Organization (WHO) declared the coronavirus outbreak to be a public health emergency on January 31, 2020 [2]. As of mid-November 2020, COVID-19 has infected more than 54 million people and resulted in the deaths of more than 1.3 million people.

The concerning features of COVID-19 are its apparent ability to spread readily and its propensity to cause severe disease or even death [3,4], which can cause fear and panic in society [5,6]. Nevertheless, the panic of the pregnant women could be doubled due to worries about the safety of themselves and their fetus.

The COVID-19 outbreak occurred 17 years after the 2003 epidemic of severe acute respiratory syndrome (SARS) in China. Currently, with the popularity of smart phones and the development of the network, in addition to the traditional means of obtaining information, such as television, radio, and newspapers, young people are more likely to use smartphones and tablets. The rapid and timely information dissemination has now become the new normal. News and information can influence people's behavior [7]. Petrie et al. conducted a cross-sectional telephone survey and found that the public perceptions could influence the members' behavioral responses in Ebola outbreak [8]. A BBC News posited that hearing a lot of information and news about COVID-19 had affected the public on daily life [9]. However, behavioral studies of epidemic outbreaks tend to focus on nonpregnant women [10–12]. There have been few studies on pregnant women's behavioral responses during disease outbreaks, including SARS, middle east respiratory syndrome coronavirus (MERS), and Ebola. Recent studies found that pregnant women had changes in behavior including self-isolating, changing their method of transportation, and so on in COVID-19 pandemic [13,14]. However, those studies only focused on pregnant women without a control group of nonpregnant women. We wondered if pregnant women would have some special behavior changes different from nonpregnant women. Therefore, we aimed to investigate the behavioral responses of COVID-19 on pregnant women in this network era in mainland China. Its related lifestyle and quality of life among pregnant women within 1 month after travel restrictions were imposed by the Chinese government. The results may assist clinicians in considering pregnant women's behavioral changes and offering early supports during the disease outbreaks.

Methods Study design

This study used a cross-sectional design and convenience sampling.

Setting and samples

Participants were recruited from online consultation according to the following criteria: each individual 1) agreed to participate in the study and gave digital informed consent; 2) ordinarily resided in Hangzhou; 3) was a married woman and living with her husband; 4) first marriage; and 5) had no history of mental diseases.

People can participate in online consultations through WeChat app (one of the most popular apps in China) or another app called the “Mother and Child Health Handbook App,” which is popular among pregnant women. People using the two apps were prompted to answer whether they were willing to complete the psychometric evaluation and the questionnaire. If the participants had any questions during the administration of the questionnaire, they could pose these questions online to the investigator.

The subjects were divided into two groups (the pregnant women group and the control group) according to whether they were pregnant or not. We matched the age and parity to select the control participants after we recruited pregnant women. The pregnant women were further divided into three subgroups: first trimester subgroup (0-13^{+6} weeks), second trimester subgroup (14-27^{+6} weeks), and third trimester subgroup (≥28 weeks).

Ethical considerations

All the study procedures were approved by the ethics committee of Hangzhou Women's Hospital (Hangzhou Maternity and Child Health Care Hospital) (Approval no. 202002-16). The participants gave written consent and were informed about the study objectives, the possibility of discontinuing the study at any time without penalty, and the protection of the confidentiality of personal information.

Measurements

The questionnaire was designed to determine the pregnant women's behavioral responses to the early stage of COVID-19 pandemic. Before designing the questionnaire, we used qualitative methods to examine the experiences of pregnant women during the outbreak.

We conducted a descriptive qualitative study and semistructured individual interviews were conducted at a time convenient for the participants. The Consolidated Criteria for Reporting Qualitative Research (COREQ) were used to report the method used and findings obtained [15]. A purposeful sampling method combined with the maximum variation strategy (for instance, age, trimester, parity, employment status, education level) was used to recruit eligible participants in our hospital. The sample size was determined by data saturation, that is, we stopped data collection at the point where no new themes from participants were emerging [16].

A total of nine women participated in the interviews, which lasted approximately 45 min per person. The audio recordings were transcribed verbatim by two researchers within 24 h of the interviews to ensure the accuracy of the information. The data were analyzed using thematic content analysis. There themes were emerged after data analysis: 1) increasing demand for comprehensive information; 2) more cautious self-protection behavior; and 3) changes in the relationship between spouse.

Based on the themes that were identified, a questionnaire was constructed to be used in the later quantitative survey. The questionnaire included six items in total: a. the frequency of watching the COVID-19 news (single-choice question: “hardly ever,” “1-2 times a week,” “once a day,” or “more than once a day”); b. preferred social media platform (single-choice question: “WeChat,” “Weibo (a platform similar to Facebook),” “Video apps (youku etc.),” “Zhihu,” “Douban,” or “Others”); c. the methods they used for preventing COVID-19 infection (multiple-choice question: “wearing masks,” “wearing gloves,” “wearing eyewear,” “wearing protective clothing,” and/or “using disinfectants”); d. the most commonly used means of transportation when going out (single-choice question: “driving a car,” “taxi,” “public transportation,” or “walking or cycling”); e. continuing exercise habits (single-choice question: “keep doing,” “reduce,” or “hardly ever”); and f. relationship between spouse (single-choice question: “better,” “worse,” or “same”).

Data collection

Data were collected between February 10, 2020 and February 25, 2020 in Hangzhou City, Zhejiang Province. This was a study to explore potential differences between the two groups, and there was no quantifiable hypothesis to test in advance. It seemed impossible to directly estimate the sample size. Thus, we referred to a rough estimation method with 5-10 times the number of variables to calculate the sample size [17]. A total of 14 variables were included in the study; therefore, the required sample size was 70 (14 × 5). Considering a sample loss of 20.0%, the minimum sample size required for this study was 88 participants. We recruited as many eligible subjects as possible. In total, 1,099 respondents who completed the questionnaires were included in the final analysis (1,099/1,200, 91.6% response rate), including 565 pregnant women and 534 controls.

Data analysis

Continuous data were compared using the independent-sample *t*-test and analysis of variance. Chi-squared analysis was used for categorical variables. A one-sample, Kolmogorov–Smirnov test was used to test nonparametric variables. We used the SAS System for Windows 9.4 software (SAS Institute Inc, Cary, NC), and *p*

Results Characteristics of the study population

A total of 1,099 participants completed all the procedures in the study. As shown in Table 1, of 565 pregnant women, 146 were in the first trimester, 212 were in the second trimester, and 207 were in the third trimester. Overall, no significant differences were observed between the pregnant women and control groups in terms of mean age, parity, employment status, education level, and time taken to complete the questionnaire. There were also no significant differences in those characteristics among the three subgroups (Table 1). No one was infected with COVID-19 at the end of the study.

Behavioral responses to the COVID-19 pandemic

We used Cronbach' α to determine the reliability of the questionnaire. The value was .76, which indicated that the study questionnaire is reliable.

Response of watching the COVID-19 news

Most of the participants (91.3% in the pregnant women group vs. 92.5% in the control group) watched the COVID-19 news at least once a day. There was no significant difference in the frequency of watching the COVID-19 news between the two groups ($p > .05$) (Table 2).

All of the participants chose smart devices, including smart phones and tablets, as the preferred way of getting news. Therefore, we further investigated their preferred social media platform. As shown in Table 2, WeChat was the most popular platform to acquire information about COVID-19, followed by Weibo. There was no significant difference between the two groups ($p > .05$).

Response of the protection methods selection

To mitigate the risk of infection, 100.0% of the subjects wore masks, and 40.0% of the pregnant women wore gloves, which was higher than the percentage in the control group (*p* p p p Table 3).

Response of the transportation means selection

There were 79.5% of the participants used self-driving car to reduce the risk of contracting the virus when going out. The use of cars was higher, while walking or cycling was lower, in the pregnant women group than in the control group. There was significant difference between the two groups (*p* Table 4).

Response of exercising

People spent most of their time at home during the outbreak in China, which would affect their exercise. There was significant difference between the two groups (*p* Table 4). There were 30.6% of the pregnant women continued to exercise at home, whereas in the control group, this percentage was 8.4%. Among those who hardly ever exercise, the rate in the pregnant women group (about 30%) was lower than that in the control group (about 40%).

Response of the spouse relationship

Staying at home may also affect relationships between the spouse. We found that 38.8% of the subjects' relationship improved, whereas only 2.3% thought the relationship was getting worse. There were no significant differences between the two groups ($p > .05$) (Table 4).

Behavioral responses to the COVID-19 pandemic in different trimesters

Among the three subgroups of the pregnant women, there were no significant differences in all those items showed above (Table 5).

Discussion

Through the present study, we found that epidemic and pandemics of COVID-19 can have behavioral effects on the population, especially on pregnant women. Our findings could be used as fundamental data for the government to pay close attention to pregnant women (a vulnerable group) in this epidemic and also provide some important information for medical workers to offer early interventions and supports by online manners. To the best of our knowledge, our study was among one of the first studies to investigate behavioral responses of pregnant women to the early stage of COVID-19 pandemic in mainland China.

Studies focus on pregnant women's behavioral state during a disease outbreak has been rare. Lee et al. reported that women in the SARS cohort adopted behavioral strategies, including wearing masks and cleaning hands vigilantly, to mitigate their risk of contracting infection [18]. However, this study compared the changes without a control group of nonpregnant women. A phenomenological research in Hong Kong during the SARS outbreak found that new mothers disrupted daily routines as they tried to eliminate their risk of contracting this disease including information gathering, avoiding places of risk, and washing bags, clothes, and hair after leaving the house [19]. Corbett et al. recruited patients in the second and third trimester of pregnancy and demonstrated that they had major changes in behavior including self-isolating, changing their primary method of transportation, bulk-buying, and so on in COVID-19 pandemic [13]. A cross-sectional, Web-based survey between March 3 and 10, 2020, in China showed that 55.7% of the participants protected themselves from contracting COVID-19 with self-efficacy [14].

However, behavioral studies of epidemic outbreaks still tend to focus on nonpregnant women. A study in Iranian residents demonstrated that social media increase perceived risk and safety behaviors [10]. Zhang et al. investigated the quality of life among local residents in Liaoning Province, China, and found that the participants changed exercising time and relax time in the COVID-19 pandemic [11]. Another study in China showed that the three most commonly used prevention measures were making fewer trips outside and avoiding contact, wearing a mask, and hand hygiene, which was similar to the results of our control group [12]. Among college students, a wide variety of behaviors, including increased phone usage, decreased physical activity, and fewer locations visited, were associated with fluctuations in COVID-19 news reporting in the United States [20]. Similar results were observed in children and adolescents. The data revealed a substantial decrease in physical activity increase in screen time during the COVID-19 pandemic [21]. However, compared with the youngers, older men reported relatively less worry and the fewest total number of behavior changes [22]. The issues related to this emerging global event may evolve into long-lasting health problems, which merits further investigation.

Epidemics and pandemics, such as those of SARS and MERS, have unique characteristics in terms of progression and control measures. The Spring Festival holiday occurred during 24–30 January, 2020, in China. The Chinese government–imposed traffic restrictions and extended the national holidays to control the outbreak during this time. At the time when this study was conducted, our city, Hangzhou, Zhejiang Province was also locked down. As of February 25, the deadline of our study enrollment, Zhejiang Province was one of the second-high epidemic areas in mainland China. Additionally, at that time, there was insufficient understanding of the new coronavirus and the epidemic situation. People were staying at home and self-isolating to avoid contracting or spreading the disease, which inevitably disrupted daily routines and decreased the quality of life. Staying at home with family and reducing recreational activities were considered to be safer ways to prevent virus infection. Our study investigated the changes in exercise and the relationship with spouse. Surprisingly, nearly one-third of pregnant women continued to exercise at home, which was obviously higher than that of nonpregnant women. Currently, using health education and popular science news, doctors suggest that pregnant women exercise properly, which is beneficial to both mothers and fetuses. Therefore, for the sake of fetal health, pregnant women themselves and their families may supervise and urge them to keep exercising. The time couples spent together increased during the epidemic period. The results were similar in the pregnant women and the control group and showed that about 40% of the subjects' relationships became better, whereas only about 3% thought their relationships were getting worse. However, Dodgson et al. demonstrated relationship difficulties in the women who became mothers during the SARS outbreak with their spouse [19], which was not consistent with our findings.

Overall, the Internet was currently the first choice for health information acquisition by the general public during the COVID-19 epidemic in China. A retrospective analysis showed that the peak of Internet searches and social media data about the COVID-19 outbreak occurred 10–14 days earlier than the peak of daily incidences, with which Internet searches and social media data had high correlation with daily incidences in China [23]. In our study, more than 90% of the subjects paid close attention to the latest information on the number of cases in the local area, the availability and effectiveness of medicines, the advice on prevention and so on. As something unthinkable, most social media platforms had not yet been born 20 years ago. Now people used social media platforms to gain information about COVID-19 for its convenience, and WeChat has become one of the most popular apps on smartphones in our participants.

The experiences of the SARS epidemic changed the attitude of the general public towards precautionary measures. The official guidance of the Chinese government advises that people should wear masks if they are going out and use disinfectants in a timely manner. People began to care more about their health. Nevertheless, they were more likely to read information from their friends through WeChat or Weibo, instead of using the official webpage [24]. Many people were also unable to discern, which information on social media was true. Research has shown that fake news and misinformation can have detrimental effects on public health [11,25]. In China, the genuine or fake news of "the increasing number of patients and suspected cases nearby," "the shortage of masks and disinfectants," etc. influenced people's behavior. The utilization rate of pregnant women (often using various measures) was higher than that of nonpregnant women. One hundred percent of the subjects wore masks. This finding was anticipated because wearing masks is a common practice when people are sick or to counter urban pollution or haze in China [26,27]. In terms of transportation, more than 70% of the participants used cars to minimize their contact with others. Pregnant women seldom walked or rode, possibly because pregnancy made those options inconvenient.

The possible reason for those behavioral responses might have been related to the fear of COVID-19 infection, which may be related to the body's normal protective responses. We also found that pregnant women were most concerned about their fetus being infected, followed by their family members and themselves. In the control group, the trends of worrying were similar (data not shown). Although there was no evidence of in utero transmission [28], pregnant women were naturally concerned about the safety of their fetuses. However, related data on COVID-19 are still rare. We may infer that if the pregnant women themselves were infected, they would further worry about spreading to the fetus, which would result in more protection responses.

The prevalence of prenatal psychological reaction could be different during the trimesters of pregnancy [29,30], which may lead to different behavioral responses. It is also controversial whether perinatal anxiety or depression is higher in a particular trimester during pregnancy [31,32]. In our study, there were no significant differences in all the behavioral items among the pregnant women in the three trimesters. This finding may be because the impact of epidemic stress on pregnant women exceeds the stress of the trimester itself, although a further study is necessary.

Study limitation

This study also has some limitations. First, the participants who wished to participate in this study were recruited though online consultation manner, which might narrow the recruitment of participants. Second, the questionnaire was designed by our team, and there was no other research to measure the effectiveness of the questionnaire. However, the questionnaire was designed based on a qualitative study and it was a collection of questions on how people react to COVID-19. The questionnaire has contributed to this research and merits use. Third, the study lacks longitudinal follow-up. The arduous situation would gradually improve, and the behavioral state of the pregnant women might also improve. Thus, we will further investigate the of long-term follow-up of the participants, including pregnancy outcomes.

Conclusion

Pregnant women had some unique behavioral responses different form that of nonpregnant women. It is important to understand the behavioral responses of pregnant women in this network era. This will then provide some important information for government and medical workers to provide early interventions and supports by online manners.

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Conflict of interest

The authors reported no conflict of interest. All authors have contributed significantly.

	Pregnant women group (n = 565)	Different trimesters	Control group (n = 534)	t or χ^2	p	First trimester subgroup (n = 146)	Second trimester subgroup (n = 212)

Third trimester subgroup (n = 207)	Age (years)	29.96 ± 3.37	30.02 ± 3.31	29.84 ± 3.44	30.05 ± 3.35	29.90 ± 3.38	0.10
.747	Gestational age (weeks)	22.62 ± 10.56	8.12 ± 2.24	21.88 ± 4.11	33.61 ± 3.70		
	Parity [n (%)]:	Nulliparous	372 (65.8)	93 (63.7)	140 (66.0)	139 (67.1)	358 (67.0)
0.18	0.674	Married [n (%)]	565 (100.0)	146 (100.0)	212 (100.0)	207 (100.0)	534 (100.0)
NA	NA	Marriage length (years):					
3.89	0.143	<5	440 (77.9)	114 (78.1)	162 (76.4)	164 (79.2)	410 (76.8)
		5 to 9	105 (18.6)	26 (17.8)	46 (21.7)	33 (16.0)	114 (21.3)
		≥10	20 (3.5)	6 (4.1)	4 (1.9)	10 (4.8)	10 (1.9)
		Employment status [n (%)]:					

0.84	.657	Full-time	445 (78.8)	116 (79.4)	168 (79.3)	161 (77.8)	430 (80.5)
		Part-time	86 (15.2)	22 (15.1)	31 (14.6)	33 (15.9)	78 (14.6)
Unemployed	34 (6.0)	8 (5.5)	13 (6.1)	13 (6.3)	26 (4.9)	Education [n (%)]:	
				0.60	.897	Less than middle school	28 (5.0)
9 (6.2)	12 (5.7)	12 (5.8)	30 (5.6)			Middle school	57 (10.1)
13 (8.9)	19 (8.9)	22 (10.7)	49 (9.2)	Bachelor	451 (79.8)	117 (80.1)	169 (79.7)
163 (78.7)	430 (80.5)	More than bachelor	29 (5.1)	7 (4.8)	12 (5.7)	10 (4.8)	25 (4.7)

Time for completing the questionnaire (seconds)	321.02 ± 125.11	311.83 ± 131.59	321.21 ± 127.55	327.33 ± 117.91	330.05 ± 128.03	1.40	.238

	Pregnant women group (n = 565)	Control group (n = 534)	X^2	p
Frequency of watching the COVID-19 news [n (%)]:			5.63	.131
Hardly ever	5 (0.9)	11 (2.1)		
1-2 times a week	44 (7.8)	29 (5.4)	Once a day	256 (45.3)
258 (48.3)	More than once a day	260 (46.0)	236 (44.2)	Preferred social media platform [n (%)]:
		1.91	.862	WeChat
425 (75.2)	398 (74.5)			Weibo
83 (14.7)	84 (15.7)	Video apps (youku etc.)	48 (8.4)	39 (7.3)
Zhihu	5 (0.9)	6 (1.1)	Douban	2 (0.4)

	Pregnant women group (n = 565)	Control group (n = 534)	X^2	p

Methods of preventing the COVID-19 infection [n (%)] :	Wearing masks	565 (100.0)	534 (100.0)	NA
NA	Wearing gloves	226 (40.0)	111 (20.8)	47.67
<.001**	Wearing eyewear	35 (6.2)	11 (2.1)	11.70
<.001**	Wearing protective clothing	8 (1.4)	1 (0.2)	5.10
.024*	Using disinfectants	300 (53.1)	222 (41.6)	14.62

	Pregnant women group (n = 565)	Control group (n = 534)	χ^2	p
Means of transportation [n (%)] :			12.68	.005**
Self-driving car	449 (79.5)	382 (71.5)		
Taxi	48 (8.5)	49 (9.2)	Public transportation	31 (5.5)
39 (7.3)	Walking or cycling	37 (6.5)	64 (12.0)	Exercise [n (%)] :
		86.14	<.001**	Keep doing
173 (30.6)	45 (8.4)			Reduce
228 (40.4)	267 (50.0)	Hardly ever	164 (29.0)	222 (41.6)

Relationship between the spouse [n (%)] :			3.98	.136
Better	219 (38.8)	231 (43.2)		
Same as before	333 (58.9)	285 (53.4)	Worse	13 (2.3)

	First trimester subgroup (n = 146)	Second trimester subgroup (n = 212)	Third trimester subgroup (n = 207)	χ^2	p
Frequency of watching the COVID-19 news [n (%)] : (single-choice question)				5.10	.531
Hardly ever	1 (0.7)	2 (0.9)	2 (1.0)		
1-2 times a week	8 (5.5)	18 (8.5)	18 (8.7)	Once a day	63 (43.1)
90 (42.5)	103 (49.7)	More than once a day	74 (50.7)	102 (48.1)	84 (40.6)
Preferred social media platforms [n (%)] : (single-choice question)				6.17	.801
WeChat	108 (74.0)	160 (75.5)	157 (75.8)		

Weibo	24 (16.4)	34 (16.0)	25 (12.1)	Video apps (youku etc.)	10 (6.8)
17 (8.0)	21 (10.1)	Zhihu	2 (1.4)	1 (0.5)	2 (1.0)
Douban	1 (0.7)	0 (0.0)	1 (0.5)	Others	1 (0.7)
0 (0.0)	1 (0.5)	Methods of preventing the COVID-19 infection [n (%)] : (multiple-choice question)			
		Wearing masks	146 (100.0)	212 (100.0)	207 (100.0)
NA	NA	Wearing gloves	64 (43.8)	85 (40.1)	77 (37.2)
1.57	.455	Wearing eyewear	8 (5.5)	17 (8.0)	10 (4.8)
2.01	.367	Wearing protective clothing	4 (2.7)	2 (0.9)	2 (1.0)

2.47	.291	Using disinfectants	82 (56.2)	111 (52.4)	107 (51.7)
0.76	.565	Means of transportation [n (%)] : (single-choice question)			
3.77	.708	Self-driving car	114 (78.1)	176 (83.0)	159 (76.8)
		Taxi	14 (9.6)	15 (7.1)	19 (9.2)
Public transportation	8 (5.5)	8 (3.8)	15 (7.2)	Walking or cycling	10 (6.8)
13 (6.1)	14 (6.8)	Exercise [n (%)] : (single-choice question)			
2.26	.689	Keep doing	45 (30.8)	60 (28.3)	68 (32.8)
		Reduce	54 (37.0)	91 (42.9)	83 (40.1)

Hardly ever	47 (32.2)	61 (28.8)	56 (27.1)	Relationship between the spouses [n (%)]: (single-choice question)	
		1.51	.825	Better	54 (37.0)
81 (38.2)	84 (40.6)			Same as before	87 (59.6)
127 (59.9)	119 (57.5)	Worse	5 (3.4)	4 (1.9)	4 (1.9)

DETAILS

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Development of a Nomogram for Carbapenem-Resistant Enterobacteriaceae Acquisition Risk Prediction Among Patients in the Intensive Care Unit of a Secondary Referral Hospital

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ABSTRACT (ENGLISH)

Purpose

This study aimed to identify the risk factors of carbapenem-resistant *Enterobacteriaceae* (CRE) acquisition to build a nomogram for CRE acquisition risk prediction and evaluate its performance.

Methods

This unmatched case-control study included 352 adult patients (55 patients and 297 controls) admitted to the intensive care unit (ICU) of a 453-bed secondary referral hospital between January 1, 2018, and September 31, 2019, in Busan, South Korea. The nomogram was built with the identified risk factors using multiple logistic regression analysis. Its performance was analyzed using calibration-in-the-large, the slope of the calibration plot, concordance statistic (c-statistic), and the sensitivity and specificity of the training set, subsets, and a new test set.

Results

The risk factors of CRE acquisition among ICU patients at a secondary referral hospital were Acute Physiology and Chronic Health Evaluation II score at the time of admission, use of a central venous catheter and a nasogastric tube, as well as use of cephalosporin antibiotics. At 20.0% of the predicted CRE acquisition risk in the training set, the calibration-in-the-large was 0, slope of the calibration plot was 1, c-statistic was .93, sensitivity was 85.5%, and specificity was 84.8%. The performance was relatively good in the subsets and new test set.

Conclusion

The nomogram can be used to monitor the CRE acquisition risk for ICU patients who have a similar case mix to patients in the study hospitals. Future studies need to involve more rigorous methodology and larger samples.

FULL TEXT

Introduction

Carbapenem-resistant *Enterobacteriaceae* (CRE) is rapidly spreading globally as the horizontal transmission of antibiotic-resistant genes occurs through plasmids to other strains [1,2]. According to the Centers for Disease Control and Prevention (CDC) report, 13 million people are infected with CRE annually, leading to 1100 deaths per year [3]. In South Korea, CRE cases have increased to 15,369 as of 2019 ever since four cases were initially reported in 2010 under sentinel surveillance [4]. As one of the control measures to CRE transmission, active screening testing (AST) is recommended to identify unrecognized CRE colonization among patients who might not be epidemiologically linked to known CRE patients [1,4]. As clinical cultures alone identify only a fraction of CRE patients [5], the majority of unrecognized CRE patients, a potential source of CRE transmission, might not be following contact precautions [1]. However, as a limited application of AST may increase the risk of missing unrecognized CRE patients, early detection of patients at high risk of CRE acquisition at hospital unit admission has been emphasized [6]. A few studies have identified the risk factors of CRE acquisition or proposed CRE acquisition risk prediction model to assess the patients at high risk of CRE acquisition [7–9]. The logistic regression model or Cox's proportional risk model is mainly used to construct predictive models for dichotomous outcome variables such as CRE acquisition, but this statistical prediction model features a complex formula that is difficult to apply in the clinical setting [10]. Nomogram is being considered as a good alternative to the conventional risk prediction model [11], and has been used in medical fields to determine the prognosis of cancer patients [11,12] or predict the development of type 2 diabetes [10]. In particular, several advantages of nomogram have been reported in oncology, so, it may assist decision-making of patients and physicians [12]. It could estimate individualized risk based on patient and disease characteristics, incorporate continuous or dichotomous variables into prediction, was easy to use, and showed better estimation than clinician's judgement [11–13]. Nomogram is a graphical expression of the numerical relationship between an event and its risk factors, and is known to help clinicians easily calculate the risk of an event occurring using a scoring system without requiring complex statistical formulae [12,14]. It is composed of graphical lines of points ranging from 0 to 100, each risk factor, total points, and the risk of an event occurring. The length of each risk factor's line reflects the regression coefficient estimated by multiple logistic regression analysis, and the longest line implies the greatest impact on the risk of the event occurring [10,14]. Regardless of the statistical significance, 100 points are assigned to the variable with the highest beta in the model, and the remaining variables have points proportionally to the highest beta [14]. For example, when we assume that three variables such as “admission by direct transfer” (β = 0.50, p = .020), “use of a central venous catheter” (β = 0.30, p = .060), and “use of cephalosporin antibiotics” (β = 1.20, p admission by direct transfer/$\beta_{\text{use of cephalosporin antibiotics}}$ multiplied by 100), and “use of a central venous catheter” gets 25 points ($\beta_{\text{use of central venous catheter}}/\beta_{\text{use of cephalosporin antibiotics}}$ multiplied by 100) [14]. Patients who admit by direct transfer use a central venous catheter and cephalosporin antibiotics will get 166.7 points in total, and will have the CRE acquisition risk matching to the total points [12,14]. As in the model performance, the nomogram performance is assessed in terms of calibration, discrimination, and clinical utility [12].

In South Korea, a CRE risk prediction model has been developed for patients admitted to the intensive care units (ICUs) at a large-sized tertiary general hospital with more than 1000 beds, and showed a relatively good level of calibration, discrimination, and clinical utility [9,15]. However, the model showed poor discrimination and clinical utility in an ICU of a secondary referral hospital because of differences in the case-mix in an external validity study, and new CRE risk prediction models for ICUs in secondary referral hospitals have been recommended [16]. Therefore, this study aimed to develop a new CRE risk prediction model for secondary referral hospitals and propose a nomogram based on the new model. The specific objectives are to: (1) identify the risk factors of CRE acquisition for ICU patients in the secondary referral hospital, (2) build a CRE acquisition risk prediction model and a nomogram from the model, and (3) evaluate the performance of the nomogram (calibration, discrimination, and clinical utility).

Methods Study setting and population

This unmatched case-control study was conducted in a 22-bed medical–surgical ICU at D hospital in Busan, a 453-bed secondary referral hospital. The inclusion criteria were patients admitted to an ICU and who were monitored by

active surveillance culture (using rectal swabs) between January 1, 2018, and September 31, 2019. The exclusion criteria were those who were readmitted to the ICU during the same period, did not have a surveillance test at ICU admission and within 7 days of ICU admission, were CRE carriers at ICU admission, and were not confirmed to be CRE acquisition or not.

The sample size of the training set was calculated using Open Source Epidemiologic Statistics for Public Health [17]. We considered a significance level (a) of .05, power (1-β) of .85, percentage of controls exposed of 25.9%, odds ratio (OR) of 2.70 based on a previous study [9], and a case-to-control ratio of 1:5–1:6 [18]. Under the aforementioned condition, a minimum number of 50–52 cases (CRE carriers) and 257–298 controls (non-CRE carriers) are required. Cases refer to patients who were tested negative for CRE in active surveillance culture test on admission, but acquired CRE later during the ICU hospitalization, whereas controls were patients who were tested negative for CRE at admission or on weekly tests until discharge. Cases were retrospectively selected first, whereas controls were selected patients who were hospitalized during the same period. We sorted non-CRE carriers by month, assigned the serial number from 1 to n to the non-CRE carriers, and consecutively generated random numbers using “RAND” function in the Excel version 2016 (Microsoft, Redmond, WA, USA) program. And then, non-CRE carriers with serial numbers corresponding to the first 14 or 15 random numbers were selected as controls.

During the study period, 1031 patients were admitted to the ICU, 483 patients were excluded with the following reasons: readmission (n = 130), no surveillance test at ICU admission (n = 134), no surveillance test within 7 days of ICU admission (n = 195), CRE carriers at ICU admission (n = 14), and were not confirmed to be CRE acquisition or not at the end of the study (n = 10). Of the 548 patients (53.2% of the population) who met the inclusion criteria, 55 patients were CRE carriers and 493 patients were non-CRE carriers. All CRE carriers were selected as cases, and in total, 297 were selected as control (Supplementary Figure 1).

Two types of test sets were established to evaluate the performance of the nomogram for CRE acquisition risk prediction—five subsets of the training set with resampling techniques for internal validation and a new test set with sampling from different but related source populations for external validation [19]. When evaluating the validation by dividing a large sample into a small sample, 10 events per variable is recommended [20]. In this study, 55 cases of the training set were randomly allocated into five groups of 11 people each; the controls were also randomly classified into five groups. The new test set was selected from October 1, 2019, to February 28, 2020, at the same medical center. During this period, a total of 201 patients were admitted to the ICU, of whom 166 subjects (8 CRE carriers and 158 non-CRE carriers) met the selection criteria. All the eight CRE carriers were included as cases and 42 non-CRE carriers were randomly selected as controls.

Study instrument

A structured data collection form was used to extract electronic medical record (EMR) data. The form consisted of the outcome variable (CRE acquisition) and several explanatory variables such as general characteristics, therapeutic procedures, use of indwelling catheters, and use of medication/antibiotics based on previous studies [8, 9]. The CRE definition adopted the Korea CDC's recommendation based on the Clinical and Laboratory Standards Institute's recommendation (M100-S27) [21]. Antimicrobial susceptibility to carbapenems was assessed using the disk diffusion and broth diffusion methods. The isolates that were intermediate or resistant to imipenem (≤22 mm, ≥2 μg/mL minimum inhibitory concentration) or ertapenem (≤21 mm, ≥1 μg/mL minimum inhibitory concentration) were considered CRE.

The following general characteristics of the patients were evaluated: age, gender, admission route, length of ICU stay, comorbidities (diabetes and stroke), Charlson comorbidity index (CCI) score, Acute Physiology and Chronic Health Evaluation (APACHE) II score at admission, and multidrug-resistant organisms isolated. Comorbidity was categorized as “Yes” if they were present. Therapeutic procedures included surgery, endoscopy (stomach, bronchial), mechanical ventilation, tracheostomy, and transplantation. Indwelling catheters included a urinary catheter, a central venous catheter, a nasogastric tube, and various drainage tubes. Medications included gastric acid suppressants, immunosuppressants, penicillin, carbapenems, third- or fourth-generation cephalosporins (hereafter cephalosporin), quinolones, vancomycin, tetracyclines, and polymyxin B.

Data collection

For data collection, one author with 3 years of experience in infection control at this study hospital reviewed and extracted EMRs, and verified the accuracy of data extracted from the EMR to the data collection form, using 10 randomly selected cases. Exposure to risk factors was investigated from ICU admission to CRE acquisition for cases and from ICU admission to discharge for controls.

Data analysis

The collected data were analyzed using IBM SPSS Statistics 25.0 for Windows (IBM., Armonk, NY, USA) and R version 3.6.3 (The R Foundation, Vienna, Austria). A two-tailed test was performed with a significance level (α) of .05. The Chi-square (χ^2) test, Fisher exact test, or Mann–Whitney U test was performed to compare the explanatory variables between cases and controls. Variables with *p*

The performance of the logit model and the nomogram were evaluated using a training set, five subsets, and a new test set in terms of calibration, discrimination, and clinical utility. Before the performance analysis, the χ^2 test or Mann–Whitney U test was performed to confirm the homogeneity in the explanatory variables between the training set and the subsets or new test set. The calibration was assessed using the Lemeshow–Hosmer goodness-of-fitness test (L–H test) [22], calibration-in-the-large, and the slope of calibration plot [19,22,23]. When the observed and average predicted risk is perfectly matched, the calibration-in-the-large is 0 and the slope of calibration plot is 1 [19]. To evaluate discrimination, concordance statistic (c-statistic) is the same as the area under the receiver operator characteristic curve and 95% CIs were obtained. The c-statistic has a value of 0.5 (not discriminated) from 1.0 (complete discrimination), and the larger the c-statistic, the better the discrimination [23,24]. To evaluate clinical utility, the sensitivity, specificity, positive and negative predictive values, as well as the correct classification rate were calculated using a 2 × 2 decision table between the actual CRE acquisition and predicted CRE acquisition at a 20% CRE acquisition risk that maximized the sensitivity and specificity of the receiver operator characteristic curve.

Ethical considerations

This study was approved by the Dongeui Hospital Institutional Review Board (Approval no. DEMC−2020−02). The requirement for informed consent was waived because the study involved a retrospective review of de-identified data.

Results Comparison of explanatory variables between cases and controls

In Table 1, we described the characteristics of the sample. For cases, 47.3% were women with a mean age of 73.02 years and a mean length of stay in ICUs of 20.02 days. The mean APACHE II score was 17.76 points, 85.5% had a central venous catheter, and 56.4% and 87.3% of them have used carbapenem and cephalosporin antibiotics, respectively. For controls, 43.4% were women with a mean age of 68.26 years and a mean length of stay in ICUs of 8.24 days. The mean APACHE II score was 10.90 points, 31.6% had a central venous catheter, and 20.5% and 37.7% of them have used carbapenem and cephalosporin antibiotics, respectively. The cases and controls showed significant differences in all characteristics except gender, comorbidities such as diabetes and stroke, invasive procedures such as surgery and endoscopy, use of urinary catheters, and use of fluoroquinolone antibiotics (Table 1).

The CRE acquisition risk prediction model and nomogram

Compared with other cases, the risk of CRE colonization was 2.47 times (OR = 2.47, 95% CI = 1.02–5.98, *p* = .044) higher in cases that were admitted by direct transfer, 2.95 times (OR = 2.95, 95% CI = 1.16–7.48, *p* = .023) higher in cases in which a central venous catheter was used, 14.20 times (OR = 14.20, 95% CI = 3.93–51.33, *p* p = .005) higher in cases in which cephalosporin was used, and 1.16 times (OR = 1.16, 95% CI = 1.07–1.25, *p* Table 2). Based on the multiple logistic regression analysis results, the logit model for CRE colonization risk prediction was as follows: E (logit of CRE acquisition) = −7.15 + 0.91 (admission by direct transfer) + 0.15 (APACHE II score at admission) + 1.08 (use of a central venous catheter) + 2.65 (use of nasogastric tube) + 1.368 (use of cephalosporin antibiotics). In the nomogram of the CRE acquisition risk prediction model, points allocated to direct transfer, use of a central venous catheter, use of a nasogastric tube, and use of cephalosporin antibiotics were 0 or 18, 0 or 21, 0 or 51, and 0 or 27, respectively, and 1 point of the APACHE II score at admission was allocated about 2.86 points (range: 0–217 points; Figure 1).

Performance of the nomogram for the CRE acquisition risk prediction model

Table 3 shows the performance of the nomogram of the CRE acquisition risk prediction model. The nomogram showed good calibration using the L–H test (p = .969), and the calibration-in-the-large was 0 and the slope was 1 (Supplementary Figure 2). The C-statistic was .93 (95% CI, .90–.96) in the training set and was .88–.97 in the subsets and new test set (Figure 2). The sensitivity and specificity of the training set were 85.5% and 84.8%, respectively, when the predicted risk of CRE acquisition was 20.0%. For the subsets and new test set, the calibration-in-the-large was −0.55 to 0.34, the slope was 0.81–1.43, and 0 and 1 were included in the 95% CI, the sensitivity was 72.7%–100.0%, and the specificity was 75.0%–93.2%.

The comparison of the characteristics between the subsets, the new test set, and the training set is shown in Supplementary Table 1. Subsets 1 and 3 differed from the training set in surgery, and subset 5 differed from the training set in admission by direct transfer. The new test set differed from the training set in age, CCI score, use of a central venous catheter and a nasogastric tube, as well as use of penicillin and vancomycin antibiotics.

Discussion

This study aimed to identify the risk factors of CRE acquisition, to build a nomogram for CRE acquisition risk, and to evaluate its performance in a 453-bed secondary referral hospital. The risk factors for CRE acquisition in ICU patients were direct transfer, APACHE II score at admission, as well as use of a central venous catheter, a nasogastric tube, and cephalosporins. And, the nomogram composed of the above five factors was shown good calibration, discrimination, and clinical utility in the training set as well as subsets, and a new test set, which means that internal and external validities have been secured. This nomogram constructed in this study makes the healthcare workers easy to calculate the individual CRE acquisition risk, enables them to frequently assess the change in CRE acquisition risk. Therefore, it is expected to contribute to early detection of high-risk CRE patients, to rapid decision making whether the actual surveillance is needed or not in ICUs of secondary referral hospitals.

In this retrospective investigation of ICU patients of a secondary referral hospital over 21 months, about 10% of patients acquired CRE by the end of the study. This figure was lower than 20% CRE acquisition reported in a large-sized tertiary hospital with 1000 beds and more [9], but higher than 5% CRE acquisition reported in a similar-sized hospital in Israeli with 550 beds [25]. The difference in the CRE acquisition rate seems to be due to differences in age, subject severity, use of therapeutic procedures or antibiotics, and timing of the investigation.

Considering that the risk factors for CRE acquisition in a previous study in South Korea were the presence of multidrug-resistant organisms, APACHE II scores at admission, as well as use of cephalosporins and carbapenem antibiotics [9], APACHE II scores at admission and use of cephalosporins antibiotics are major risk factors for CRE acquisition, regardless of the size of the hospital and case mix. In particular, the APACHE II score at admission showed the longest line in the nomogram, which implies the greatest impact on the CRE acquisition risk [10,14]. As APACHE II score increases by 1 point, the CRE acquisition increases 1.16 times. Therefore, if other factors are the same, those with an APACHE II score of 20 points have 4.4 times higher in CRE acquisition than those with 10 points. However, age and CCI score were associated with CRE acquisition in the univariate analysis only. This finding may be explained that the correlation between age or CCI score and APACHE II score at admission was not enough to cause multicollinearity but weak (r = .38) or moderate (r = .42) correlation, respectively [26].

The CRE acquisition increases by approximately 4.0 times with use of cephalosporins in this study, which supports the results of previous case–control studies. The use of cephalosporins was increased CRE-induced bloodstream infection by 7.7 times in patients with neutropenia due to hemato-oncologic cancers [27], and the carbapenem-resistant *Klebsiella pneumoniae* (CRKP) infection by 8.0 times [28]. However, the use of aminoglycosides or quinolones has been reported as risk factors for CRKP infection in previous studies [28,29], but not in the present study. This may be because the use of aminoglycosides and quinolones in the control and control groups was too low (

In this study, patients who were transferred from acute or non-acute medical centers showed a higher CRE acquisition rate than those who were not. In a study by Goodman et al. [8], the presence of CRO at the time of admission to a general hospital was related to a direct transfer from acute or non-acute medical centers. Other

studies have reported previous hospitalization instead of transfer as a risk factor of CRE or CRKP infection [29,30], which may be possible because CRE or CRKP acquisition could have occurred during the previous hospitalization and then developed into an infection during the new hospitalization. However, as we intended to identify the risk factors of CRE acquisition not limited to CRE infection, we excluded the patients detected with CRE at ICU admission using surveillance culture tests and included direct transfer instead of previous hospitalization as an explanatory variable of CRE acquisition. The use of a central venous catheter was identified as a risk factor for CRKP infection (OR, 2.30) in a meta-analysis [29]. The risk of acquiring CRE was increased by about 14 times in nasogastric tube users (42%) compared with non-users, which was a key factor influencing CRE acquisition risk in this study. A study of patients in 43 acute and non-acute medical centers in Japan reported a three-fold increase in CRE acquisition risk depending on gastric tube feeding status [31].

In this study, a central venous catheter, a nasogastric tube, or cephalosporin antibiotics was used in more than 40% of the total samples. That is, these can be frequently seen in the ICU settings. Those who have exposure to three factors and an APACHE score of 12 points at admission corresponding to the average score will get 131 points in total and about 30% of CRE acquisition risk. If patients admit by direct transfer, the total points and CRE acquisition risk increase to 149 and more than 50%, respectively. Therefore, nurses working in ICUs need to be aware that the CRE acquisition risk rapidly increases as patients start to use a central venous catheter, a nasogastric tube, and cephalosporin antibiotics without an increase in the APACHE score.

The performance of the nomogram of the CRE acquisition risk prediction model constructed in this study showed good calibration on the L–H test and the calibration plot analysis [19,22] and good discrimination with a c-statistic of >.9 [23,24]. Assuming that 20% risk of CRE acquisition is a cutoff point for deciding CRE acquisition, the correct classification rate, sensitivity, and specificity are about 85%, showing relatively satisfactory clinical utility. However, when we changed 2.86 points to 3 points per 1 point of APACHE II score to facilitate the calculation in the clinical setting, the values of the performance indices of the nomogram were slightly changed, but they still showed good performance (Supplementary Table 2). Therefore, we recommended conversion of the APACHE II score to 3 points for easy use in the clinical setting. In this case, the total points of the nomogram were 0–222. The performance of the nomogram was additionally evaluated using five subsets randomly resampled from the training set and new test set. Although the sets differed significantly in several factors, including direct transfer and use of a central venous catheter and nasogastric tube, they showed relatively good calibration, discrimination, and clinical utility, which implied that the nomogram would have good internal and external validities.

This study is meaningful as it identified the risk factors of CRE acquisition for ICU patients in a secondary referral hospital. Furthermore, we built a nomogram for the CRE acquisition risk prediction model to enable its easy calculation in the clinical setting and evaluated its performance using the training set, subsets, and a new test set to help identify their internal and external validities. However, careful interpretation of the results is required because of the following limitations. First, we adopted an unmatched case–control study design not to exclude demographic characteristics (e.g., gender and age) by matching. However, the case–control study without matching increases the risk of selection bias, so cohort studies or propensity score-matched case–control studies should be considered. Second, the nomogram assumes that the event remains constant over time [12], but the CRE acquisition rate may change over time. Like the event, the distribution of risk factors may change over time. In the nomogram constructed in this study, the APACHE II score at the time of admission was 0–35 points, but some future patients may have scores outside this score range. Hence, the performance of the nomogram may decrease over time, requiring a new nomogram that reflects the change. Third, as this study was performed in a single ICU in a secondary referral hospital, it is difficult to generalize the results to other settings and regions.

Conclusion

The risk factors of CRE acquisition among ICU patients at a secondary referral hospital are APACHE II score at the time of admission, use of a central venous catheter and a nasogastric tube, as well as use of cephalosporin antibiotics. The nomogram for the CRE acquisition risk prediction model was built based on the risk factors, and showed good performance in terms of calibration discrimination and clinical utility for the training set, subsets, and a

new test set. Therefore, the nomogram constructed in this study can be used to assess the risk of CRE acquisition and to early detect high-risk CRE patients in secondary referral hospitals. However, considering the limitations of this study, further studies with higher methodological rigor and larger samples in various settings are recommended.

Conflict of interest

The authors declared no conflict of interest.

Appendix A Supplementary data

The following are the Supplementary data to this article:**Multimedia component 1**Multimedia component 1

Multimedia component 2 Multimedia component 2

Appendix A Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anr.2021.02.005.

Variables	Total (n = 352)	n (%) or Mean ± SD		X^2 or Z	p
Case (n = 55)	Control (n = 297)	General characteristics			
Age (yr)	69.00 ± 13.26	73.02 ± 12.94	68.26 ± 13.21	−2.67	.008§
Women	155 (44.0)	26 (47.3)	129 (43.4)	0.28	.598
Admission by direct transfer†	49 (13.9)	21 (38.2)	28 (9.4)	32.02	<.001
Length of stay in ICU (days)	10.08 ± 10.99	20.02 ± 13.19	8.24 ± 9.48	−7.80	<.001§
Diabetes	118 (33.5)	22 (40.0)	96 (32.3)	1.23	.268
Stroke	68 (19.3)	14 (25.5)	54 (18.2)	1.58	.210
Charlson comorbidity index	3.28 ± 1.86	3.82 ± 1.74	3.18 ± 1.87	−.253	.012§
APACHE II at ICU admission	11.97 ± 5.31	17.76 ± 5.27	10.90 ± 4.58	−8.03	<.001§
MDROs isolated	60 (17.0)	19 (34.5)	41 (13.8)	14.12	<.001
Invasive procedures					
Surgery	97 (27.6)	12 (21.8)	85 (28.6)	1.08	.300
Endoscopy	5 (1.4)	1 (1.8)	4 (1.3)	0.07	.575¶
Bronchoscopy	10 (2.8)	5 (9.1)	5 (1.7)	9.23	.011¶
Indwelling catheters use					

Urinary catheter	346 (98.3)	55 (100.0)	291 (98.0)	1.13	.595¶
Central venous catheter	141 (40.1)	47 (85.5)	94 (31.6)	55.95	<.001
Mechanical ventilator	47 (13.4)	21 (38.2)	26 (8.8)	34.74	<.001
Tracheostomy	13 (3.7)	10 (18.2)	3 (1.0)	38.47	<.001
Nasogastric tube	148 (42.0)	52 (94.5)	96 (32.3)	73.73	<.001
Drainage tube	76 (21.6)	21 (38.2)	55 (18.5)	10.60	.001
Medication use					
Gastric acid suppressant	128 (36.4)	28 (50.9)	100 (33.7)	5.96	.015
Penicillin	115 (32.7)	42 (76.4)	73 (24.6)	56.57	<.001
Carbapenem	92 (26.1)	31 (56.4)	61 (20.5)	30.85	<.001
Cephalosporin‡	160 (45.5)	48 (87.3)	112 (37.7)	45.98	<.001
Aminoglycoside	13 (3.7)	2 (3.6)	11 (3.7)	0.01	1.00¶
Fluoroquinolone	34 (9.7)	3 (5.5)	31 (10.4)	1.32	.250
Vancomycin	45 (12.8)	22 (40.0)	23 (7.7)	43.30	<.001

Variables	b	SE	OR (95% CI)	p
Admission by direct transfer†	0.91	0.45	2.47 (1.02−5.98)	.044
APACHE score	0.15	0.04	1.16 (1.07−1.25)	<.001
Central venous catheter use	1.08	0.48	2.95 (1.16−7.48)	.023
Nasogastric tube use	2.65	0.66	14.20 (3.93−51.33)	<.001
Cephalosporin antibiotics use‡	1.37	0.49	3.93 (1.51−10.22)	.005
Constant	−7.51	0.98		<.001

(Nagelkerke R^2 = 0.562)				

Data set	Calibration			Discrimination	Clinical usefulness (%) at cut point of 20.0%		
X^2 (p) by L–H test	a (95% CI)	b (95% CI)	c (95% CI)	Sen	Spe	CCR	Training data
1 (n = 352)	2.34 (.969)	0.00 (−0.38−0.38)	1.00 (0.74−1.26)	.93 (.90-.96)	85.5	84.8	84.9
Subset of training data							
1 (n = 71)	6.04 (.643)	0.00 (−0.85−0.85)	1.00 (0.42−1.58)	.92 (.85−1.00)	81.8	85.0	84.5
2 (n = 71)	3.86 (.870)	0.00 (−0.79−0.79)	1.00 (0.30−1.70)	.88 (.81-.96)	100.0	75.0	78.9
3 (n = 70)	4.95 (.763)	0.00 (−0.98−0.98)	1.00 (0.45−1.55)	.96 (.90−1.00)	81.8	93.2	91.4
4 (n = 70)	2.35 (.968)	0.00 (−0.78−0.78)	1.00 (0.39−1.61)	.91 (.84-.98)	72.7	84.7	82.9
5 (n = 70)	1.84 (.985)	0.00 (−1.03−1.03)	1.00 (0.36−1.64)	.97 (.92−1.00)	90.9	86.4	87.1
New test set							
1 (n = 50)	2.32 (.940)	0.00 (−0.93−0.93)	1.00 (0.30−1.70)	.88 (.75−1.00)	87.5	78.6	80.0

DETAILS

Subject: Comorbidity; Hospitals; Variables; Diabetes; Surveillance; CRE bacteria; Performance evaluation; Catheters; Antibiotics; Intensive care; Calibration; Risk factors; Medical referrals

Location:	South Korea
Identifier / keyword:	Calibration; Carbapenem-resistantEnterobacteriaceae; Models, Statistical; Risk factors
Publication title:	Asian Nursing Research; Seoul
Volume:	15
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Publisher:	Elsevier Limited
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Relationship Between the Exposure to Occupation-related Psychosocial and Physical Exertion and Upper Body Musculoskeletal Diseases in Hospital Nurses: A Systematic Review and Meta-analysis

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ABSTRACT (ENGLISH)

Purpose

Nurses' musculoskeletal diseases (MSDs) are worldwide prevalent and are considered to be a costly occupational injury. This study aims to investigate the relationship between exposure to occupation-related psychosocial factors, physical workload, and upper body musculoskeletal diseases among hospital nurses.

Methods

An electronic search was implemented using nine databases with June 2019 as the latest search date. English and Chinese studies were chosen, and data were independently and separately extracted by two investigators. Pooled odds ratio (OR) and its 95% confidence interval (CI) were estimated for each subset, using the fixed or random-effects model, following heterogeneity between studies for research synthesis. The source of heterogeneity was explored through subgroup, sensitivity, and meta-analyses.

Results

Eighteen studies were included in the meta-analysis. Most participants were women (51.4%–100.0%), aged between 20 and 60. A correlation was found between high job demand and the prevalence of low back pain (OR = 1.41; 95% CI = 1.23-1.62). Total job strain was related to the risk of low back pain (OR = 1.71; 95% CI = 1.15-2.55), neck pain (OR = 1.67; 95% CI = 1.26-2.20), shoulder pain (OR = 1.62; 95% CI = 1.06-2.48) and back pain (OR = 1.45; 95% CI = 1.10-1.91). Furthermore, the physical workload was significantly associated with the prevalence of low back pain (OR = 1.76; 95% CI = 1.32-2.35), neck pain (OR = 1.17; 95% CI = 1.08-1.27), shoulder pain (OR = 1.59; 95% CI = 1.37-1.85) and back pain (OR = 1.66; 95% CI = 1.45-1.90).

Conclusion

There were significant associations between occupational strain, more physical workload and upper body MSDs, but the evidence advocating a growth risk in MSDs due to low levels of social support is quite weak.

FULL TEXT

Introduction

Musculoskeletal diseases (MSDs) refer to the state of discomfort, disability, damage, or persistent pain in support systems, including the nerves, muscles, bones, joints, ligaments, tendons and blood vessels [1]. Musculoskeletal diseases are widespread worldwide and are considered to be a major occupational injury, both in developed and developing countries [2,3], and the prevalence is especially high among nurses [4,5]. Saberipour B et al. [2] and Habibi E et al. [6] reported a prevalence rate of 84.2% and 87.6% for musculoskeletal diseases among Iranian nurses, respectively. Luan HD et al. reported a prevalence rate of 74.7% for musculoskeletal diseases among nurses in Vietnam [7]. Nutzi M et al. in Switzerland reported a prevalence of MSD of 66% among nurses [8]. Similarly,

numerous studies have also been carried out across the other countries such as Bakola H et al. [4]in Greece, Yan P et al. [5] in China and Kasa AS et al. [9] in Africa that respectively reported a prevalence rate of 74.9%, 62.7% and 68.5%, for MSDs among studied nurses.

Musculoskeletal diseases can lead to severe complications such as carpal tunnel inflammation, tendonitis, chest outlet syndrome, etc., and massive economic losses. In work, they are the main reason for sickness absenteeism in the United States and Brazil [10], as well as western European countries [11], in which, regardless of productivity losses and social costs, musculoskeletal diseases cost about 2% of its gross domestic product (GDP) [12]. In Japan, work-related MSDs account for more than 62% of the causes of sick leaves longer than four days [13]. In recent years, studies have shown that the prevalence of MSDs in China remains high, including various environments and reaching over 85.7% in some industries, which has caused huge economic losses [14].

According to scientific reports, the significant correlation of MSDs can be attributed to facts that nurses experience greater occupational strain, such as high job demands, low job control or low social support [15, 16] and events of the physical work overload that occurred during the patient's transferring activity. These duties, which are exposed to changing clothes, transferring, moving, cleaning, injection postures and handling of patients before and after surgeries, have been recognized to be a significant source of hospital nurses' musculoskeletal diseases [17, 18]. Musculoskeletal diseases occur in different parts of the body; however, the upper body areas are more frequently more problematic than the lower extremities [17, 19, 20]. In other words, nurses are more prone to experience MSD in the upper body than in the lower body [17, 21, 22]. Although the effect of MSD on the lower-limbs region may be as important as the effect on the upper body area, there is limited research that supports lower-limbs disorders as a symptom [17, 22]. Studies reported that discomfort was mostly felt in the shoulders, neck, and lower back [22–24]. For example, recent research conducted by Lin et al. indicated that the greatest prevalence of MSD symptoms among hospital nurses was found in the right shoulder (85.8%), left shoulder (80.9%), neck (62.4%) and lower back (60.4%) [22].

It is obvious that nurses' mental and physical health problems with musculoskeletal diseases and vocational stressors are key factors in reducing the quantity and quality of their work performance, especially patient care. Concomitantly, poor job performance can result in psychosocial and physical problems that could lead to depression [23]. Therefore, the prevalence of MSDs in nurses and their association with some personal and professional factors need to be studied to prevent and treat them in this sensitive group.

Many psychosocial and physical factors play a significant role in the occurrence of musculoskeletal diseases [25–27]. The relationship among occupation-related psychosocial stressors and musculoskeletal diseases, physical workload, and musculoskeletal diseases has been studied in several reviews. However, most of these are narrative reviews rather than systematic, and thus, perhaps not as comprehensive or transparent. Bernal et al. [28] conducted a systematic review and a meta-analysis to examine the relationship between work-related psychosocial factors and musculoskeletal diseases, which identified associations between high psychosocial demands with prevalent and incident low back pain, prevalent shoulder pain, and low social support with incident back pain. However, correlations between work-related low social support and prevalent or incident neck pain, shoulder pain, and low back pain were not revealed. Additionally, Koohpayehzadeh et al. [24] found that low or high psychological workload was not linked to the prevalence of shoulder or neck complaints, although correlation with high physical workload was significant.

The mechanical workload of workers can generate muscular tension, which, in turn, may induce pain or aggravate pre-existing discomfort [29]. Soroush et al. [19] reviewed and analyzed the prevalence of musculoskeletal diseases as common problems among Iranian nurses and found a strong relationship between musculoskeletal diseases and inappropriate body mechanics, such as working while bending or twisting the waist, uncomfortable postures, bending to lift an item from floor level, among others. Because of the close connection between physical workload and musculoskeletal diseases, it has been argued that vocational psychosocial and physical opportunities must be taken into account when analyzing the risk factors of career-oriented musculoskeletal diseases [30]. Although some studies have reported strong associations between physical risk factors in the workplace and musculoskeletal

diseases in hospital nurses [24,26,27], to the best of our knowledge, no meta-analysis has specifically addressed the relationship between psychological, physical, and social factors on MSDs.

The purpose of the current study is to present an up-to-date meta-analysis based on cross-sectional and longitudinal study data on the relationship between occupation-related psychosocial factors, physical workload, and musculoskeletal diseases of the upper body among hospital nurses to comprehensively and systematically evaluate and quantify associations. The results of this study can provide a reference for nursing administrators and policymakers to take measures to reduce musculoskeletal diseases among nurses to promote their health, and thus, boost the quality and performance of patient care.

Methods Search strategy

An electronic search was implemented using Web of Science, PubMed, PubMed Central, MEDLINE (OVID), Springer link, EBSCO host, CNKI, Wan Fang, SinoMed from June 15 to August 15, 2019. Our information retrieval strategy was similarly applied to all databases and incorporated three main blocks to acquire diverse aspects of our review: exposure, outcome, study population, and June 2019 as the latest search date, exploiting a combination of search criteria. The search words used were: ("Work-related stress" or "Work-related strain" or "job stress" or "work stress" or "occupational stress" or "occupational strain" or "stress at work" or "strain at work" or "effort-reward imbalance" or "psychological strain" or "job strain" or "work strain" or "mental workload" or "psychosocial risk" or "job content" or "workload" or "physical overload") AND ("work-related musculoskeletal diseases" or "back pain*" or "shoulder pain*" or "neck pain*" or "wrist pain*" or "elbow pain*" or "hand pain*" or "arm pain" or "musculoskeletal pain*") AND ("hospital patient care workers" or "nurse").

Study selection and eligibility criteria Inclusion criteria

Inclusion criteria were (1) cross-sectional, prospective cohort, case-control studies, randomized controlled trials, published in English or Chinese, evaluating the relationship between musculoskeletal diseases and occupationally psychosocial or physical risk factors among hospital nurses; (2) types of interventions, including coaching interventions for coping with work stressors, work-place stress management and prevention programs involving psychological intervention; types of controls, including general physical exercise programs, physical training programs and physiotherapy; types of outcome measures, including incidence and location of pain; (3) nurses' occupational stress and workload, including the number, incidence and prevalence of musculoskeletal diseases with each anatomic site among groups.

Exclusion criteria

(1) Unpublished documents (e.g., dissertation) or studies that lacked detailed instruction for either exposure or outcome, incidence or prevalence of MSDs, odds ratios (OR), and 95% confidence intervals (95% CI) were excluded; (2) along with studies that considered a wide range of hospital occupation workers, but in which data for hospital nurses were not separately analyzed.

Literature screening was independently undertaken by two researchers according to retrieval strategy and selection criteria. After duplicates were removed, the titles and abstracts were browsed to finish the record screening, then full-text articles assessed for disqualification and irrelevance were eliminated. Accordingly, the required detailed information was collected by two reviewers concerning the full text of the publications. In case of inconsistencies, a consensus meeting is held by a third reviewer or an arbitration panel to resolve conflict. As shown in Figure 1, out of 1,968 potential articles were included through database searching and other sources. A total of 532 articles were screened based on their titles and abstracts and 93 of full-text articles assessed for eligibility. Among the 93 articles, 5 that were not English or Chinese publication, 8 without specific measurement or job strain or MSD, 32 irrelevant, 25 odds ratio absent and 5 of inadequate quality were excluded. Finally, 18 publications [3,15,17,18,20,24–26,31–40] that satisfied the selection criteria were analyzed quantitatively and qualitatively. Figure 1 shows the flowchart of the study selection.

Quality assessment of the included studies

The methodological quality of each study that was included in the synthesis was appraised by an adapted version of the checklist for quality assessment developed by Windt et al. [41] and once utilized in a review of epidemiological

literature by Bongers et al. [42]. This checklist is built on preexisting systematic reviews of observational studies of occupational risk factors for musculoskeletal discomfort [43]. The checklist contains the quality assessment of prospective cohort (12 items), cross-sectional (11 items), and case-control studies (15 items), including five dimensions of content: study objective, study population, exposure measurements, assessment of the outcome, analysis, and data presentation. Each item was scored as positive if the information was matched, negative (potential bias) if the information was not matched, or unclear when the paper provided insufficient information on a specific item. For each publication, a quality score was quantified according to the sum of items that were rated as positive. Publications were viewed as high-quality (low risk of bias) when the score was above 80% of the maximum possible score, intermediate quality (intermediate risk of bias) when it was between 70% and 79%, and low quality (high risk of bias) when it was below 70% [28].

Statistical analysis

When at least two studies provided data on the same outcome indicators, we conducted a quantitative synthesis. A pooled OR and its 95% CI were estimated for each subset, using fixed or random-effects models, under heterogeneity between papers for research synthesis. Cochran's Q test of heterogeneity and inverse variance (I–V) method with I^2 was performed to detect heterogeneity among the studies. According to the difference in heterogeneity, the random effect and fixed-effect models were used for the estimate, respectively. The value of I^2 is between 0% and 100%, of which 0%, 25%, 50% and 75% means that there is no, low, medium and high heterogeneity, respectively [44]. A choice for a random effect model occurred if $I^2 \geq 50\%$; otherwise, the fixed-effect model was selected to estimate a pooled OR and its 95% CI. In the fixed effect model, the inverse variance weighted average was used to estimate the effect size, whereas, in the random-effect model, it was the inverse variance heterogeneity method. All results were presented as forest plots. We explored the source of heterogeneity through subgroup analyses, sensitivity analysis, and meta-regression to check study location, study design, measurement of outcome, measurement of exposure, mean age of subjects, sample sizes and quality of studies as possible sources of heterogeneity among study findings [28]. In the sensitivity analysis, the influence of each study on the pooled effect was evaluated by excluding one study at a time. Publication bias was estimated via a funnel plot, Egger's linear regression, and Begg's rank correlation. When the funnel plot was significantly asymmetric, it was suggested that there was obvious publication bias. All statistical analyses were conducted using Stata software (version 14.0 MP) with packages METAN, METABIAS6, METANINF and METAREG, and *p* **Results Characteristics of the included studies**

A total of 18 studies were included in our meta-analysis, with the literature consisting of 15 cross-sectional designs, two prospective cohort studies, and one retrospective cohort study. Most volunteers were women (54.1%-100%), between the ages of 20 and 60. The general and methodological information of the included studies are as follows (Table 1): author's name, year of publication, country, research design, response rate, study participants, sample size, mean age, measurement questionnaire, analytical method, adjustment variables and quality evaluation. Furthermore, characteristics of psychosocial risk factors (high job demand, low social support and total job strain) and physical risk factors (physical workload), as well as OR and 95% CI from each study, were collected. The participants were from twelve different countries and areas. Most studies were from Asia (n = 10), seven studies were conducted in Europe, and one in Australia. Fourteen studies investigated the association between psychosocial factors (high job demand, low social support and total job strain) and MSDs, while eleven studies considered physical factors (physical workload). Four anatomic sites (lower back, neck, shoulder and back) were the focus of our included designs. Thirteen studies discussed lower back pain, nine studies considered neck and back pain, and six studies considered shoulder pain. Exposure and outcome were measured using a different questionnaire. Twelve designs used a standardized questionnaire such as the Nordic Questionnaire and Karasek Job Content questionnaire to measure MSDs and psychosocial and physical risk factors, while the other six studies used the other standard scales or questionnaires designed by the researchers.

Methodological Quality

All the included publications were observational studies and were critically appraised using an adapted version of

the checklist for quality assessment. Of all the included studies, 10 studies were considered high quality, having a low risk of bias (score ranged between 82.0% and 91.0%), three studies were considered intermediate quality, having an intermediate risk of bias (score ranged between 75.0% and 78.6%), and five studies were considered low quality, having a high risk of bias (score ranged between 63.6% and 69.2%). The results of each study are shown in Table 1, and there is a possibility of risk of bias.

Meta-analysis

Pooled analysis and heterogeneity are summarized in Table 2. In our meta-analysis, psychosocial risk factors were related to high job demand, low social support and total job strain. Positive outcomes were found with the prevalence of low back pain for high job demand (OR = 1.41; 95% CI = 1.23–1.62) and total job strain (OR = 1.71; 95% CI = 1.15–2.55). Exposure to total job strain was also associated with the risk of neck pain (OR = 1.67; 95% CI = 1.26–2.20), shoulder pain (OR = 1.62; 95% CI = 1.06–2.48), and back pain (OR = 1.45; 95% CI = 1.10–1.91). Unexpectedly, no statistically significant results were detected in a subset of low back pain–low social support (OR = 1.23; 95% CI = 0.85–1.78), neck pain (OR = 1.02; 95% CI = 0.97–1.08), shoulder pain (OR = 0.92; 95% CI = 0.53–1.61), and back pain (OR = 1.12; 95% CI = 0.99–1.25). However, the physical workload was significantly associated with the prevalence of low back pain (OR = 1.76; 95% CI = 1.32–2.35), neck pain (OR = 1.17; 95% CI = 1.08–1.27), shoulder pain (OR = 1.59; 95% CI = 1.37–1.85), and back pain (OR = 1.66; 95% CI = 1.45–1.90).

Subgroup analysis

High heterogeneity was found in three subsets of studies (that is, an association between low back pain and low social support; between low back pain and total job strain; and between low back pain and physical workload). Heterogeneous sources were explored via subgroup analysis planned by location, type of design, measurement, mean age, sample size and quality evaluation (Table 3). The subgroup analysis reported that high heterogeneity might stem from the mean age and location in subsets.

Sensitivity analysis

Sensitivity analysis was performed to investigate the possible sources of heterogeneity. Then, two studies created by Feng et al. [20] and Harcombe et al. [26] were ruled out in the subset of low back pain–low social support, and heterogeneity was therefore reduced with the remaining seven studies (I^2 = 45.2%, p = .090), while the pooled effect size turned out to become statistically significant (OR = 1.37; 95% CI = 1.09–1.73). High heterogeneity in the subset of low back pain–physical workload was attributed to the study of Harcombe et al. [26] detected by sensitivity analysis. After excluding that paper, heterogeneity remarkably declined (I^2 = 36.7%, p = .177), while the association between low back pain and physical workload was still statistically significant with a pooled odds ratio of 1.95 (95% CI = 1.57–2.42). The heterogeneous source of these studies may originate from different study populations, including nursing aides in nursing rooms in the study by Feng et al. [34], while the other investigations only recruited hospital nurses. In the subset of low back pain–total job strain, heterogeneity decreased from 58.8% (p = .045) to 48.2% (p = .122) after ruling out the study of Smith et al. [33].

Meta-regression

Three subsets with high heterogeneity were also considered for meta-regression. Only variables of “mean age” (β = 0.598, SE = 0.089, R^2_{adj} = 100.0%, p = .026) partially explained the high heterogeneity found in subset low back pain–physical workload (data not shown).

Publication bias

Funnel plot, Begg’s and Egger’s tests were conducted to evaluate publication bias in the included studies. No significant publication bias was identified according to the funnel plot in this study. Following Begg’s test and Egger’s test (Table 4), no evidence of publication bias was found for the subsets of high job demand, total strain, and physical workload. However, both studies reported a possible publication bias for the association between low social support and low back pain. Egger’s test indicated publication bias in the relationship between physical workload and back pain. This may be explained by the inclusion criteria since exposure to social support consists of coworker and supervisor support, but some studies include two kinds of support, while others include only one. Moreover, when the heterogeneity is unexplainable, regression to test publication bias may lead to false-positive outcomes.

Discussion

Our meta-analysis assessed the pooled effects of 18 studies on work-related risk factors for upper body MSDs. The quality evaluation of most studies was intermediate or high (ranging from 63.6% to 91.0%). Most of the included studies used standard questionnaires (such as the Nordic Questionnaire [45] based on the Karasek model [46] and Job Content Questionnaire [47]) to measure MSDs, occupationally psychosocial factors, and physical environment, while others used questionnaires designed by investigators or published in previous literature. It is conceivable that different measurement criteria may produce confounding variables, and subgroup analysis did display obvious heterogeneity decreases in groups of both measurement of exposure and outcome with standard scales in the subset of low back pain–physical workload (Table 3).

Exposure to both psychosocial factors and the physical workload was correlated with the prevalence of MSDs [29,30]. Most studies revealed statistically significant associations between high job demand, total job strain, and MSDs. These results are similar to those reported by Bernal et al. [28] Nevertheless, comparing to studies in which low social support was related to the risk of suffering low back pain, neck pain, shoulder pain and pain at any anatomical site, the meta-analysis does not suggest any statistically significant association between low social support and low back pain, neck pain, shoulder pain or back pain. However, these findings were consistent with a cohort study [48], which showed no evidence to indicate the correlation between work-related factors (such as low social support) and low back pain. In fact, Bernal's review included nurses and aids and used random-effect models to analyze the effects of exposure factors on outcomes. We should carefully interpret the results because the high degree of heterogeneity between studies may lead to false-positive results. A possible explanation for this might be that different questionnaires and different definitions of MSDs may contribute to deviations [28]. Moreover, further analysis showed that there was a statistically significant connection between low social support and low back pain after two studies were excluded through sensitivity analysis. Subgroup analyses (Table 3) indicated that location and mean age might be the sources of heterogeneity in the subset low back pain–physical workload. A systematic review suggested a difference in the prevalence of low back pain among nurses in different countries, which may be related to occupational factors [19]. These findings recommend attention to the heterogeneous sources and caution.

The correlation between physical workload and upper body MSDs was identified based on our comprehensive evaluation of 11 relational studies [3,15,17,18,20,24,26,32,33,36,39]. Syntheses reported that higher physical workload was associated with a much greater risk of developing low back pain (random OR = 1.76; 95% CI = 1.32–2.35; I^2 = 62.0%), neck pain (fixed OR = 1.17; 95% CI = 1.08–1.27; I^2 = 44.6%), shoulder pain (fixed OR = 1.59; 95% CI = 1.37–1.85; I^2 = 46.3%), back pain (fixed OR = 1.66; 95% CI = 1.45–1.90; I^2 = 0.0%) among hospital nurses. Therefore, the findings of our study were, to a great degree, in line with other evidence serving to an increased risk of musculoskeletal dysfunction stemming from high physical workload [24,26,35].

In a systematic review of Iran, an enhancing prevalence of musculoskeletal complaints among nurses was reported [19], in agreement with Switzerland's [8], Chinese [43], and Vietnam's [7] studies. Our research showed that high levels of physical workload led to an increase in the risk of lower back, upper back, shoulder, and neck pain by 1.76, 1.66, 1.59 and 1.17 times, respectively, indicating that the lower back is more prone to MSDs when exposed to overload physical conditions. This is consistent with most previous studies [15,19,40]. In Japan, having more than four days of sick leave and work-related low back pain accounted for 62% of cases [21]. Low back, upper back, shoulder and neck pain among the nurses might be physically attributed to recurrent transferring/lifting patients or heavyweights, continual bending and standing, frequent long walk, pulling and pushing, and sudden movements in improper posture, inappropriate body postures that nurses experience given the nature of nursing, particularly of some emergencies in hospital wards [1,28,39].

Repetitive abnormal movements impose compression and shear forces on the spinal column, shoulder joints, and cervical vertebrae, causing back, shoulder and neck damage. Therefore, some nurses, such as those of intensive care units, operating rooms, are more prone to MSDs [32].

Based on these findings, clinical nurses should strengthen their awareness of self-protection and improve their self-protection skills and knowledge level. This can be done in their usual work through the principle of labor-saving

when lifting heavy objects or patients is necessary to avoid long-term engagement in forced postures or wrong positions for lifting, which cause musculoskeletal injury. By enhancing their musculoskeletal syndrome-related knowledge, nurses can perceive early warning symptoms of MSDs in a timely manner, reasonably arrange rest time, and take effective measures to deal with high work demands, as well as high occupational stress [21,49].

As far as the hospital is concerned, On the one hand, hospitals should strengthen the training of the principles of labor-saving in the work process of nurses and encourage and provide ergonomics lifting devices for transfers and repositioning, which are more effective to control or prevention of MSDs among nurses. Based on other studies, motivating health care staff to use lifting devices was strongly associated with the decreasing percentage of MSD prevalence during a patient's transfer and repositioning [49]. This finding highlights the demand for a plan that allows or encourages nurses to use ergonomic lifting devices when required by ensuring that sufficient lifting devices are available for the number of patients in each ward. The results of other studies corroborate those of the current study; they affirm that more attention is required for preventing and controlling these disorders before they occur [2,9,21]. On the other hand, hospitals need to take all measures to reduce the occupation-related psychosocial pressure on nurses, to promote the health of nurses, and to ensure that nurses can provide high-quality nursing care for patients.

Limitations and prospects

This study had three main limitations: (1) as the data were collected using self-reported techniques, participant responses may be biased as a result of social desirability to provide favored answers instead of real experiences; (2) cultural (participants from 12 countries, and Asia, Europe, and Australia) and language (English, Chinese)differences may have influenced the individuals' understanding and interpretation of the study items; (3) when the study was restricted mainly to female nurses (51.4%–100.0%), a bias for certain gender and preference parameters might have occurred. For instance, in the psychological domain, females are generally found to have lower decision latitude than men in most populations. Future studies could try to use more objective indicators, conduct subgroup analysis based on culture and language, and recruit more male nurses to reduce bias. (4) Because hospitals around the world have diverse medical delivery systems, size, and manpower, specific departments, and severity of patients and the burden of nurses'' work, there is not enough evidence to conduct a subgroup analysis. In the future, in-depth research can be carried out according to different countries or hospitals. Further limitations can be pointed out. There were 15 cross-sectional studies but only two prospective cohort studies and a retrospective cohort study. More longitudinal research should be conducted to explore the occupational risk factors for upper body MSDs in future work. There was no evidence to indicate the correlation between low social support and low back pain; thus, future studies on this topic are highly recommended. Subgroup analysis, sensitivity analysis and meta-regression were used to explore heterogeneous sources, and a certain degree of heterogeneity may reduce the estimation accuracy. Additionally, using different questionnaires and measurement standards to test the same outcome indicators was unreasonable. Further studies that consider these variables need to be undertaken. Furthermore, our study only focused on psychosocial risk factors and physical workload but ruled out additional interventions that could prevent and reduce the occurrence of MSDs. In future investigations, more theoretical and experimental research could be performed.

Conclusion

To our knowledge, this meta-analysis is the first attempt to comprehensively and systematically identify and critically appraise published studies that explore the relationship between exposure to occupational psychosocial, physical factors, and MSDs in hospital nurses simultaneously; however, most present literature findings included in this review drew the conclusion that there was a significant association between more physical workload and MSDs, as well as occupational strain among hospital nurses. These findings are correspondingly in step with current scientific knowledge, the demonstration advocating a growth risk in upper body MSDs among nurses due to low levels of social support is statistically insignificant. Executing a longitudinal design to validate our explanation and apply it to national prevention programs for health care workers is strongly recommended.

A high prevalence of chronic MSDs will result in low quality, low-efficiency work performance, high medical costs or

even job changes. Providing effective preventive measures to reduce nurses' occurrence of MSDs is necessary. These preventions should consider both occupational physical and psychosocial factors, including ergonomics, appropriate exercises and the improvement of the organizational environment.

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Conflict of interest

None declared.

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Study	Country	Design, Response rate	Participants, Sample size, Age	Female (%)	Measure	Analysis, Adjustment variables	Quality (%)	Exposure variables	Anatomic site	OR	95% CI
Alexopoulos (2006)	The Netherlands and Greece	Retrospective cohort 64 %	Nurses n = 393 38.6 (9.4) 37.1 (7.3)	93 81	Karasek model, Nordic Questionnaire	Logistic regression, adjusted for physical demands	78.6	Physical workload[a] Physical workload[b] Physical workload[a] Physical workload[b]	Shoulder[a] Shoulder[b] Back[a] Back[b]	1.19[a] 2.08[b] 1.93[a] 1.98[b]	0.62–2.30[a] 1.25–3.46[b] 1.23–3.03[a] 1.19–3.31[b]
Arsalani (2014)	Iran	Cross sectional 92 %	Nurses n = 520 <40: 66.7 %	79.4	Copenhagen Psychosocial Questionnaire, Nordic Questionnaire	Logistic regression, adjusted for age and gender	75.0	High job demand, Physical workload, Physical workload,	Low back Low back Neck	1.15 1.18 1.86	0.76–1.73, 0.73–1.88, 1.07–3.23,

Bos (2007)	The Netherlands	Cross sectional 63%	Nurses n = 197738 (10)	82	Copenhagen Psychosocial Questionnaire, Nordic Questionnaire	Logistic regression multivariate model, adjusted for physical demands	84.6	Low social support Physical workload Low social support	Neck Neck Back	1.02 0.98 1.10	0.97–1.08 0.75–1.28 0.97–1.24
Choobineh (2006)	Iran	Cross sectional 84%	Nurses n = 641 22–66	84.7	Job Content Questionnaire, Nordic Questionnaire	Logistic regression, adjusted for age, physical demands	63.6	Physical workload Physical workload Physical workload Physical workload	Low back Neck Shoulder Back	2.10 2.09 2.01 2.14	1.50–2.70 1.15–3.80 1.20–3.38 1.24–3.70
Choobineh (2010)	Iran	Cross sectional 80%	Nurses n = 375 19–62	66.4	Job Content Questionnaire, Nordic Questionnaire	Logistic regression, adjusted for age, physical demands	84.6	Physical workload Physical workload Physical workload	Low back Shoulder Back	2.04 3.04 2.25	1.09–5.31 1.65–5.59 1.26–4.01
Dhaini (2016)	Switzerland	Cross sectional 76.6%	Nurses n = 3471 18–50:67% >50: 33%	92.4	Health Professions Stress Inventory	Logistic regression, adjusted for facility and care workers characteristics	63.6	Low social support Physical workload	Low back Back	1.25 1.52	0.78–1.99 1.29–1.79
Elfering (2002)	Switzerland	Prospective cohort 75.8%	Nurses n = 186 23.9 (2.2)	-	Instrument for Stress Oriented Task Analysis, Nordic questionnaire	Logistic regressions, adjusted for age, sex, physical workload, problems at baseline, BMI, leisure time sport, smoking, general health	88.9	Low social support	Low back	5.75	1.27–25.97

Feng (2007)	Taipei, Taiwan	Cross sectional 91.3%	Nursing aides n = 244 43.3 (7.9)	100	Job Content Questionnaire, Nordic Questionnaire	Logistic regression, adjusted for smoking, BMI and care workers characteristics	83.3	High job demand Low social support	Low back Low back	1.46 0.62	1.24–1.73 0.42–0.91
Freimann (2013)	Estonia	Cross sectional 57 %	Nurses n = 237 23–59	100	Nordic Questionnaire, Copenhagen Psychosocial Questionnaire	Logistic regression, adjusted for age and all risk factors	86.0	Total job strain Total job strain	Neck Shoulder	1.40 0.70	0.70–2.80 0.30–1.70
Golabadi (2013)	Iran	Cross sectional 84.5%	Nurses n = 545 32.1 (7)	79.4	Job Content Questionnaire, Nordic Questionnaire	Logistic regression, adjusted for age,sex, Physical demands	84.6	High job demand Total job strain Total job strain	Low back Low back Back	1.73 2.49 1.82	1.18–2.53 1.46–4.26 1.10–3.001
Gonge (2002)	Denmark	Cross sectional 84 %	Nurses n = 200 18–64	100	Whitehall II study, Nordic Questionnaire	Logistic regression, adjusted forage, smoking, neuroticism.	82.0	High job demand Low social support	Low back Low back	1.00 1.20	0.60–1.60 0.70–2.00
Harcombe (2010)	New zealand	Cross sectional 58 %	Nurses n = 280 20–59	-	Whitehall II study, Nordic Questionnaire	Logistic regression, adjusted for occupation, age, sex and Body Mass Index	91.0	Low social support Low social support Total job strain Low social support Total job strain Physical workload	Low back Neck Neck Shoulder Shoulder Shoulder	1.25 1.06 3.46 0.75 2.18 1.41	0.78–1.99 0.62–1.81 1.30–9.21 0.43–1.32 0.76–6.24 1.17–1.69

Kohpayehzadh (2016)	Iran	Cross sectional 79 %	Nurses n = 405 26–60	51.4	Job Content Questionnaire, Nordic Questionnaire	Logistic regression	63.6	Physical workload	Neck	1.20	1.06–1.30
Smith (2004)	China	Cross sectional 92 %	Nurses n = 282 34(9.2)	100	Nordic Questionnaire	Logistic regression, adjusted for age, total career length and department of employment.	85.7	Low social support Total job strain Low social support Total job strain Physical workload Low social support Total job strain Low social support Total job strain	Low back Low back Neck Neck Neck Shoulder Shoulder Back Back	2.30 1.14 2.52 1.79 0.87 2.00 1.69 1.90 1.24	0.96–6.15 0.68–1.91 1.09–6.23 1.06–3.03 0.49–1.54 0.90–4.59 0.99–2.89 0.85–4.35 0.72–2.13

Smith (2006)	Japan	Cross sectional 72.6%	Nurses n = 844 32.9 (8.8)	100	Nordic Questionnaire	Logistic regression adjusted for age, physical demands	90.9	Low social support Total job strain Physical workload Low social support Total job strain Physical workload Low social support Total job strain Physical workload Low social support Total job strain Physical workload	Low back Low back Low back Neck Neck Neck Shoulder Shoulder Shoulder Back Back Back	0.92 1.12 2.76 1.07 1.53 1.58 0.68 2.07 2.09 1.16 1.37 1.69	0.59–1.45 0.72–1.72 1.50–5.13 0.71–1.60 1.02–2.31 0.86–2.93 0.44–1.06 1.35–3.17 1.11–3.89 0.77–1.74 0.88–2.15 0.85–3.58
Warming (2009)	Italy	Cross sectional 100%	Nurses n = 148 21–60	92	Log book instrument	Logistic regression, adjusted for gender, age, physical demands	76.9	Total job strain Total job strain	Neck Back	1.16 1.17	0.24–5.54 0.27–5.01
Yip (2002)	HongKong, China	Prospective cohort 65%	Nurses n = 236 31.3	84.7	General Health Questionnaire	Logistic regression model, adjusted for physical demands	66.7	Low social support	Low back	1.85	1.00–3.42

Yip (2004)	Hong Kong, China	Prospective cohort 64.3%	Nurses n = 144 31.10	85.5	General Health Questionnaire	Multivariate logistic regression, adjusted for age	69.2	Low social support Physical workload	Low back Low back	2.52 2.76	1.03–5.68 1.06–7.22

Anatomic site	Variables		Studies (n)	OR (95 % CI)	Test of ES = 1		Heterogeneity		Studies
z	p	I^2	p	Low back	Psychosocial factors	High job demand	4	1.41 (1.23,1.62)	4.91
<.001	26.9	.251	Arsalani (2014), Feng (2007), Golabadi (2013), Gonge (2002).	Low social support	9	1.23 (0.85, 1.78)	0.34	.737	70.8

.001	Dhaini (2016), Elfering (2002), Feng (2007), Gonge (2002), Harcombe (2010), Smith (2004), Smith (2006), Yip (2002), Yip (2004).	Total job strain	5	1.71 (1.15,2.55)	2.66	.008	58.8	.045	Golabadi (2013), Gonge (2002), Harcombe (2010), Smith (2004), Smith (2006)
Physical factors	Physical workload	6	1.76 (1.32,2.35)	3.85	<.001	62.0	.022	Arsalani (2014), Choobineh (2006), Choobineh (2010), Harcombe (2010), Smith (2006) , Yip (2004).	Neck
Psychosocial factors	Low social support	4	1.02 (0.97,1.08)	0.90	.367	28.3	.243	Bos (2007), Harcombe (2010), Smith (2004), Smith (2006) .	Total job strain

5	1.67 (1.26, 2.20)	3.63	<.001	0.0	.587	Freiman (2013), Harcombe (2010), Smith (2004), Smith (2006), War	Physical factors	Physical workload	7

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1.17 (1.08 ,1.27)	3.93	<.00 1	44.6	.094	Arsalani (2014) , Bos (2007) , Choobineh (2006) , Harcombe (2010) , Koohpayehzadeh (2016) , Smith （2004） , Smith(2006) .	Shoulder	Psychosocial factors	Low social support	3

0.92 (0.53,1.61)	0.29	.772	62.9	.067	Harcombe (2010), Smith (2004), Smith(2006).	Total jobstrain	4	1.62 (1.06,2.48)	3.54
<.001	40.6	.168	Freiman (2013), Harcombe (2010), Smith (2004), Smith (2006)	Physical factors	Physical workload	6	1.59 (1.37,1.85)	6.11	<.001

46.3	.097	Alexopoulos[a] (2006), Alexopoulos[b] (2006), Choobineh (2006), Choobineh (2010), Harcombe (2010), Smith (2006).	Back	Psychosocial factors	Low social support	3	1.12 (0.99,1.25)	1.87	.062
0.0	.423	Bos (2007), Smith (2004), Smith (2006).	Total job strain	4	1.45 (1.10, 1.91)	2.60	.009	0.0	.742

Golabadi (2013), Smith (2004), Smith (2006), Warming (2009).	Physical factors	Physical workload	6	1.66 (1.45,1.90)	7.30	<.001	0.0	.566	Alexopoulos[a] (2006) ,Alexopoulos[b] (2006) , Choobineh (2006), Choobineh (2010), Dhaini (2016), Smith (2006)

Sub-group		Low back pain-Low social support				Low back pain-Total strain				Low back pain-Physical workload			
n	OR (95% CI)	Heterogeneity		n	OR (95% CI)	Heterogeneity		n	OR (95% CI)	Heterogeneity		I^2	p
I^2	p	I^2	p	Location	Asia	5	1.31 (0.76,2.28)	77.1	.002	3	1.45 (0.88,2.38)	67.0	.048
5	1.95 (1.57,2.42)	36.7	.177		Europe	4	1.17 (0.66,2.08)	69.9	.019	1	2.30 (1.33,3.98)	-	-
0	-	-	-		Australia	0	-	-	-	1	2.85 (1.01,8.04)	-	-
1	1.35 (1.14,1.60)	-	-	Design	Cross-sectional study	6	0.95 (0.68,1.33)	61.1	.025	-	-	-	-

5	1.53 (1.34,1.76)	66.0	.019		Prospective study	3	2.28 (1.42,3.65)	0.0	.379	-	-	-	-
1	2.76 (1.06,7.20)	-	-	Measurement of outcome	Nonstandard questionnaire	3	0.87 (0.60,1.28)	42.0	.178	2	2.41 (1.48,3.92)	0.00	.720
4	1.63 (1.13,2.37)	58.7	.064		Standard scale	6	1.62 (0.91,2.87)	77.3	.001	3	1.45 (0.88,2.38)	67.0	.048
2	2.09 (1.59,2.76)	0.0	.946	Measure of exposure	Nonstandard questionnaire	3	0.87 (0.60,1.28)	42.0	.178	4	1.54 (1.00,2.36)	54.0	.089
2	1.81 (0.91,3.61)	79.3	.028		Standard scale	6	1.62 (0.91,2.87)	77.3	.001	1	2.49 (1.46,4.25)	-	-
4	1.82 (1.28,2.57)	38.9	.178	Mean age	<40	5	1.86 (1.07,3.24)	61.0	.036	3	1.45 (0.88,2.38)	67.0	.048
4	2.22 (1.74,2.84)	0.0	.835		≥40	4	0.85 (0.57,1.28)	64.8	.036	2	2.41 (1.48,3.92)	0.00	.720
2	1.33 (1.13,1.56)	0.0	.600	Sample (n)	<500	6	1.62 (0.90,2.90)	77.2	.001	2	1.61 (0.81,3.20)	70.00	.068
2	2.31 (1.25,4.25)	0.0	.634		500–1000	2	0.76 (0.49,1.17)	34.2	.217	3	1.85 (0.98,3.49)	68.6	.041
4	1.67 (1.20,2.33)	73.3	.010		≥1000	1	1.25 (0.78,1.99)	-	-	-	-	-	-

-	-	-	-	Quality (%)	<70	3	1.61 (1.10,2.35)	15.4	.307	-	-		
2	2.31 (1.25,4.25)	0.0	.634		70–80	0	-	-	-	-	-		
1	1.18 (0.74,1.89)	-	-		≥80	6	1.03 (0.66,1.61)	69.9	.005	5	1.71 (1.15,2.55)	58.8	.045
3	1.86 (1.23,2.80)	80.1	.007	Overall		9	1.23 (0.85,1.78)	70.8	.001	5	1.71 (1.15,2.55)	58.8	.045

Anatomic site	Exposure	Intercept and 95% CI	t	p	Publication bias
Low back pain	High job demand	−1.17 (−7.25,4.90)	−0.83	.493	No
Low social support	4.28 (1.39,7.16)	3.51	.010	Yes	Total job strain
3.39 (−5.26,12.05)	1.25	.301	No	Physical workload	1.63 (−1.34,4.61)
1.52	.203	No	Neck	Low social support	0.92 (−1.97,3.82)
1.37	.305	No	Total job strain	0.48 (−2.91, 3.87)	0.45
.681	No	Physical workload	0.64 (−1.58, 2.88)	0.75	.490
No	Shoulder	Low social support	5.40 (−16.81,27.63)	3.09	.199

No	Total job strain	−1.74 (−10.52,7.02)	−0.86	.482	No
Physical workload	1.6 9 (−0.75,4.14)	1.92	.127	No	Back
Low social support	1.09 (−6.51,8.70)	1.82	.319	No	Total job strain
−0.44 (−5.36,4.47)	−0.39	.735	No	Physical workload	1.33 (0.38,2.28)

DETAILS

Subject:	Occupational stress; Musculoskeletal diseases; Shoulder; Social support; Back pain; Risk factors; Gross Domestic Product--GDP; Neck pain; Psychological aspects; Workloads; Systematic review; Nurses; Meta-analysis
Business indexing term:	Subject: Occupational stress Gross Domestic Product--GDP Workloads
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A Five-step Systematic Therapy for Treating Plugged Ducts and Mastitis in Breastfeeding Women: A Case–Control Study

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ABSTRACT (ENGLISH)

Purpose

This study aimed to describe the clinical response to five-step systematic therapy (FSST) in the management of plugged ducts and mastitis. FSST was a comprehensive milk stasis dredging treatment, which contained five steps to make the milk out of the plugged duct.

Methods

This retrospective study included 922 breastfeeding women, 714 with plugged ducts, and 208 with mastitis who received FSST from June to September 2017. The breast pain score, swelling degree, and range of breast induration were recorded pre-FSST and post-FSST.

Results

After a single FSST, pain score and swelling degree were significantly improved (both $p < .001$) in all cases. After FSST, the mean breast pain relief score was 1.69 ± 0.70, whereas the mean swelling fade away degree was 1.61 ± 0.62. In the subgroup analysis, pain score and swelling degree were significantly improved (both $p < .001$) in the plugged ducts group and the mastitis group. The score of pain relief in the plugged ducts group was less than that in the mastitis group (1.63 ± 0.68 vs. 1.91 ± 0.70, $t = 5.30$; $p < .001$), whereas improvement of swelling fade

away was greater in the plugged ducts group than the mastitis group (1.65 ± 0.64 vs. 1.48 ± 0.56, $t = 3.49$; $p = .001$). The composition ratio of changes in induration range between the two groups was statistically different (Pearson $\chi 2 = 137.87$, $p < .001$), of which more obvious improvement in the plugged ducts group than the mastitis group ($\chi 2 = 25.65$, $p < .001$).

Conclusion

FSST can relieve pain, reduce breast swelling and range of induration, and for plugged ducts or mastitis varied degree differently.

FULL TEXT

DETAILS

Subject:	Edema; Abscesses; Patients; Pain; Inflammation; Breastfeeding &lactation; Lasers; Mothers; Breasts; Womens health; Massage
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Model Setting and Interpretation of Results in Research Using Structural Equation Modeling: A Checklist with Guiding Questions for Reporting

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ABSTRACT (ENGLISH)

Purpose

This study develops a checklist with guidelines for the methods and important factors to consider in research using structural equation modeling (SEM).

Method

The paper discusses the factors to consider in the process across the three stages of 1) model setting, 2) model evaluation and modification, and 3) interpretation and reporting of SEM-based studies.

Results

The authors present a checklist for researchers during the stages of model setting, model evaluation and modification, result analysis, and reporting, along with examples of figures and tables with explanations.

Conclusion

A checklist will help to improve the reporting quality of SEM-based studies.

FULL TEXT

Introduction

Structural equation modeling (SEM) is a research method that is widely used to verify complex phenomena in the field of nursing, related to various themes such as humans, health, and the environment. It formalizes the structural relationships between cause-and-effect variables in the area of interest into an equation system. Theories or abstract constructs that cannot be directly measured or observed often serve as research topics in the nursing field

to not only understand humans in an integrated manner but also identify the relationships between these concepts [1].

SEM is a data analysis method that is widely used in many fields of study as it has many advantages: First, measurement errors can be controlled. Second, mediating variables can be easily utilized. Third, a statistical evaluation of the theoretical model is possible [2]. In other words, the researcher can evaluate how well the theoretical model constructed by himself/herself fits the actual data and either accept the model as valid, or modify it as necessary.

However, it is difficult to show an appropriate consistent form in reporting the research methods, results, and discussions because the SEM data analysis process is complicated [3]. This is because sufficient data on the model's goodness-of-fit, significance of hypothetical relationships, variances in the structural model, and explanations of how the theoretical model fits the actual data must be provided. Due to such difficulties, a considerable number of studies do not effectively utilize the advantages of SEM [4]; moreover, researchers have been criticized for the inappropriate use of SEM and its resulting problems [1].

This paper presents a checklist with the factors that should be taken into consideration when analyzing data using SEM by dividing the process into the following stages: the model setting stage, the model evaluation and modification stage, and the interpretation and reporting stage. It is hoped that the suggestions put forth will be considered by researchers in their attempts to improve research quality and descriptive narratives.

Checklists and guiding questions when conducting an SEM-based study

Table 1 presents a checklist and guiding questions to address during the stages of model setting, model evaluation and modification, result analysis, and reporting in SEM-based studies. Details on each topic will be explained below.

Model setting

The researcher conducting confirmatory research may have some prior knowledge about the structure of data from existing theories or empirical research results. Thus, he/she may be in a position to state it in a hypothetical form and test the hypothesis through actual data. Such a hypothesis is usually constructed on the basis of specific theories that need to be tested, the given experimental plan, known experimental conditions, and preliminary research results based on big data.

Meanwhile, exploratory research focuses on concisely describing the phenomena of interest, exploring valuable information about the data, and discovering meaningful interpretations, without assuming the aforementioned types of prior knowledge. Of course, the researcher may conduct an exploratory and a confirmatory research concurrently in an actual research situation, rather than clearly distinguishing between the two types of research. However, since SEM is a part of confirmatory research in the sense that it is based on research hypotheses, it is important to establish a valid hypothesis based on theories of and empirical results from the relevant field. For example, determining which variable is the cause and which is the effect in the causal relationship between two variables should be based entirely on the knowledge of the theory and practice in the relevant field. Therefore, sufficient prior research of theories and actual phenomena in the relevant field should be conducted when employing SEM.

In general, SEM includes a number of observed, latent, and error variables. In Figure 1 (A), x_1 and y_1 are observed variables; motivation and satisfaction are latent variables; and δ_1, ε_1, and ζ_1 are error variables. The relationship between these variables is divided into a measurement model and a structural model.

Measurement model

The measurement model defines how latent variables are measured through observed variables. The characteristics of observed variables are of interest because measurement variables construct abstract hypothetical concepts. Here, measurement errors that inevitably occur during the measurement process are also reflected.

The direct analysis targets of SEM are the variance and covariance of the observed variables. Therefore, observed variables should be measured using tools whose validity and reliability have been verified. Tools should be reviewed prior to conducting SEM research because their validity and reliability cannot be evaluated during the course of the research process.

The validity of the measurement model is of primary importance in developing the SEM. Some points to remember

are: (1) Observed variables that represent each latent variable must be set. For example, when defining the latent variables of language abilities, we cannot agree whether the observed variables of Korean, English, music, and physical education are selected. If an observed variable that is not valid for a latent variable is selected, SEM results will not be recognized on a logical basis, regardless of their statistical significance. An indirect approach employed in SEM includes latent variables being reflected through the observed variables. From this perspective, the observed variables are called indicators of the latent variables. There are additional considerations when defining latent variables through observed variables [5]. (2) Observed variables that define one latent variable should be able to measure the same concept. (3) A latent variable is not simply a bundle or a description of observed variables. For example, it is meaningless to not only define a latent variable as a “general characteristic” by grouping observed variables such as gender, age, occupation, and education, but also to define a latent variable as a “work characteristic” by grouping them based on wards worked, years of service, positions, and educational background. (4) A latent variable should be defined to represent a single concept. For example, it is not desirable to define a latent variable called a “psychological state” with observed variables of happiness, confidence, depression, and anxiety, since each of these observed variables measures a different concept. (5) Path coefficients should be interpreted with directionality when describing the causal/correlational relationship between latent variables. In other words, they should be able to gauge the size of the latent variables. However, it is difficult to determine whether “general characteristic” or “work characteristic” are large or small.

It is “desirable” to have at least two, but usually “recommended” that there be three to four, observed variables for one latent variable [6,7]. However, inevitably, there are some cases wherein there may be only one observed variable for one latent variable, which means that the observed variable for the latent variable has not been sufficiently secured. In such cases, the theoretical or practical reason should be explained. When a single indicator problem occurs, the method usually employed for model identification involves fixing the variance of the error variable at a specific value. In general, the error variance is fixed at 0. However, it is recommended that it be fixed with “variance of observed variable × (1-reliability)” if the measurement reliability is known, since this reflects the estimates of the measurement error [8].

Structural model

The structural model defines the causal relationships and associations between latent variables. It also includes a description of error variations that are not explained through the model. Of course, setting an appropriate structural model is important. In the path diagram shown in Figure 1 (A), the one-way arrow refers to the researcher's hypothesis that there is a causal relationship between the variables. However, it is important to remember that the hypothesis is reflected even in paths without arrows. As can be seen, there are no arrows between “motivation” and “performance.” This means that the researcher establishes the hypothesis that there is no causal relationship between these two variables. It should also be reiterated that the establishment of this structural model should be based on theories of and empirical results from the relevant field.

Several studies have low goodness-of-fit because they have failed to consider the relationship of exogenous variables [9]. When the relationship between exogenous variables is not established in the structural model, it is the same as assuming independence between them. This will result in a greatly deteriorated goodness-of-fit. Therefore, it is necessary to establish the relationship between exogenous variables when setting up the model, except in cases where there is clear evidence that no relationship exists. Note that the LISREL software automatically establishes the relationship between exogenous variables. AMOS, on the contrary, requires that the user establish these relationships.

Evaluation and modification of model

The primary purpose of SEM is to evaluate how much of the model assumed by the researcher is supported by the data. SEM should be based on the researcher's confirmatory hypothesis as a whole. However, modification is allowed to some extent through actual phenomena.

Goodness-of-fit

Since the goodness-of-fit is an indication of whether the established SEM reflects the data situation well, a poor

goodness-of-fit renders the results unreliable. Therefore, model evaluation through the goodness-of-fit indices is a primary process that should be performed when interpreting the results of SEM.

Because there are various goodness-of-fit indices, it is not easy to determine which index to use for an evaluation since each evaluates different aspects of the model fit. The literature recommends the chi-square statistic and degrees of freedom (χ^2/df), goodness-of-fit index (GFI), adjusted goodness of fit index (AGFI), root mean squared error of approximation (RMSEA), and standardized root mean square residual (SRMR) as absolute fit indices; comparative normed fit index (CFI) and Tucker-Lewis index (TLI) as incremental fit indices; parsimony normed fit index (PNFI) as a parsimonious fit index; and expected cross validation index (ECVI) as a predictive fit index [2, 6, 10, 11].

In most cases, the quality of the goodness-of-fit tends to worsen with smaller sample sizes. In such cases, care should be taken when interpreting the goodness-of-fit. In addition, the quality of the goodness-of-fit tends to worsen as the number of observed variables increases. The number of observed variables can be reduced in to simply improve the goodness-of-fit. However, the purpose of the SEM analysis is to verify the hypothetical theory, not to increase the model fit. Attempts to simply increase the goodness-of-fit can lead to incorrect model setting; consequently, the model will not properly reflect reality, and the persuasive power of the researcher's argument will be lost [12].

Goodness-of-fit measures how well the researcher's model reproduces the actual phenomenon presented in the data. However, many researchers often confuse a high degree of fit with a good model. High goodness-of-fit is the most basic of the many necessary requirements for a good model, but is not a necessary and sufficient condition. The evaluation of a good model should be made comprehensively depending on the size of the coefficients, statistical significance, and coefficient of determination (R^2). Even if the goodness-of-fit is high, it is difficult to conclude that a model is good if some coefficient values are much lower than expected or if the coefficient of determination is small.

Another frequently made error arises from confusing the goodness-of-fit with the explanatory power. While the goodness-of-fit is an indication of the appropriateness of the model, the explanatory power represents the strength of the relationship between a specific endogenous variable and explanatory variables. Explanatory power is the degree to which explanatory variables explain the variations of an endogenous variable. In general, the explanatory power of individual endogenous variables in the causal model is measured by the coefficient of determination (R^2).

Model modification

There are two ways by which to modify a model. First, parameters can be added to create a more complex model. A common reason for a poor model fit is that the model is too simple to properly represent the data structure. In such cases, it is necessary to relax the constraints on the model by introducing additional path coefficients or covariances. The modification index can be used to obtain information about which parameters should be added. The criteria for a large modification index are 4 and 10 for a small and a large number of observed variables, respectively. There are cautionary notes when using the modification index: (1) The modification index only suggests a numerical direction, not parameters that need to be added to the model, which should be determined based on theories or hypotheses in the relevant field. It is not right to add parameters simply because the modification index is large. It also does not mean that the parameters should be added in the order of the large modification index values. (2) Modifying the model by adding some parameters affects the estimation and testing of others. Therefore, even if there are several large modification indices, free parameters should not be added at once.

Second, unnecessary parameters can be deleted to create a simpler model. Given that the goal of constructing a statistical model is to simplify and explain the complex data structure, a model that has not attempted to reduce the number of parameters is less valuable in terms of parsimony. The researcher should explain the structure of the data by using a simple model as far as possible. Statistical hypothesis testing results for parameter estimates can be used.

Equivalent model

A problem that researchers often overlook in the model modification stage is the existence of an equivalent model,

which refers to a model that produces the same predicted covariance matrix although the established paths between variables may differ. A model that differs only in the direction of causal relationship but has the same df is likely to be an equivalent model. Figure 1 (B) shows an example of equivalent models. Since they have the same goodness-of-fit and df, the former alone cannot determine which of the models is superior to the other. In addition, there may be alternate models rather than an equivalent model that can explain the same phenomenon. Thus, there is the need to acknowledge the existence of such a model and present a theoretical or logical basis for the model selected by the researcher. A model with a similar-sized df and goodness-of-fit is likely to be an alternative model.

Kim (2015) stated that during the model modification and selection process, 9.8% and 18.0% of the nursing papers published in Korean reporting equivalent and alternative models, respectively, needed to be supplemented [1]. All SEMs must have equivalent models in which the relationship between variables with the same data values is arranged in different ways. Thus, there are bound to be several equivalent models in the model set by the researcher, who should be able to present a reasonable basis for the adoption of the chosen model.

Correlation of error variables

SEM contains several error variables. An error variable is a kind of exogenous variable that is introduced into the model as a cause of variation in the endogenous variable, which cannot be explained by the causal relationships included in the model. It is generally assumed that the error variables are independent of each other. In some cases, they can be assumed to be related to each other. The theoretical basis must be presented to explain the relationship between the error variables.

There are two types of error variables: First, measurement error variables may be attached to each observed variable, reflecting the measurement and observation errors of the latent variables corresponding the observed variables. When two observed variables are measured by similar tools, the association between the error observed variables may be established. In Figure 1 (A), when the observed variables x_2 and x_4 are measured by a measurement tool comprising similar content, there may be an association between the corresponding measurement error variables. It is not advisable to add the correlation of measurement errors only to improve the goodness-of-fit or because the modification index is large. Because the correlation of measurement errors is related to the validity of the measurement model, the reasons should be explained and the results should be interpreted and reported [5].

Second, there may be endogenous error variables attached to endogenous variables, reflecting not only exogenous variables missing from the current theoretical structure but also errors in the functional form of the constructed model. The association between endogenous error variables should be interpreted as a partial correlation between endogenous variables in a situation in which the relevant explanatory variables are controlled [5]. In Figure 1 (B)(c), the association between the two error variables indicates the relationship between endogenous variables y_1 and y_2, in the situation in which explanatory variables x_1 and x_2 are controlled. Many researchers face problems because they do not know the concept of partial correlation, neglect to search for partial correlations, or neglect to report the results.

Confirmatory factor model

When the number of observed and latent variables is large and the model has a complex structure, it is often difficult to determine which part to review first for model modification when the model's fit is poor. A good strategy in this case would be to separate the measurement model from the structural model and review them one by one.

The confirmatory factor model considers all latent variables only as exogenous variables. Thus, it refers to a model that is established with an association between all latent variables. No further increase in the goodness-of-fit can be expected in the structural model since all latent variables are associated with each other in the confirmatory factor model. Therefore, if the confirmatory factor model's goodness-of-fit is poor, the scope of model modification can be narrowed by re-examining the relationship between the latent and observed variables in the measurement model. After sufficiently modifying the problems occurring in the measurement model part, the structural model can be reset to its original state, following which the modification index can be used in to review the problems in the structural model part [9].

Although the strategy of separating the measurement and structural models for review by using the confirmatory

factor model is very useful, it is not absolutely necessary. In simple models, model modification can be easily made without performing the aforementioned procedure. In addition, some theoretical models have been established with all associations or causal relationships between latent variables, so that they are equivalent to the confirmatory factor model.

Model interpretation and reporting

Here are examples and commonly recommended formats for reporting observed variables, goodness-of-fit, coefficients and mediating effect estimates in measurement models and structural models, in SEM studies.

Descriptive statistics of observed variables

In SEM, the variation and association of observed variables obtained from the given data lead to the inference of causality within the model. In general, the variation is measured by the standard deviation, while the association is measured by the correlation coefficient. Therefore, they should be reviewed in detail before a full-scale analysis. Table 2 provides an example of the correlation coefficients and standard deviations between observed variables.

Care should be taken if the standard deviation is too large, because outliers may exist. However, if the standard deviation is too small, there may not be much information in the observed variables, therefore the reasons for this should be investigated. It is necessary to examine whether the sign and size of the correlation coefficients match the theoretical empirical expectations. If they are different from what is expected, the analysis results based on this data would not be valid. Each observed variable should have a relatively high correlation coefficient with the variable group defining the same latent variables, particularly when establishing a model with latent variables.

Tabachnick (2007) recommended looking at the size of the correlation coefficient based on the criterion of 0.3. [13]. When the correlation coefficient was ±0.3, ±0.4, and ±0.5, Hair (1995) classified the size as “minimal level,” “important,” and “practically significant,” respectively [14]. On the contrary, if the correlation coefficient is too large, it must be checked whether the absolute value is close to 1. If the correlation coefficient of the two measured variables is close to 1, it may mean that the two variables have the same meaning or information.

Evaluating the validity and reliability of the measurement of observed variables, while also reviewing the mean, standard deviation, skewness, kurtosis, and correlation coefficient, should be completed before applying SEM, otherwise errors occurring in the data will make the subsequent analysis meaningless.

Goodness-of-fit index

Researchers often report only favorable fit indices. However, the chi-square statistic (χ^2), which is the most basic fit index, should be reported along with at least one absolute fit index and one incremental fit index. When comparing two or more models, it is necessary to report parsimonious fit indices or measures based on the information criteria. Table 3 provides examples of reporting results that mainly use fit indices. For detailed evaluation criteria, refer to [5, 11].

Evaluation of the measurement model

Evaluation of the measurement model is crucial as it forms the logical basis for defining latent variables. Kim et al. (2015) pointed out that further extensive reports on the validity of the measurement model in the nursing field are necessary [1].

Table 4 depicts an example of the presentation of main results of the measurement model. Factor loadings, standardized estimates, *p*-values, and squared multiple correlations (SMC) for the measurement model are reported. If an association between measurement error variables is established, this should also be presented. For reference, SMC (R^2) in the measurement model indicates the size of the variation explained by the latent variables for a certain observed variable, and the relationship of ‘measurement error = 1-SMC’.

The convergent validity of the measurement model implies that the observed variables defining the same latent variable should have a relatively high correlation, which is evaluated by the factor loadings. There are several empirical views on the standardized estimate of the factor loadings. Generally, values of at least 0.3 and greater than 0.5 are interpreted as good, while values greater than 0.7 are interpreted as very good.

In addition, it is necessary to review and report whether there is a relatively large modification index for the measurement model part. The discriminant validity of the measurement model implies that there must be a low correlation between the observed variables defining different latent variables. Thus, a relatively large modification

index for the measurement model part indicates a problem with discriminant validity.

Estimates of structural model

The researcher's main interest is generally in the structural model. Table 5 provides an example of the presentation of the main results of the structural model. Path coefficient estimates, standardized estimates, *p*-values, SMCs, etc. should be reported, as should the details of the associations between exogenous variables. In addition, it is necessary to provide information on the association between endogenous error variables, if any. In the structural model part, it is also necessary to review and report whether there is a relatively large modification index. For reference, SMC (R^2) indicates the size of the variation explained by other explanatory variables for a certain endogenous variable, which can be interpreted as the size of the explanatory power for each endogenous variable.

Mediating effects of structural model

One of the important features of the path analysis model or the SEM, unlike the general statistical model, is that mediating variables can be introduced. It is necessary to report the direct, indirect, and total effects of the mediating variables. Table 6 presents the standardized estimates in parentheses, along with the size of the effect, as an example of presenting the main results for mediating effects.

The Sobel test and bootstrapping are mainly used as statistical tests for mediating effects. However, the methods may differ slightly depending on the software used. Recently, an increasing number of studies have used the bootstrapping method since several software programs provide this feature.

Conclusion

The concept of SEM encompasses a very wide spectrum of models, including the measurement, regression, path analysis, and factor models. Therefore, researchers are required to have a considerable level of statistical knowledge in order to understand and perform SEM properly. However, it is not easy to understand such concepts clearly. This paper aimed to not only provide a guide to help researchers in their research with SEM, but also address possible problems in the actual data analysis process and provide precautions. We recommend that researchers use the suggested a checklist in the future to improve the reporting and research quality of SEM studies. Researchers should be able to answer “yes” to all of the items on Table 1.

Conflict of interest

The authors declared no conflicts of interest to disclose.

Topic	Item	Guide questions
Model setting	1	Measurement of observed variables–Are the observed variables measured by a valid and reliable measurement tool?
2	Measurement model setting-Do observed variables represent each latent variable?-Do the observed variables that define each latent variable measure the same concept?-Is each latent variable defined to represent a single concept (or meaning)?-Can the sizes of the latent variables be compared? Or, is it possible to compare the size of the measurements of the latent variable? Or, can you tell the size (large/small) of each latent variable?	3

Structural model setting-Are there any missing causal relationships or associations between latent variables?-Are causal relationships or associations between latent variables based on theory and empirical facts or results?	Evaluation and modification of the model	4
Do most GFIs show reasonable fitness?	5	Have all the relatively large modification indices been considered?
6	Has the parsimony of the model been pursued?	7
Have the equivalent and alternative models been considered?	8	Has the relationship between measurement and endogenous error variables been reviewed?
Interpretation and reporting of the model	9	Have all the descriptive statistics and correlation coefficients of the observed variables been reviewed?
10	Have major GFIs been reported?	11
Have the main results of the measurement model been presented appropriately?	12	Were the main results for the structural model adequately presented?

	x1	x2	x3	x4	x5	y1	y2	y3
x1	1							
x2	.43*	1						
x3	.34*	.29*	1					
x4	.25*	.35*	.62*	1				

x5	−.39*	−.41*	−.33*	−.28*	1			
y1	.18*	.22*	.63*	.51*	−.28*	1		
y2	.38*	.35*	.48*	.39*	−.18*	.46*	1	
y3	.23*	.25*	.51*	.40*	−.09*	.48*	.66*	1
S.D.	.99	.93	1.08	1.08	1.84	1.02	1.77	1.53

Model	χ^2	df	GFI	AGFI	RMSEA	SRMR	CFI	TLI	PNFI	ECVI
Hypothetical model	24.5	3	.917	.587	.204	.103	.862	.586	.284	.246
Modified model1	2.0	2	.992	.943	.000	.028	1.000	1.000	.220	.127
Modified model 2	2.2	3	.995	.975	.000	.033	1.000	1.000	.329	.151

A. Estimates of loadings	Latent variables	Measurement variables	Loadings	Standardized estimates	p-value
SMC	Motivation	x1	1.00	0.61	–
0.37		x2	0.98	0.58	<.001
0.34	Self-esteem	x3	1.00	0.89	–
0.80		x4	0.78	0.71	<.001
0.50	Verbal ability	x5	1.00	0.92	–
0.85	Performance	y1	1.00	1.00	–
1.00	Satisfaction	y2	1.00	0.79	–
0.62		y3	0.93	0.84	<.001

A. Regression weights	Endogenous variables	Exploratory variables	Estimate	Standardized estimates	p-value
SMC	Performance	Self-esteem	0.74	0.70	<.001
0.49	Satisfaction	Motivation	2.55	1.10	<.001
0.62		Verbal ability	0.61	0.74	<.001
0.71		Performance	0.44	0.32	.019

Endogenous variables	Exploratory variables	Direct effects	Indirect effects	Total effects
Performance	Self-esteem	0.74 (0.70)*	–	0.74 (0.70)*
Satisfaction	Motivation	2.55 (1.10)*	–	2.55 (1.10)*
	Self-esteem	–	0.32 (0.22)*	0.32 (0.22)*
	Verbal ability	0.61 (0.74)*	–	0.61 (0.74)*
	Performance	0.44 (0.32)*	–	0.44 (0.32)*

DETAILS

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Effects of Virtual Reality Simulation Program Regarding High-risk Neonatal Infection Control on Nursing Students

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ABSTRACT (ENGLISH)

Purpose

Virtual reality simulation can give nursing students a safe clinical experience involving high-risk infants where access to neonatal intensive care units is limited. This study aimed to examine the effects of a virtual reality simulation program on Korean nursing students' knowledge, performance self-efficacy and learner satisfaction.

Methods

A nonequivalent control group design was applied. Senior nursing students were divided into an experimental group (n = 25) experiencing virtual reality simulation and routine neonatal intensive care unit practice and a control group (n = 25) having routine neonatal intensive care unit practice. The program consisted of three scenarios: basic care, feeding management and skin care and environmental management for prevention of neonatal infection. The total execution time for the three scenarios was 40 minutes. The simulation created immersive virtual reality experiences using a head-mounted display with hand-tracking technology. Data were collected from December 9, 2019, to January 17, 2020, and were analyzed using descriptive statistics and the t-test, paired t-tests, Mann-Whitney test and Wilcoxon signed-ranks test.

Results

Compared to the control group, the experimental group showed significantly greater improvements in high-risk neonatal infection control performance self-efficacy (t = −2.16, p = .018) and learner satisfaction (t = −5.59, p < .001).

Conclusion

The virtual reality simulation program can expand the nursing students' practice experience in safe virtual spaces and enhance their performance self-efficacy and learning satisfaction.

FULL TEXT

Introduction

The goal of practical clinical education in nursing is to improve the clinical abilities of nursing students by giving them first-hand experience in applying their skills to patients under complex, real-world conditions. However, South Korea lacks legal protections against liability for nursing students' actions, and the health rights of medical consumers and the importance of patient safety management must be considered [1]. Thus, students' practical training focuses more on observation and ancillary tasks than on direct skill application to patients, and many obstacles must be overcome to enhance students' clinical practice abilities. In compensating for these constraints, several forms of simulation education have been developed. These include use of the following scenarios: peer-to-peer learning; partial task trainer models; standardized and simulated patients; computerized task trainers and mannequins; screen-based computer simulations; and more recently, virtual reality (VR) and haptic systems [2,3]. Simulation involves mimicking the reality of clinical environments to demonstrate procedures to students and develop their decision-making and critical thinking skills; specific simulation techniques include role-playing and the use of devices, such as interactive videos or mannequins [4]. Among the simulation learning methods introduced within the past few years, VR simulation involves the creation of an artificial environment experienced through sensory stimuli (such as sights and

sounds) provided by a computer, and with high-level VR simulation, the user's actions partially determine changes in the environment [5,6].

Although existing high-fidelity simulations have been proven effective, the VR approach is a user-oriented learning method that is not restricted by limited faculty preparation time, staff or schedules and that allows students to practice clinical techniques in a safe environment [3]. Furthermore, VR simulation is a practical means of circumventing the restrictions imposed by the Coronavirus disease 2019 (COVID-19) pandemic on face-to-face interaction or clinical education and practice in hospitals. Therefore, VR simulation may prove beneficial in circumstances where student access to mannequin-based training or clinical practice is limited [7].

In the neonatal intensive care unit (NICU) setting, providing nursing students with practical clinical education is particularly challenging due to the restrictions on their activities in that environment. Nonetheless, nursing students require extensive practical training for this environment, particularly in the domain of infection control. All newborn infants are prone to nosocomial infections because of their intrinsic susceptibility to infection and the invasive procedures they are subjected to. This is particularly the case for infants born prematurely or with low birth weight [8, 9]. Therefore, infection control is the most important issue in caring for infants during their first week after birth, when their immunity is limited, and protecting infants from infection is a major responsibility of the nurses who care for them [10]. Therefore, to prepare for clinical practice in the NICU, nursing students require thorough and accurate training in neonatal infection management. However, particularly in South Korea, the number of hospitals that have reduced NICU access for students is increasing due to rising rates of premature birth and stricter management policies [11,12]. Due to the infection-related deaths of four infants in a NICU in South Korea in 2017, institutional policies for infection control have grown stricter, and thus, nursing students' ability to develop their clinical skills and gain practice experience with newborns in NICUs is severely limited.

Previous studies have reported on the positive effects of simulation education on nursing and other students' confidence, decision-making ability, communication skills and clinical judgment [2, 13–15]; clinical knowledge and performance [16,17]; and self-efficacy or self-confidence, as well as ability to manage anxiety and stress [18]. Insofar as VR simulation is a new learning method, however, the literature around it is limited [5]. According to a recent systematic review of VR simulation programs in nursing education [19], VR studies for nursing students have been conducted in the United States, Canada, Israel, Kuwait and South Korea. These involved VR skill training for urinary catheterization and phlebotomy [20–22], children's postoperative care and medication administration using virtual gaming simulation [23,24], and an intravenous simulator incorporating VR and a haptics device [25]. Furthermore, Williams et al. [3] studied a VR program addressing neonatal resuscitation for midwifery students in Australia. However, no studies that we are aware of have yet examined the effectiveness of a VR simulation program for infection control in the NICU.

Therefore, the objective of this study was to apply a VR simulation program for high-risk neonatal infection control (HirNIC) to evaluate its effects on nursing students' knowledge of neonatal infection control, self-efficacy for infection control performance, and satisfaction with the learning process. The study hypotheses were as follows:**Hypothesis 1**

Participants experiencing the VR simulation program (experimental group) will have a higher level of HirNIC knowledge than the control group who only participated in clinical practice in a NICU (control group).

Hypothesis 2

The experimental group will have a higher level of self-efficacy for infection control performance than the control group.

Hypothesis 3

The experimental group will have a higher level of learner satisfaction than the control group.

Methods Study design

This study used a nonequivalent control group design to evaluate the effectiveness of a HirNIC VR simulation program.

Sample and setting

The target population was Korean senior nursing students, and the study was conducted at a nursing college in J

city, Korea. The sample size was calculated using a t-test (one-tailed) and the G * power 3.1 program [26]. Considering that the effect sizes in two previous studies of a similar nature [1,27] were 0.40 and 0.80, we employed a significance level of .05, a power of 0.85, and an effect size of 0.80 for the calculation. A sample size of 48 participants was calculated to be sufficient for this study. In accounting for a potential dropout rate of approximately 5%, 51 participants were recruited from a cohort of 71 senior nursing students by means of convenience sampling.

Procedure Framework for simulation education

The conceptual framework for the simulation program was based on the National League for Nursing (NLN)/Jeffries Simulation Framework [28]. This model identifies five essential concepts of simulation design that support desired student outcomes, including (a) teacher, (b) student, (c) educational practices, (d) simulation design characteristics and (e) outcomes. The central proposition of this model is that student outcomes are influenced by the incorporation of best education practices into the design and implementation of the simulation experience. Furthermore, the model posits that learning depends on the teacher and student interactions, expectations and roles; hence, when the model's teacher, student and educational practices concept variables are considered in simulation design, student satisfaction and performance improve [4]. In the current study, the "teacher" developed a HirNIC VR simulation program based on her more than 10 years of simulation education experience and her clinical practice career in the NICU environment; the teacher then served as facilitator and evaluator during program operation and provided feedback to students. Each "student" was a senior nearing graduation, and the "educational practices" included 4 hours of lecture on neonatal infection control and 45 hours of clinical practice in the NICU. The "simulation design characteristics" included the HirNIC VR simulation consisting of three scenarios and a short prebriefing and debriefing before and after the scenarios. The "outcomes" included HirNIC knowledge, HirNIC performance self-efficacy and learner satisfaction (see Figure 1).

VR simulation program application

The HirNIC VR simulation program employed in this study was developed by Yu and Mann [29]. It consisted of three scenarios representing basic nursing situations related to infection control—basic care, feeding management and skin care and environmental management—that could be easily understood by nursing students (see Table 1). The program user has to perform enteric precautions, skin care, proper disposal of waste (including the gown and soiled diaper) and incubator disinfection following contact precaution guidelines.

The VR program, with its three scenarios, was produced using VR simulation program software developed by SAMWOOimmersion Co., Ltd., of South Korea. The program employed a Vive Pro Full-Kit Head Mounted Display and sensor (HTC VIVETM, USA), a Leap Motion Controller™ (Ultraleap, USA) hand-tracking device with a VR Developer Mount, and a VR kit containing an EliteDesk 800 G4 laptop computer. In the program, the user wearing the HMD enters the VR world and performs the applicable nursing procedures. The controller attached to the HMD is capable of tracking the user's hands within a 3D interactive zone. The user experiences the three VR scenarios consecutively on a single day, and the total execution time is 40 minutes.

During the study, the student participants received a team-based, 30-minute prebriefing, which included an introduction to the scenarios and use of VR before completing the scenarios. They also received a 20-minute debriefing after scenario completion.

Instruments and measures General characteristics

Information on students' gender, age and previous semester grade was collected using a questionnaire created by the first author.

HirNIC knowledge

Student knowledge regarding HirNIC was assessed using the High-Risk Neonatal Infection Control Competency Scale Knowledge (HirNICCS_K) developed by Yu et al. [30]. The HirNICCS_K consists of five subdomains: basic care, skin care, feeding management, medication and invasive procedure management, and environmental management. In this study, we condensed this scale to include 10 items for basic care, 8 items for feeding management and 10 items for skin care and environmental management according to the scenario topics. The possible item responses were "Yes," "No," and "I don't know. " Each correct answer received 1 point, while incorrect

answers received 0 points. The total possible score was 28 points, including 10 points for basic care, 8 points for feeding management and 10 points for skin care and environmental management; the higher the total score, the higher the knowledge level. The reliability for the overall scale was KR-20 = .67 in a previous study [30] and .61 in this study.

HirNIC performance self-efficacy

In the education context, self-efficacy refers to "perceived capabilities for learning or performing behaviors in designated levels" [31]. HirNIC performance self-efficacy was assessed using a modified version of a self-efficacy measure employed in a previous nursing student simulation study [32]; the instrument was modified based on the High-Risk Neonatal Infection Control Competency Scale_Performance by Yu et al. (2020) [30]. The original instrument consisted of 17 items addressing self-confidence in caring for patients with gastrointestinal bleeding or acute myocardial infarction. The HirNIC performance self-efficacy scale consisted of 21 items covering three domains: basic care (7 items), feeding management (9 items) and skin care and environmental management (5 items). Each item was rated on a 10-point scale ranging from 0 = "not confident at all" to 10 = "maximum confidence," with higher scores indicating higher levels of confidence. As to reliability, the original instrument showed a Cronbach's α of .91 in the previous study [32]. In the present study, the modified instrument had a Cronbach's α of .96, and the Cronbach's α values for the basic care, feeding management, and skin care and environmental management domains were .89, .93 and .89, respectively.

Learner satisfaction

Learner satisfaction was measured using three items developed by Cho [33] to examine nursing students' satisfaction with a root cause analysis education program intended to improve patient safety competencies and modified by the researcher. In the present study, the first item differed for the experimental and control groups: for the experimental group, it was The HirNIC VR simulation program after clinical practice will help me work as a nurse in clinical practice, and for the control group, it was Clinical practice in the NICU will help me work as a nurse in clinical practice." The second and third items were I want to recommend this program to other nursing students and I think this training is necessary as part of the nursing college curriculum. Each item was rated on a five-point Likert scale ranging from "very unsatisfied" (1 point) to "very satisfied" (5 point). Higher total scores indicated higher levels of satisfaction. The Cronbach's α for this instrument was .81 in Cho's study [33] and was .81 in the present study.

Data collection

Data were collected from December 9, 2019, to January 17, 2020. Under the study inclusion criteria, study participants had to be senior nursing students with prior clinical experience and prior high-fidelity simulation training who were willing to volunteer to participate. The 51 participants were divided into six teams, each containing 8 or 9 participants, based on their clinical practice schedules. The three teams that first had clinical practice in the NICU were assigned to the control group, and the next three teams to have clinical practice were assigned to the experimental group. Finally, a total of 25 participants were in the control group and 26 in the experimental group. For both groups, a pretest was administered after lectures related to neonatal infection control. For preventing diffusion of the experiment, the posttest for the control group was administered first, after they completed routine clinical practice in a NICU. After data collection for the control group was completed, the experimental group was enrolled in the VR simulation program performed in the simulation lab, and posttest data were collected immediately after the intervention. The control and experimental groups experienced the same lectures and performed their clinical practice in the NICU. All but one participant completed the study; the single exception in the experimental group did not submit the posttest.

Data analysis

Data were analyzed using the SPSS Statistics 25.0 program (IBM Corp., Armonk, NY, USA). Participants' general characteristics, HirNIC knowledge and HirNIC performance self-efficacy were analyzed using frequencies, percentages, means and standard deviations. A Chi-square test, independent t-test and Mann-Whitney test were used to verify pretest homogeneity between the two groups. A Shapiro-Wilk test was performed to ensure normal distributions of knowledge and performance self-efficacy data. A paired t-test and Wilcoxon signed-ranks test were

used to determine differences in HirNIC performance self-efficacy and HirNIC knowledge between the pretest and posttest within the groups. For determining differences between the groups, an independent t-test was used for HirNIC performance self-efficacy and learner satisfaction, and a Mann-Whitney test was used for HirNIC knowledge.

Ethical considerations

This study was approved by the institutional review board (IRB) of the researcher's university (Approval no. GIRB-A19-Y0077). The participants were provided with a thorough explanation of the study's purpose and procedures and were informed that they could refuse to participate without any impact on their grades. Each participant then provided written informed consent. Additionally, participants were informed that the research data would be used only for the stated research purpose, would be coded to ensure their confidentiality and anonymity, and would be disposed of after completion of the study. A research assistant distributed and collected the presurvey and postsurveys, which took participants 10 to 15 minutes to complete, and after data collection, each participant was compensated with a gift card worth about 10 USD. The collected data were encrypted using an identification code, and all data were stored in a locked cabinet. The data will be stored for no more than 3 years and will then be securely disposed off.

Results General characteristics and homogeneity of study variables

Through homogeneity tests for gender, age and previous semester grade, HirNIC knowledge and performance self-efficacy of the experimental and control groups were determined to be homogeneous ([Table 2]).

Virtual reality simulation program effects

[Table 3] shows the results of the effect verification tests for the HirNIC VR simulation program.

Hypothesis 1

There was no significant difference between the experimental and control groups (U =272.00, p = .213) in terms of HirNIC knowledge. Furthermore, there were no significant differences between the groups in the three subdomains of HirNIC knowledge, namely basic care (U =292.50, p = .335), feeding management (U =311.00, p = .488), and skin care and environmental management (U =271.50, p = .205). Therefore, [Hypothesis 1] was rejected.

Hypothesis 2

Based on the pretest and posttest results, HirNIC performance self-efficacy significantly increased in both the experimental (t = 10.03, p p p = .018). In the domains of basic care (t = –2.73, p = .005) and skin care and environmental management (t = –2.28, p = .013), the experimental group had significantly higher self-efficacy scores than the control group. The experimental group also showed a higher score in the feeding management domain, but the difference from the control group was not significant (t = –1.28, p = .103). Therefore, [Hypothesis 2] was partially accepted.

Hypothesis 3

The experimental group showed a significantly higher learner satisfaction score (4.79 ± 0.35 points) than the control group (4.13 ± 0.47 points) (t = –5.59, p Hypothesis 3 was accepted.

Discussion

In all healthcare settings, the infection control practices used during patient care are intended to prevent and control the transmission of microorganisms. Particularly in an environment such as the NICU, pathogenic organisms can easily spread. This study applied a VR simulation program that we designed to help nursing students learn infection control processes, as well as to compensate for the inadequate clinical experience they receive due to practical restrictions placed on nursing students in the NICU.

In simulation teaching methods, role-playing and simulation using a mannequin have the disadvantage that the content delivered depends on the instructor's teaching methods and can vary with each learning session [5,34]. In addition, long operating hours and preparation times are required for each session, so more team than individual training often occurs, offering fewer opportunities for students to practice their skills. Compared to screen-based virtual simulation programs such as SecondLife and vSim, the HirNIC VR program applied in this study provides a more immersive virtual experience using the HMD and mobilizes vision, hearing and touch in ways similar to reality. Furthermore, this form of simulation allows the repeated practice of techniques without being greatly affected by the

instructor's time limitations and teaching methods.

The results of the study showed that nursing students' performance self-efficacy regarding infection control and their satisfaction with the program increased significantly after participating in the HirNIC VR simulation program. However, no significant difference was observed between the experimental and control groups in terms of HirNIC knowledge.

During the application of our VR simulation program, performance self-efficacy levels in the experimental group increased significantly, from a mean score of 5.36 to 8.57 (of 10), and this increase was greater than that observed in the control group. In particular, the experimental group's mean scores for basic care and skin care, and environmental management increased significantly. These results are similar to those of three previous studies of a high-fidelity patient simulation's effect on nurses' self-efficacy [35] and a computer (or screen)-based resuscitation simulation's effects on nursing students' self-efficacy [36,37]. Another previous study [23] examined a Canadian VR program related to child care after appendectomies and also observed increased self-efficacy in nursing students due to the program. We know that simulation as a learning method improves cognitive, emotional and psychological abilities in a safe and realistic environment by forming a bridge between theoretical knowledge and practical skills [38]. In particular, the theoretical core of simulation learning is that learning takes place through experience, and thus, simulation helps students to think like nurses by giving them experiences similar to real-life clinical conditions. As this approach allows nursing students to acquire theoretical and practical knowledge while also verifying and integrating previous learning experiences [39], it is not surprising that simulation employing a VR environment increased nursing students' performance self-efficacy.

The experimental group's satisfaction with the HirNIC VR program was much higher than the learner satisfaction exhibited by the control group. This result is supported by previous studies. For example, the learning satisfaction of new nurses participating in high-fidelity simulation-based high-risk neonatal care education was higher than that of a nonsimulation group [40]. In another study, participation in a computer-based resuscitation simulation was a significant predictor of learner satisfaction in an emergency nursing clinical course [41]. In the present study, the control group's satisfaction level after practice averaged 4.13 points (of 5), while the experimental group had an average satisfaction score of 4.79, a significant difference. In particular, among the items, the mean score for "It helped to acquire infection control capability" was 4.04 in the control group and 4.76 in the experimental group. For the item "I want to recommend it to others," the control group's mean score was 4.08 points compared to the experimental group's 4.88 points. Clearly, students who received only clinical practice in the NICU were less satisfied as learners than those in the experimental group, who had the opportunity to further practice their techniques through the VR simulation. In the debriefing following the VR simulation program, students described the program as "fun" and helpful in allowing them to practice nursing skills that they were denied to opportunity to use in the NICU. Many also asserted that other students should experience this program too.

Importantly, however, our posttest results showed no significant difference in HirNIC knowledge between the two groups, although both groups did show a slight increase. This finding differs from Verkuyl et al.'s [23] study results, which indicated a significant difference in the knowledge of nursing students after the application of a screen-based virtual gaming program. Moreover, Dubovi et al. [24] found that their experimental group's medication knowledge increased after the application of a screen-based VR program. However, Verkuyl et al. [23] used only posttest measures, while Dubovi et al. [24] employed only a single group of nursing students who used a nonimmersive, screen-based virtual simulation program instead of receiving a full VR experience. Therefore, it is difficult to directly compare the results of those studies with our own. Nevertheless, no significant differences in posttest HirNIC knowledge were visible between our two groups, presumably because both had increased their knowledge through basic clinical practice. Additionally, the debriefing time provided after the VR simulation program may have been inadequate. Debriefing is an important component of the learning process, and it has been found to reduce the learning gap between observers and participants [42]. Therefore, in employing the VR simulation program, it will be necessary to allocate more time for debriefing so that learners can discuss their experiences and further expand their knowledge.

Although nursing knowledge is essential, it alone cannot improve novice nurses' or nursing students' competence. It has to be reinforced by the practice of requisite procedures. Few studies have directly compared clinical practice in the NICU environment to simulation in terms of skill performance. However, considering that simulation observation and effective debriefing have shown benefits similar to scenario participation [42], it is reasonable to assume that nursing students would benefit from closely observing nurses' behavior in clinical practice and engaging in self-reflection similar to a debriefing afterward.

The VR simulation program applied in our study offered nursing students repeated practice in performing such procedures. As nurses play a major role in infection control in all intensive care settings, practical educational programs rooted in simulation theory and nursing knowledge are needed to ensure control of infection and reduce morbidity and mortality in neonates cared for in the NICU [43]. Therefore, in addition to knowledge transfer, VR simulation technology should be exploited to support the accurate application of knowledge related to infection control.

Implications and Limitations

This study has significant implications for nursing education and nursing theory. First, it is noteworthy that our VR simulation program was the first to be applied to neonatal infection management. With the growing popularity of VR simulation, it is inevitable that this technology will become more prominent in neonatal health education, training and research [3], particularly at a time when the COVID-19 pandemic makes in-person instruction problematic. Second, our study was guided by the NLN/Jeffries Simulation Framework, and Lafond and Van Hulle Vincent [44] pointed out that rigorous research is needed to test the relationships among this model's concepts and the associated concept variables. Given that the validation of the concepts of a theory is empirically important to the overall development of nursing theory, this study is also significant in its application and partial verification of the NLN/Jeffries Simulation Framework within nursing education; that is, this study confirmed that VR simulation program can improve learners' self-efficacy, knowledge and satisfaction to a degree similar to other simulations.

This study's limitations should be noted. First, within the NLN/Jeffries Simulation Framework, the effectiveness of learning is posited to be dependent on teacher-student interactions. During VR simulation, however, students solve problems and practice skills without direct interaction with the instructor. Hence, there are some limitations in applying the concept of teacher-student interactions in VR programs. However, in our approach, the prebriefing and debriefing do provide opportunities for instructor-student discussion of questions and observations associated with the simulation scenarios; hence, teacher-student interactions are, in fact, present. Second, the debriefing after the VR simulation was limited to a single 20-minute session addressing all three scenarios. This limited timeframe for sharing of knowledge without repetitive practice may have affected study findings. Third, as the study only involved nursing students at one university, the results may differ with other groups of VR simulation program users. Finally, due to time constraints imposed by the university schedule, the VR simulation program could not be implemented with the control group, which could be considered an ethical limitation.

Conclusion

This study implemented a VR simulation program among nursing students that focused on high-risk neonatal infection control, and we observed improvements in students' performance self-efficacy, as well as greater learner satisfaction compared to nonusers of the program. We demonstrated that VR simulation can help nursing students learn how to solve problems in virtual situations that mimic the real world and can expand their practice of skills in a realistic environment. We also showed that VR simulation facilitates repetitive learning by minimizing environmental constraints such as instructor capacity. In the future, studies will undoubtedly continue to confirm various benefits of VR simulation programs in comparison to traditional simulations. However, one area of need is to develop VR simulation programs and scenarios that build problem-solving skills by means of communication and cooperation between multiple learners in the same virtual space.

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Conflict of interest

The author declared no conflicts of interest.

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Procedure	Topic/Scenario	Contents and Situation	Time expended (minutes)
Prebriefing	Introduction of scenarios	Simulation scenarios are briefly explained, including learning objectives and principles of high-risk neonatal care and infection control.	20
Use of VR and precautions	The simulation lab environment is overviewed, including use of VR equipment such as the HMD and Leap Motion Controller, as well as disposable eye masks for the headset to prevent cross-contamination.	10	VR Simulation
Basic care	A premature infant (34 weeks, 2,750 grams) is transferred from the delivery room to the neonatal intensive care unit. For preventing neonatal infection, initial nursing care is performed.	10	Feeding management

A premature infant (30 weeks, 1,250 grams) needs to breastfeed through a gastric tube. Frozen breastmilk preparation, gastric tube feeding and actions to prevent aspiration are performed.	15	Skin care and environmental management	A full-term newborn (3,010 grams) with diarrhea is transferred from another hospital due to rotavirus infection and diarrhea. The baby is isolated in an incubator. Enteric precautions, skincare, waste disposal and environmental disinfection are performed according to contact precaution guidelines.
15	Debriefing	Discussion	Students reflect on the simulation experience and exchange feedback with the instructor.

Characteristics	Categories	Total n(%)	Group		$t/\chi^2/U$	p
Control group (n = 25)	Experimental group (n = 25)	Gender	Women	46(92.0)	23(92.0)	23(92.0)
—	>.999	Men	4(8.0)	2(8.0)	2(8.0)	—
—	Age (years)	21–22	31(62.0)	14(56.0)	17(68.0)	0.76
.329	23–25	19(38.0)	11(44.0)	8(32.0)		
Mean ± SD	22.40 ± 1.05	22.36 ± 1.22	22.44 ± .87	−0.27	.791	Previous semester grade[a]
Under 3.0	3(6.0)	1(4.0)	2(8.0)	0.48	>.999	3.0–4.0
33(66.0)	17(68.0)	16(64.0)	—	—	Over 4.0	14(28.0)
7(28.0)	7(28.0)	—	—	HirNIC Knowledge†	Basic care	8.58 ± 1.11
8.40 ± 1.32	8.76 ± 0.83	275.00	.217	Feeding management	7.64 ± 1.48	7.36 ± 1.66
7.92 ± 1.26	261.00	.153	Skin care and environmental management	6.44 ± 1.28	6.48 ± 1.36	6.40 ± 1.22
291.50	.337	Overall	22.42 ± 2.84	22.05 ± 3.31	22.79 ± 2.28	284.00
.288	HirNIC performance self-efficacy	Basic care	5.03 ± 1.60	5.19 ± 1.56	4.86 ± 1.65	0.72

.239	Feeding management	5.32 ± 1.67	5.30 ± 1.54	5.33 ± 1.83	−0.06	.478
Skin care and environmental management	6.13 ± 1.70	6.15 ± 1.54	6.10 ± 1.88	0.10	.461	Overall

Variables	Categories	Group	Pretest	Posttest	Difference between time		Program effect	
Mean ± SD	Mean ± SD	t/z	p	t/U	p	HirNIC knowledge[a]	Basic care	Cont.
8.40 ± 1.32	8.84 ± 0.90	−1.43	.076	292.50	.335	Exp.	8.76 ± 0.83	8.84 ± 0.99
−0.58	.282	—	Feeding management	Cont.	7.36 ± 1.66	8.28 ± 1.46	−2.28	.011

311.00	.488	Exp.	7.92 ± 1.26	8.72 ± 1.10	−2.12	.017	—	Skin care and environmental management
Cont.	6.48 ± 1.36	6.36 ± 0.70	−0.81	.208	271.50	.205	Exp.	6.40 ± 1.22
6.40 ± 1.04	−0.08	.467	—	Overall	Cont.	22.05 ± 3.31	23.29 ± 1.92	−2.12
.017	272.00	.213	Exp.	22.79 ± 2.28	23.44 ± 2.15	−1.45	.074	—

HirNIC performance self-efficacy	Basic care	Cont.	5.19 ± 1.56	7.46 ± 1.34	7.91	<.001	−2.73	.005
Exp.	4.86 ± 1.65	8.36 ± 1.05	10.05	<.001	Feeding management	Cont.	5.30 ± 1.54	7.71 ± 1.54
7.17	<.001	−1.28	.103	Exp.	5.33 ± 1.83	8.35 ± 1.21	8.87	<.0001
Skin care and environmental management	Cont.	6.15 ± 1.54	8.12 ± 1.56	5.62	<.001	−2.28	.013	Exp.
6.10 ± 1.88	9.24 ± 0.88	8.35	<.001	Overall	Cont.	5.47 ± 1.47	7.72 ± 1.37	7.48
<.001	−2.16	.018	Exp.	5.36 ± 1.68	8.57 ± 0.98	10.03	<.001	Learnersatisfaction
This program will help me work as a nurse in clinical practice	Cont.	—	4.04 ± 0.45	—	—	−5.12	<.001	Exp.

—	4.76 ± 0.44	—	—	This training is necessary as part of the nursing college curriculum	Cont.	—	4.28 ± 0.74	—

—	−2.54	.008	Exp.	—	4.72 ± 0.46	—	—	I want to recommend this program to other nursing students
Cont.	—	4.08 ± 0.57	—	—	−6.05	<.001	Exp.	—
4.88 ± 0.33	—	—	Overall	Cont.	—	4.13 ± 0.47	—	—

DETAILS

Subject:	Simulation; Students; Nursing education; Teaching methods; Clinical medicine; Hypotheses; Training; Premature birth; Nosocomial infections; Knowledge; Skin care; Decision making; Environmental management; Performance evaluation; Coronaviruses; Virtual reality; Learning; Disease control; COVID-19; Skills; Newborn babies
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Evaluation of a Mobile-based Maternal Feeding Education Program for Overweight Prevention in Infants

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ABSTRACT (ENGLISH)

SUMMARYPurpose

The purpose of this study was to evaluate a mobile-based maternal feeding education program for overweight prevention in infants based on breastfeeding attitude, breastfeeding self-efficacy, breastfeeding duration, recognition of hunger and satiety cues of infants, and knowledge regarding providing solids foods.

Methods

A nonequivalent control group pretest-posttest design was used for the study. Participants included 15 primiparas in the experimental group and 14 primiparas in the control group in all the follow-up tests. Using self-reported questionnaires in electronic format, data were collected four times (before the intervention, 1 month after childbirth, 3 months after childbirth, and 6 months after childbirth). Using SPSS 24 version, independent *t*-test and repeated-measures analysis of variance were used to test the effects of the mobile-based maternal feeding education program.

Results

The experimental group showed significantly more positive breastfeeding attitude ($F = 5.28$, $p = .008$), higher breastfeeding self-efficacy ($F = 3.50$, $p = .041$), and increased breastfeeding duration ($t = -2.09$, $p = .046$) than the control group. In addition, the experimental group showed significantly improved knowledge regarding providing solid foods to the infants ($F = 4.86$, $p = .009$) in comparison with the control group. However, for education on recognizing hunger and satiety cues of infants, the mobile-based maternal feeding education program was not effective ($F = 0.23$, $p = .878$).

Conclusion

According to the results of this study, the mobile-based maternal feeding education program has the potential to contribute to overweight prevention in infants.

FULL TEXT

Introduction

Infancy is a developmental stage when the formation of feeding patterns and eating habits causing overweight in childhood [[1]]. In this regard, rapid weight gain might easily develop in infancy, and rapid weight gain during infancy is

significantly associated with the development of overweight and obesity in childhood after infancy [2]. In previous studies, overweight infants had 3.1-fold and 17.5-fold increased likelihood of overweight and obesity in preschool age and adolescence, respectively [3,4]. Therefore, infancy was considered to be a critical period for the early prevention of overweight and obesity in children [5]. In particular, as overweight in infancy resulted from excessive energy intake and overnutrition via feeding [5], Cloutier et al. [6] emphasized the need for a maternal feeding education program for overweight prevention in infancy.

According to a model for the development of an early childhood obesity prevention program, the maternal feeding education program for the prevention of excessive weight gain in infants might increase the maternal positive attitude and self-efficacy in breastfeeding and providing food to the infants by helping recognize and respond sensitively to the hunger and satiety cues of the infants [6]. Infantile feeding and eating patterns for the prevention of excessive weight gain were formed on the basis of the maternal feeding behaviors [6]. In existing family-based and parental programs for overweight prevention of infants, educational content has mainly focused on improving positive breastfeeding attitudes, breastfeeding self-efficacy, sensitivity to recognize hunger and satiety cues of infants, and knowledge about the correct solid foods to be given to infants [7–10]. Therefore, as an early life intervention for the prevention of overweight in infants, maternal feeding education programs should focus on addressing the key factors responsible for the formation of maternal feeding patterns.

According to previous studies, the maternal feeding education programs for the prevention of excessive weight gain of infants were mainly provided by postpartum home visits and face-to-face meetings [8–10]. However, in the Korean health care system, a postpartum home visiting program is not provided for parenting education and health care of mothers and their infants. In addition, Korean mothers traditionally limit contact with other people for approximately 3 months postpartum. Therefore, maternal education based on a home visiting program and face-to-face meetings might be inappropriate intervention strategies during postpartum periods in Korean society.

However, mobile-based parental education programs have been actively developed because most Korean people use smartphones [11,12]. Mobile websites might contain various educational contents, such as pictures, figures, and videos required for modeling a parental education program [13]. The success rates and satisfaction levels with the online education programs were high because of the availability of repeated learning and practice by frequently using mobile websites [13]. In addition, for mothers with newborns who cannot receive education at a fixed place and time [14], mobile-based education programs can prove to be highly user friendly, helping the mothers receive education at a place and time convenient for them.

Therefore, the purpose of this study was the development and evaluation of a mobile-based maternal feeding education program for the prevention of overweight in infants. We proposed the following hypothesis. The mothers who participated in the intervention would have an increased (1) positive breastfeeding attitude, (2) breastfeeding self-efficacy, (3) breastfeeding duration, (4) sensitivity to recognize hunger and satiety cues of their infants, and (5) knowledge regarding providing solid foods for overweight prevention in infants.

Methods Study design

A nonequivalent control group pretest-posttest design was used to test the effects of the mobile-based maternal feeding education program for overweight prevention in infants.

Participants

The participants of the study were first-time pregnant mothers with more than 36 weeks gestational age, recruited from two different obstetrics and gynecology clinics located in Daejeon (metro city), South Korea. We used a convenience sampling method to select the clinics and participants. From each of the clinics, participants for the experimental and control groups were selected according to the inclusion and exclusion criteria. The inclusion criteria were as follows: (1) mothers who gave consent to participate, (2) mothers who were primary caregivers of their infants, and (3) mothers of infants born after more than 37 weeks and weighing more than 2500g at birth. The exclusion criteria were as follows: (1) mothers with twin infants, (2) mothers of infants with congenital deformities (e.g., cleft palate) and other health issues related to feeding difficulties, and (3) mothers who had participated in other maternal feeding education programs for overweight prevention in infants within 1 year of this study.

Using the G-3.1.2 power program, 24 was the required sample size with a medium effect size of 0.25 [15], a significance level of 0.05, statistical power of 0.80, two groups, four measures, and two-way repeated-measures analysis of variance (ANOVA). When considering a 20% dropout rate similar to a previous study with mobile-based health education [11], 29 might be the appropriate number for the final sample size. From July to August 2019, 19 and 14 mothers for the experimental and control groups, respectively, were selected. After the pretest, four mothers in the experimental group refused to participate in this study because of increased burden of caring for infants. Thus, 15 mothers in the experimental group were involved in all follow-up tests. Among the 14 mothers in the control group, there were no dropouts during the study process (Figure 1).

Ethical consideration

All the procedures and methods of this study were approved by the institutional review board of the research institute at the Chungnam National University, where a researcher of this study was involved (Approval no. 201903-SB-034-01). The researcher and a trained research assistant explained the purpose, procedures, methods of the study, informed the participants that the participation was voluntary and they could leave the study at any stage, and that the study respected individual rights and all information collected from the participants would be used confidentially and only for this study. Written informed consent was obtained from all the participants. Approximately 20 US dollars (20,000 won in Korea) was provided at every stage of evaluation, including pretest and follow-up tests.

Measures

To verify homogeneity of characteristics in the experimental and control groups, characteristics of infants and mothers were evaluated with risk factors for overweight in infancy. Characteristics of infants involved sex (female or male), gestational age (weeks), birth weight (grams), and delivery type (vaginal delivery or cesarean section). In addition, maternal characteristics involved current age (years), marital status (married or other), educational level (high school, 2-year and 4-year college, or more than 4-year college), perceived current socioeconomic status of family (high, middle, or low), weight gain during pregnancy (kilograms), smoking experience during pregnancy (yes or no), diagnosed with diabetes mellitus during pregnancy (yes or no), and diagnosed or treated for depression by certified psychiatrist during pregnancy (yes or no).

To evaluate the effects of the mobile-based maternal feeding education program, breastfeeding attitude, breastfeeding self-efficacy, and breastfeeding duration were assessed. In addition, recognition of hunger and satiety cues of infants and knowledge regarding providing solid foods for overweight prevention in infants were assessed with the mothers.

Breastfeeding attitude

Breastfeeding attitude was assessed using the Iowa Infant Feeding Attitude Scale, originally developed by De la Mora and Russell [16] and translated and validated in Korean by Ra and Chae [17]. The instrument consisted of 17 items, and responses toward each item were available on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). Possible total scores ranged from 15 to 85 points, where a higher score indicates a more positive breastfeeding attitude. Cronbach's α is .86 in a study by De la Mora and Russell [16] and .72 in a study by Ra and Chae [17]. Cronbach's α in this study was .64–.82 according to the follow-up test of experimental and control groups.

Breastfeeding self-efficacy

Breastfeeding self-efficacy was assessed using the Breastfeeding Self-efficacy Scale-Short Form, originally developed by Dennis [18] and translated and validated in Korean by Ra and Chae [19]. The instrument consisted of 14 items, and response toward each item was available on a 5-point Likert scale (1 = *never confident* to 5 = *always confident*). Possible total scores ranged from 14 to 70 points, where a higher score indicated higher breastfeeding self-efficacy. Cronbach's α is .96 in a study by Dennis [18] and .94 in a study by Ra and Chae [19]. Cronbach's α in this study was .84–.92 according to the follow-up test of experimental and control groups.

Breastfeeding duration

Breastfeeding duration was assessed from a single question. Participants were asked to indicate for how many days they had breastfeed until 6 months (180 days) after childbirth.

Recognition of hunger and satiety cues by infants

Recognition of hunger and satiety cues by infants was assessed through four items of the Infant Feeding Questionnaire, originally developed by Baughcum [20] and translated and validated in Korean by Ra, Jeong, and Kim [21]. Response toward each item was available on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The mean score per item ranged from 1 to 5 points, where a higher score indicated increased recognition of hunger and satiety cues by infants. Cronbach's α is .70 in a study of Baughcum [20] and 75 in a study by Ra et al [21]. Cronbach's α in this study was .70–.85 according to follow-up test of experimental and control groups.

Knowledge regarding providing solid foods for overweight prevention in infants

Knowledge regarding providing solid foods for overweight prevention in infants was assessed with four items in the instrument, which evaluated infant feeding knowledge of mothers [22]. One correct response for each item scored 1 point, and higher score (ranged 0–4 points) indicated increased knowledge regarding providing the solid foods, which would not cause overweight in infants.

Intervention procedures

Development of mobile-based maternal feeding education program for overweight prevention of infants

Themes, subthemes, and content development of the education program

For the development of themes, subthemes, and the content of the education, a literature review was conducted. According to the review, maternal feeding behaviors associated with overweight in infants was formula feeding with/without breastfeeding [1,23]; regular feeding pattern in fixed schedules and overfeeding without considering hunger and satiety cues of infants [1,24]; early providing of solid foods (25]; and providing of sweet beverage, juices, and high calories snacks with solid foods [1,24]. Thus, breastfeeding, responsive feeding considering hunger and satiety cues of infants, and providing appropriate solid foods were categorized as the themes. In addition, according to the themes, the subthemes and the content were developed, which included textbooks, currently developed educational material that is open to the public, and educational articles (Table 1).

Then, five pediatricians and five professors in child health nursing confirmed the contents' validity. They suggested the need for educational content for understanding childhood overweight or obesity (e.g., causes, problems because of childhood overweight or obesity, and prevention methods). Consequently, themes, subthemes, and contents of education regarding childhood overweight or obesity were added. Finally, according to content validity from five pediatricians and five professors in child health nursing, the content validity index was calculated as 3.2–4.0 points.

Mobile website construction

For mobile website construction, the researcher developed storyboards including short and core subtitles, pictures, figures, and videos according to the contents. Also, narrations were developed for each storyboard. Pictures, figures, and videos were used from the web with the permission of the copyright holder. If permission was not provided for using of pictures, figures, and video, illustrations replaced them. A total of 58 storyboards were developed, with 53 containing educational content, two for instruction on the program, and three for summary and wrap-up. Three professors in child health nursing and one pediatrician confirmed the content validity of the storyboards and narration.

In initial meetings, two web designers and the researcher designed the web pages, including layout, background color, letter style and colors, and symbols according to the educational contents. Designed web pages were revised several times by the researcher and the web designers, and narration was finally recorded by a professional audiobook narrator for every web page.

Contents of mobile web were mainly categorized into three sections, including the introduction of the program, educational contents, and summary and wrap-up. In the introduction section of the program, the purpose of the program, using methods from the web, and the contact number of the researcher were presented. In the educational contents section, detailed education was provided according to the themes, subthemes, and educational content. Finally, in the summary and wrap-up section, summary and key points were presented according to the themes. Considering the attention span of 10–15 minutes in adults [26], all the educational content was provided within 10-minute blocks (4–9 minutes).

To make the website user friendly, icons representing the main three sections were placed on the homepage. In

addition, touch icons for accessing detailed educational contents were provided. To revisit the information, icons for returning to previous pages of the educational contents were provided. In addition, icons for narration were placed to assist repeated hearing of the narration. On every last page, icons representing the educational contents were placed for accessing the subthemes. In addition, on every last page, icons for asking questions and giving opinions were also provided according to the themes. The researcher and two research assistants with doctoral degrees in nursing managed the website and answered any questions and comments from the participants. The web address is https://www. Healthybaby. online.

Through a model operation with three professors in child health nursing, five registered nurses with more than five years of working experience in pediatric wards, two web designers, and five first-time mothers of infants, the benefits, accuracy, comprehension of the website components, functionality, purpose, interactivity, confidentiality, and reliability of the website were evaluated (4.5~4.9 points/5 points) [[11]].

Implementation and data collection

For the experimental group, the feeding education program for overweight prevention in infants was provided through mobile from 38 weeks gestation to 6 months after childbirth. To ensure better understanding and recall by repetition, the researcher and the research assistants encouraged the mothers to access the website at least once every 2 days, considering that memory from once accessed learning might be maintained up to 24 hours [[27]]. In addition, they confirmed the mothers' attendance every day and measured their access rates from the initial introduction section to the final summary and wrap-up section to guarantee completion of the entire educational content. For mothers who accessed the same educational contents for 3 days in a row and/or discontinued accessing the educational contents for 3 days, the researcher and research assistants sent text messages to encourage them to access the entire educational contents in the program.

Pamphlets containing information pertaining to basic cardiopulmonary life support for infants and prevention of sudden infant death syndrome were distributed to the control group participants. Using self-reported electronic questionnaires, data collection was conducted four times: before participation in the intervention and 1 month, 3 months, and 6 months after childbirth.

Statistical analysis

Statistical analysis was conducted using SPSS 24 version (IBM Corp., Armonk, NY, USA). Chi-square and independent *t*-tests were used for testing homogeneity characteristics of the participants and baseline breastfeeding attitude, breastfeeding self-efficacy, recognition of hunger and satiety cues of infants, and knowledge regarding providing solid foods for overweight prevention in infants between experimental and control groups, in the pretest. In addition, an independent *t*-test was conducted for comparing the mean values of breastfeeding duration until 6 months (180 days) after childbirth, between the experimental and control groups, in the final follow-up test (6 months after childbirth). A repeated-measures ANOVA was used to compare the changes in mean values of breastfeeding attitude, breastfeeding self-efficacy, recognition of hunger and satiety cues of infants, and knowledge regarding providing solid foods for overweight prevention in infants between the two groups in a pretest and three times in the follow-up test. A *p*-value p-value needed to be**Results Homogeneity of characteristics of infants and mothers and outcome variables between experimental and control groups**

There were no statistically significant differences in the characteristics (of infants and mothers) between the experimental and control groups ([Table 2]). In addition, in the pretest, there were no statically significant differences in breastfeeding attitude, breastfeeding self-efficacy, breastfeeding duration until 6 months (180 days) after childbirth, recognition of hunger and satiety cues of infants, and knowledge regarding providing solid foods for overweight prevention in infants between the two groups ([Table 3]) (See [Table 4]).

Effects of mobile-based maternal feeding education program for overweight prevention in infants

Regarding breastfeeding attitude, statistically significant differences were noticed across time points (F = 11.84, p F = 5.28, p = .008), although there was no significant between-group difference (F = 1.09, p = .305). According to the Bonferroni test, although breastfeeding attitude score at 1 month after childbirth was significantly lower compared with the baseline score (95% confidential interval [CI]: −4.80 to −1.96, p p p

Furthermore, for breastfeeding self-efficacy, statistically significant differences were noted between the groups (F = 5.34, p = .029) across time points (F = 5.64, p = .007) and interactions between the groups and times (F = 3.50, p = .041). According to the Bonferroni test, breastfeeding self-efficacy score at 1 month after childbirth was significantly lower when compared with the baseline score (95% CI: −4.61 to −0.75, p = .008). According to the Bonferroni test, breastfeeding self-efficacy score at 1 month after childbirth was significantly lower when compared with the baseline score (95% CI: −4.61 to −0.75, p = .008). However, the breastfeeding self-efficacy score significantly increased at 6 months after childbirth (95% CI: 2.17–7.04, p = .001) than the score at 1 month after childbirth. In addition, breastfeeding self-efficacy score at 6 months after childbirth increased significantly than the score at 3 months after childbirth (95% CI: 0.59–3.46, p = .008).

Regarding breastfeeding duration until 6 months (180 days) after birth, the mean breastfeeding duration of the experimental group (134.27 ± 46.75 days/180 days) significantly increased compared with the control group (94.36 ± 55.95 days/180 days; t = −2.09, p = .046).

With regard to recognition of hunger and satiety cues of infants, although there was a statistically significant difference across time points (F = 27.71, p F = 0.17, p = .685) and interaction between the groups and times (F = 0.23, p = .878). According to the Bonferroni test, the score of recognition of hunger and satiety cues of infants significantly increased from the baseline score after the intervention.

Regarding knowledge of providing solid food for overweight prevention in infants, statistically significant differences were noted across time points (F = 22.01, p F = 4.87, p = .009), although there was no significant difference between the groups (F = 3.31, p = .080). According to the Bonferroni test, knowledge scores regarding appropriate providing of solid foods at 1 month (95% CI: 0.36–1.00, p p p p p **Discussion**

This study identified the effects of a mobile-based maternal feeding education program developed for overweight prevention in infants. According to the results in this study, the experimental group showed significantly more positive breastfeeding attitude, higher breastfeeding self-efficacy, and increased breastfeeding duration than the control group. In previous maternal education programs using various educational materials including pamphlets and lectures [28,29], breastfeeding education had a significant effect on increased positive breastfeeding attitude, breastfeeding self-efficacy, breastfeeding practice, and longer breastfeeding duration.

According to a conceptual framework explaining maternal breastfeeding practice based on social cognitive theory [30], social support such as advice and educational programs from health care providers can improve knowledge, positive attitude, and self-efficacy toward breastfeeding, leading to increased breastfeeding behaviors. On the same lines, Meedya et al [31] also reported that breastfeeding attitude and self-efficacy were significant modifiable factors influencing breastfeeding intention and duration. In detail, as breastfeeding attitude was a strong predictor of feeding choice, the breastfeeding attitude had maximum effect on the breastfeeding intention of mothers [32]. In addition, maternal breastfeeding attitude was influenced by relationships with significant people in close social networks, including family members and health care providers [33]. In detail, hearing about the benefits of breastfeeding from various sources such as health care providers was associated with increased positive breastfeeding attitude, which led to improved breastfeeding intention [34]. Furthermore, as increased breastfeeding self-efficacy was significantly associated with longer breastfeeding duration for 6 months after childbirth [31], maternal breastfeeding self-efficacy was influenced by increased knowledge, positive breastfeeding attitudes, and social support such as guidance from health care providers that plays an important role in the onset and continuation of breastfeeding [33]. In this context, Parsa et al [35] emphasized the importance of social support for a more positive breastfeeding attitude and increased breast self-efficacy, leading to successful breastfeeding after childbirth. Therefore, the mobile-based maternal feeding education program might improve positive breastfeeding attitude and breastfeeding self-efficacy, which can lead to increased breastfeeding duration with high breastfeeding intention, by providing advice and knowledge regarding breastfeeding methods and benefits of breastfeeding, such as overweight prevention in infants. In particular, the intention to breastfeed by Korean mothers might be influenced by significant family members such as their mothers and mothers-in-law. This is in line with Korean culture, where, as in other Asian countries, parenting practices for young children tend to be followed with advice from grandparents [19]. However, Korean grandparent's

knowledge about breastfeeding was less than that of Korean mothers of infants and undergraduate students [36]. Therefore, the mobile-based maternal feeding education program will be helpful in improving breastfeeding attitudes and breastfeeding self-efficacy from increased accurate knowledge, which could lead to increased intention to breastfeed among Korean mothers.

In addition, the experimental group showed significantly increased knowledge regarding providing solid foods for overweight prevention in infants than the control group. According to a previous study, a video-based maternal feeding education for overweight prevention in infants was also effective for improving maternal infant feeding knowledge and behaviors [22]. As parents and primary caregivers, mothers are key people for structuring early feeding; according to the family ecological model, parental practices for obesity prevention of their children were determined by child and parental factors [37]. Among the parental factors, increased parental agreement on weight management of their children with high knowledge about behaviors to reduce obesity risk was a significant factor [37]. In this context, the mobile-based maternal feeding education program containing information regarding providing solid foods for overweight prevention in infants might contribute to maternal feeding practice by improving maternal agreement and behaviors.

However, regarding the improvement of recognition of hunger and satiety cues by infants, the mobile-based maternal feeding education program was not effective. To sensitively recognize the hunger and satiety cues, it is important that infants send clear cues to their mothers, and mothers should distinguish the characteristics of each cue and interpret them accurately [38].

Mothers should acquire the skills to recognize their infant's unique hunger and satiety cues expressed by body movement, facial expressions, and vocalization [39]. However, the mobile-based maternal feeding education program only included education about common and classic hunger and satiety cues. In addition, maternal recognition of their infant's hunger and satiety cues might be improved with high-quality interaction between mothers and infants, which is influenced by various factors, including socioeconomic status, environment, and perception of the infant's weight [39]. Therefore, to develop sensitive recognition of their infant's hunger and satiety cues, mothers might need repeated and varied experiences of interaction with their infants as well as knowledge-based education. In this context, the effectiveness of the mobile-based maternal feeding education program for providing information regarding hunger and satiety cues of infants might be limited.

The study had certain limitations. Owing to the small sample size, statistical power was insufficient. Participants were recruited from only two obstetrics and gynecology clinics located in a metro city. Therefore, further studies are needed with sufficient participants from multiple obstetrics and gynecology clinics from diversely populated urban and rural areas. Next, this study did not test the effects of mobile-based education against other educational material. Therefore, in future studies, which compare educational effects according to educational material, the effects of mobile-based education should be verified. Finally, this study did not confirm the effects related to adiposity of infants. Therefore, further studies might be required for test effects on adiposity of infants, with longer follow-up periods.

Conclusion

The results of this study showed that a mobile-based maternal feeding education program for overweight prevention in infants was effective in improving positive breastfeeding attitudes, breastfeeding self-efficacy, breastfeeding duration, and knowledge regarding providing appropriate solid foods to infants. Furthermore, mobile-based education is an extremely user-friendly method as mothers can access necessary information such as healthy maternal feeding practices without any physical contact and at a place and time convenient for them.

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Conflict of interest

The author declares that they have no conflict of interest.

Themes	Subthemes	Contents
Childhood overweight/obesity	1.Characteristics of childhood overweight/obesity	1)Characteristics of childhood overweight/obesity. (Increased number and size of fat cells)
2)The need for childhood overweight/obesity prevention in early life, including infancy.	2.Diagnosis of childhood overweight/obesity	1)Diagnostic criteria for childhood overweight/obesity.
2)Interpretation methods of children's weight status based on the developmental growth curve.	3.Causes of childhood overweight/obesity.	1)Causes of childhood overweight/obesity.
4.Problems associated with childhood overweight/obesity.	1)Physical, psychological, social health problems associated with childhood overweight/obesity.	Breastfeeding
1.Beneficial effects and methods of breastfeeding.	1)Beneficial effects of breastfeeding for growth and development in infancy.	2)Methods of breastfeeding initiation and maintaining and precautions for breastfeeding.
3)Postures for breastfeeding.	4)Methods to stop breastfeeding.	5)Understanding the satiety cues of breastfed infants.
2.Overweight prevention during breastfeeding in infancy.	1)Overweight prevention effects of breastfeeding, compared with formula feeding, and mixed feeding with formula feeding and breastfeeding.	2)Composition of breast milk for overweight prevention in infants.
3)Improving self-regulation ability via breastfeeding for the prevention of obesity in infants.	4)Overweight prevention effects based on breastfeeding duration.	Responsive feeding
1.Responsive feeding according to hunger and satiety cues of infants.	1)Overweight prevention effects of responsive feeding according to hunger and satiety cues.	2.Hunger and satiety cues.
1)Understanding of hunger cues in infants.	2)Understanding of satiety cues in infants.	3.Similar cues compared with hunger cues.
3)Causes associated with similar cues (crying and irritation) in comparison with hunger cues.	4.Caring according to causes of similar cues, in comparison with hunger cues.	4)Caring according to causes of similar cues (crying and irritation), in comparison with hunger cues.

Providing solid food	1.General methods and precautions for providing solid food.	1)Need for solid food and precautions related to providing solid food.
2)Methods for the provision of solid food according to age in months.	2.Providing solid food for overweight prevention in infants.	1)Significance of solid food for obesity prevention in infants.
2)Association between the early provision of solid food and overweight in infants.	3)Limiting food for overweight prevention in infants when providing solid food.	4)Methods of providing solid food for overweight prevention in infants.

Variables		Exp (n = 15) n (%)/M ± SD	Cont (n = 14) n (%)/M ± SD	t/χ^2	p
Infants' characteristics					
Sex	Boy	6 (40.0)	4 (28.6)	0.42	.518
Girl	9 (60.0)	10 (71.4)			Gestational age (wk)
	39.22 ± 1.22	39.04 ± 1.02	−0.44	.661	Birth weight (g)
	3,066.00 ± 264.60	3,080.93 ± 283.08	0.15	.884	Delivery type
Vaginal delivery	10 (66.7)	6 (42.9)	1.66	.198	Cesarean section
5 (33.3)	8 (57.1)			Maternal characteristics	

Current age (yr)		32.07 ± 4.15	31.14 ± 4.07	−0.69	.499
Marital status	Married	15 (100)	14 (100)		
Others	0 (0.0)	0 (0.0)			Educational level
High school,	0 (0.0)	2 (14.3)	3.19	.363	2-yr and 4-yr college
14 (93.3)	10 (71.4)			More than 4-yr college	1 (6.7)
2 (14.3)			Perceived current socioeconomic status of family	High	2 (13.3)
0 (0.0)	2.17	.338	Middle	11 (73.4)	11 (78.6)
		Low	2 (13.3)	3 (21.4)	
	Weight gain during pregnancy (kg)		10.94 ± 2.77	12.24 ± 4.19	0.99
.329	Smoking experience during pregnancy	Yes	0 (0.0)	0 (0.0)	
	No	15 (100)	14(100)		

Diagnosed or treated for diabetes mellitus during pregnancy	Yes	1 (6.7)	3 (21.4)	1.33	.249
No	14 (93.3)	11 (78.6)			Diagnosed or treated for depression during pregnancy
Yes	0 (0.0)	0 (0.0)			No

Variables	Exp (n = 15), M±SD	Cont (n = 14), M±SD	t	p
Breastfeeding attitude	57.20 ± 4.41	57.79 ± 2.91	0.43	.675
Breastfeeding self-efficacy	44.80 ± 6.99	41.50 ± 12.97	−0.86	.397
Recognition of hunger and satiety cues of infants	2.93 ± 0.40	2.89 ± 0.61	−0.21	.832
Knowledge regarding providing of solids foods	1.60 ± 0.63	1.93 ± 0.73	1.30	.205

Variables	Group	Before intervention	1 mo after child birth	3 mo after child birth	6 mo after child birth	Source	F/t	p
M±SD				Breastfeeding attitude	Exp. (n = 15)	57.20 ± 4.41	52.87 ± 3.23	60.20 ± 4.89

61.27 ± 5.13	Group	1.09	.305	Time	11.84	<.001	Cont. (n = 14)	57.79 ± 2.91
55.36 ± 2.27	57.14 ± 4.42	57.21 ± 4.12	Group × time	5.28	.008	Breastfeeding self-efficacy	Exp. (n = 15)	44.80 ± 6.99
43.87 ± 6.20	47.67 ± 7.10		Group	5.34	.029	Time	5.64	.007
Cont. (n = 14)	41.50 ± 12.97	37.07 ± 9.38	38.43 ± 11.45		Group × time	3.50	.041	Breastfeeding duration (over 180 d)
Exp. (n = 15)	-	-	-	134.27 ± 46.75		−2.09	.046	Cont. (n = 14)

-	-	-	94.36 ± 55.95				Recognition of hunger and satiety cues of infants	Exp. (n = 15)
2.93 ± 0.40	3.17 ± 0.34	3.38 ± 0.43	3.70 ± 0.34	Group	0.17	.685	Time	27.71
<.001	Cont. (n = 14)	2.89 ± 0.61	3.25 ± 0.61	3.43 ± 0.42	3.80 ± 0.32	Group × time	0.23	.878
Knowledge regarding appropriate providing of solids foods	Exp. (n = 15)	1.60 ± 0.63	2.60 ± 0.63	2.73 ± 0.59	3.20 ± 0.56	Group	3.31	.080
Time	22.01	<.001	Cont. (n = 14)	1.93 ± 0.73	2.29 ± 0.61	2.36 ± 0.50	2.50 ± 0.52	Group × time

DETAILS

Subject:	Overweight; Pregnancy; Likert scale; Childbirth &labor; Breastfeeding &lactation; Attitudes; Eating behavior; Prevention; Education; Gestational age; School dropout programs; Variance analysis; Obesity

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Personal Listening Device Use Habits, Listening Belief, and Perceived Change in Hearing Among Adolescents

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ABSTRACT (ENGLISH)

Purpose

This study aimed to identify personal listening device (PLD) usage habits, listening belief, and perceived change in hearing, and to investigate how the variables related to perceived change in hearing among adolescents.

Methods

The participants were 183 middle school students and 233 high school students from Ulsan. Data were collected by self-reported questionnaires from August 1, 2019, to October 22, 2019, and analyzed with descriptive statistics, $\chi 2$ test, Mann–Whitney *U* test, and hierarchical multiple logistic regression.

Results

Most students started to use PLDs from elementary school, and mean preferred listening level was 70.13 dB. Mean perceived susceptibility to music-induced hearing loss (MIHL) and perceived barriers to prevent MIHL were 5.18 and 3.40, respectively. Perceived change in hearing was reported on 14.2% of middle school students and 32.2% of high school students, and as the average score of perceived barriers to prevent MIHL increases by one point, the odds of decrease in hearing increase by 2.05 times ($p < .001$) and 1.35 times ($p < .05$), respectively.

Conclusion

Considering that most adolescents are exposed to PLD in elementary schools and about a quarter experienced a decrease in hearing after PLD use, educational programs on hearing conservation are required to start as early as in schools. Particularly, knowledge and skills to overcome barriers to prevent MIHL should be emphasized in educational programs.

FULL TEXT

Introduction

Noise-induced hearing loss is caused by damage to the inner ear sensory cells after prolonged exposure to noise environment [1], and as this damage begins to progress slowly, people do not recognize the hearing damage until a serious irreversible level is reached [2]. It has been mainly related to noise exposure to work, but in recent years, personal noise exposure has been increasing in leisure activities, and health concerns about it have increased [1]. Personal listening devices (PLDs) from cassette tapes to smartphones are major sources of noise during leisure activities [3]. More than 90% of Korean adolescents use mobile phones or smartphones [4], and 98.8% of them enjoy listening to music through the Internet, watching videos, and playing online games as leisure activities [5].

Hearing damage caused by noise is cumulative, so the longer the exposure time to noise, the greater the risk of hearing loss [6], as well as negative consequences impacting individual cognitive function, social well-being or quality of life, and academic achievement or employment opportunities [1,7]. Therefore, adolescents are thought to be especially vulnerable to noise and important period in their life to prevent hearing loss. Most adolescents expose to PLDs daily or several times per week for longer periods [8] and more than half of the PLDs users exceed the daily

noise limit [9], but most are unaware of the risk because the negative consequence occurs later [10]. According to a previous study, 17.0% of first-year Korean middle and high school students revealed hearing loss during their hearing screen test in 2016 [11]. Therefore, healthy listening behavior such as PLDs use of safe listening volume is very important for adolescents to prevent hearing loss.

Accordingly, the maximum permissible volume of portable sound systems has been newly amended as per the Noise and Vibration Control Act (Article 45-3) to limit the maximum volume to 100 dB [12], but the peak volume of PLDs released since 2014 was still measured over 100 dB [13,14]. The situation is similar in other countries. For example, in Canada, modern digital audio players tended to exceed the noise exposure limit because the measured maximum volume among modern digital audio players was from 101 to 107 dB [15]. That is, it is necessary but insufficient to enact regulations at the national level to prevent hearing loss among PLDs users. In particular, like most adolescents, although the peak volume levels of PLDs keep under the noise exposure limit, prolonged listening time cannot avoid the risk of hearing loss [16]. Fortunately, PLDs users can minimize the exposure level of noise by adjusting the volume or listening times voluntarily unlike occupational noise sources.

As the risk of hearing loss because of unhealthy listening behaviors with PLDs among adolescents is increasing, a few studies have identified the relationship between personal factors, PLDs usage habits, and hearing loss among adolescents. Besides listening volume [9], hearing loss during leisure activities including PLDs use has known to be related to ear diseases such as tinnitus [8] or ear infection [11], daily exposure time [3,17], exposure duration [18], and headphone use [11]. Recently, cognitive variables such as belief about listening volume (listening belief) have been considered as risk factors of PLDs usage habits. Health beliefs are well-known factors that influence health behaviors, and Health Belief Model [19] has been identified as particularly effective in explaining the relationship between health beliefs and preventative health behaviors [20]. Listening belief was measured using listening habits questionnaire developed according to Health Belief Model [19], and was shown the relation to the preferred listening level (PLL). Adolescents' PLL increased with increasing perceived barriers to prevent music-induced hearing loss (MIHL) and decreased with increasing perceived benefits of preventing MIHL. However, the relationship between listening belief and change in hearing among adolescents has not been reported in the previous study [21]. Even in Korea, the studies to investigate PLDs usage habits, listening belief, and their relation to change in hearing among adolescents are currently very limited.

Under the background, this study was aimed to identify PLDs usage habits, listening belief, and perceived change in hearing, and to investigate how the variables related to perceived change in hearing among adolescents in Korea. Meanwhile, high school students showed more PLDs users, longer listening time, and higher level of volume than middle school students did in previous studies in Korea [17,22]. Considering the differences in PLDs use characteristics according to school level, we tried subgroup analyses according to school level.

Methods Study participants

The participants of this cross-sectional study were first-year students at general middle and high schools in Ulsan, currently listening to music using their PLDs with earphones, who understood the purpose and method of this study, and agreed to participate in it by themselves and their parents. The students of the special purpose of schools and arts high schools were excluded due to different patterns of school life compared to those who attend the general schools. The sample size of this study was calculated using G·Power version 3.1.9.4 [23]. The significance level was set at (α) .05, statistical power at (1-β) .85, and the effect size at P_1 = .20, P_2 = .48, which is calculated from the previous study that analyzed the relationship between listening levels and hearing loss among 17-year-old Swedish adolescents [8]; the proportion of adolescents exposed to high-level noise above 85 dB was 20.0% in the normal hearing group and 48.0% in the hearing loss group. Likewise, according to a study [11], 17.0% of adolescents reported hearing loss during the Korean adolescent health screening test, and the ratio of the hearing loss group to the normal hearing group was considered to be 1:5. Within this condition, the minimal number of samples required was 167 (normal hearing group: 139; hearing loss group: 28), and considering the 25.0% dropout rate, 208 participants with an additional 42 participants were required. Participants in this study were separately sampled from middle schools and high schools, and this number comprised 2.0% of 10,148 first graders from middle school and

10,308 first graders from high school as of 2019 in Ulsan [24].

The participants were recruited with two stages stratified sampling; school level (middle vs. high) and gender (boy vs. girl). About 60 middle schools and 52 high schools, six middle schools (1 girls', 1 boys', and 4 coeducational schools), and seven high schools (1 girls', 1 boys', 3 coeducational, and 2 vocational schools) were agreed to participate in the study. One class was randomly selected from each school, and all students in the class were asked to participate in the study. Finally, 183 middle school students (93 boys and 90 girls) and 233 high school students (110 boys and 123 girls) were included in the study.

Study instruments

The tools for this study were a structured self-administered questionnaire composed of explanatory variables (general characteristics, PLDs usage habits, listening belief) and an outcome variable (perceived change in hearing). General characteristics included gender, school level, and history of ear diseases (tinnitus, ear pain, or ear infection) based on the previous studies [8,11]. PLDs usage habits included the number of PLDs, the first time that PLDs was used, the common place of PLDs use, type of earphones, listening days per week and listening hours per day, and PLL. The period of PLDs use was calculated from the difference between age and the first time PLDs were used. The type of earphones is presented with pictures of earphones, over the ear type, earbuds type, and in-ear type, and one selected type of earphone is usually used. The listening time per week was calculated as the product of listening days per week and listening hours per day, which were also presented with a picture of a 24-hour clock to minimize the recall bias. PLL was measured by asking to select their typical setting on the volume control from 1 to 15 steps while listening to the provided music, and the volume at the setting was converted to dB according to Min's [25] study. For measuring PLL, many researchers assessed it using a self-reported questionnaire because of difficulties while listening to music with earphones [11,26]. However, the validity of self-reported method for PLL measurements has not yet been established, and is unclear how well they reflect actual PLL [21]. Although the laboratory measurements using either a microphone-in-real-ear technique [27] or a technique using a manikin with an ear-simulating microphone [28] are more accurate and reliable than self-report measurements, we could not use those measurements because of lack of equipment. Instead, we additionally asked the participants to rate the preferred volume using a 10-point visual analog scale, when the maximum volume of their PLDs was assumed to be 10. For example, if a student usually listens to music at level 6 using a PLD with 12 levels of volume, he/she was asked to mark 5 on the scale. Both methods showed good agreement with .60–.70 of intraclass correlation coefficient [29]. As PLL was not met the normality assumption, in the analysis process, we classified it based on 70 dB (>70 dB and ≤70 dB), which means loud noise [30].

Listening belief was measured with Listening Habit Questionnaire [21]. After obtaining permission from the author, the researcher translated the questionnaire into Korean and two experts, a bilingual English teacher and a nursing professor, reviewed original and Korean translations to evaluate the validity of the translated tools and the appropriateness of words and phrases. After the first preliminary survey with five middle school students and five high school students who were not eligible for the research, the meaning of the Likert score was expressed in Korean to make it clear. Original listening habits questionnaire includes five variables and 26 items; four items of perceived susceptibility to MIHL, six items of perceived severity of MIHL, seven items of perceived benefits to prevent MIHL, four items of perceived barriers to prevent MIHL, and five items of perceived self-efficacy for taking action to prevent MIHL. Each item is a seven-point Likert scale from “Not at all (1 point)” to “Very much so (7 points),” indicating the higher the score, the higher perceived susceptibility, severity, benefits, barriers, and self-efficacy, respectively. The average score for each variable is calculated but not the total sum for all variables [21]. At the listening habits questionnaire development stage, the correlation between the listening level measured by a laboratory test and the self-reported measurement was from .31 to .68, and the Cronbach's α was from .81 to .89 [21]. In this study, Cronbach's α was .63 and .66 for perceived susceptibility, .86 and .92 for perceived severity, .85 and .85 for perceived benefits, .87 and .86 for perceived barriers, and .89 and .87 for perceived self-efficacy for middle school students, and high school students, respectively. After deleting item number 4 item, the Cronbach's α of perceived susceptibility were improved on .71 and .69, respectively. The values were almost recommended level [31

], so we measured perceived susceptibility with 3 items.

Perceived change in hearing was defined as “no change,” “slightly worse,” “worse” to the question, “After PLDs use, have you ever experienced any change in hearing ability?” In the analysis process, “slightly worse” and “worse” were classified as “decreased” (1), and “no change” was classified as “no change” (0).

Data collection

Data were collected from August 1, 2019, to October 22, 2019. The researcher visited the study schools in person and explained the purpose and method of this study to the principals and teachers and asked for cooperation. Schools participating in this study posted notices for recruitment on the first grade bulletin board and school health office bulletin board 1 week before the survey. Students who were willing to take part in the survey were provided with assent and consent forms from the school nurse, and then were asked to read the explanations with their parents at home and sign the consent form. Students who agreed to participate in the study visited the survey site (a school nurse's office or an empty classroom, which was provided by the school) on a prescribed date, submitted the consent form to the researcher, and completed the questionnaire. After completing the questionnaire, the student measured the listening level in the same place. To measure the PLL, the researcher provides in-ear earphones (QuietComfort® 20 of Bose Corporation, Framingham, USA) connected to the smartphone to the student and asked them to wear the earphones, and then while listening to music, Hyuk-Oh's Tom Boy, and asked the student to inform the student of the usually comfortable listening level with raising the level step by step according to student's response. During the measured listening level test, the range of background noise was from 45 to 53 dB, which was measured by a noise meter (TES-53S, Taiwan) within 50 cm of the student in a quiet environment. The collected survey and measured data were encrypted and stored in the locker storage box and the researcher's computer. The students who participated in this study were offered a small gift (school supplies).

Data analysis

The collected data were tested on both sides at significance level (α) .05 using the IBM SPSS win (version 26) program (IBM Corp., Armonk, NY, USA); the specific analysis method is as follows:

1. The variables in the study were analyzed by frequency and percentage or average and standard deviation, and were compared according to school level with χ^2 test and Mann–Whitney *U* test.

2. The relationship between explanatory variables and outcome variable was analyzed using the χ^2 test and Mann–Whitney *U* test according to school level.

3. Hierarchical multiple logistic regression analysis was conducted to identify the related factors of perceived change in hearing according to school level. Multicollinearity was assessed based on the correlation coefficient ≥ .85. Variables were entered into the model in a series of steps, and the order for entry was general characteristics, PLDs usage habits, and listening belief. The relationship between each variable and perceived change in hearing was determined by the odds ratio and 95% confidence intervals.

Ethical consideration

This study was approved by Pusan National University Institutional Review Board (Approval no. 2019-69-HR) and was conducted according to the criteria approved by the committee. Written informed assent and consent were obtained from all participants and their parents after informing them about the possibility of withdrawal from this study, and kept confidentiality of participants’ information.

Results Characteristics of the variables in the study according to school level

The results of analyzing the variables in the study are presented in Table 1. For middle school students, 73.8% of them have had a history of ear diseases, most of them have used a smartphone as PLDs and in-ear type of headphone, mean total period of PLDs use was 3.52 years, and mean listening time per week was 15.34 hours. Mean PLL was 70.57 dB and 31.7% of them showed greater than 70 dB. Mean perceived susceptibility and barriers was 5.02 and

3.02, respectively, and 14.2% of them showed a decrease in hearing after PLDs use. For high school students, 85.8% of them have had a history of ear diseases, most of them have used a smartphone as PLDs and in-ear type of headphone, mean total period of PLDs use was 6.26 years, and mean listening time per week was 20.14 hours. Mean PLL was 69.79 dB and 34.8% of them showed greater than 70 dB. Mean perceived susceptibility and barriers were 5.31 and 3.70, respectively, and 32.2% of them showed a decrease in hearing after PLDs use.

Therefore, middle school students showed a higher mean score of the perceived benefits (p = .036), perceived self-efficac p = .004), and lower perceived barriers (p p = .002), the period of PLDs used (p p p = .012), perceived susceptibility (p = .005), and perceived change in hearing (p **The relationship between explanatory variables perceived change in hearing**

The results of bivariate analysis between explanatory variables and perceived change in hearing are presented in Table 2. The perceived change in hearing was related to gender (p = .034), history of ear diseases (p = .027), period of PLDs use (p = .002), PLL (p = .029), perceived susceptibility (p = .008), perceived benefits (p = .011), perceived barriers (p p p = .048) and perceived barriers (p p = .022), perceived barriers (p p **The related factors to perceived change in hearing**

According to the results of multiple logistic regression in Table 3, the perceived change in hearing was influenced by perceived susceptibility, perceived severity, and perceived barriers. As the average score of perceived susceptibility and perceived barriers increases by one point, the odds of decrease in hearing increase by 1.83 times (p p p p

Discussion

Regarding the PLDs usage habits, the most common PLDs were smartphones, regardless of school level, which reflects the increase in the use of smartphones by teenagers [4]. Most participants started to use PLDs at grades 4–6 of elementary school, therefore, in order to establish healthy PLDs usage habits, appropriate hearing conservation programs should be initiated at least the first year of elementary school. Most adolescents spend about 2.5 hours a day on their PLDs on average, indicating an increase in listening time compared to a previous study [22]. This finding may be explained not only by improving the prolonged battery life of PLDs and large amount of PLDs' storage space [32], but also by a data collection method. That is, we presented a picture of a clock to collect data on the time spent listening to PLDs to minimize the memory bias of the participants and fluctuations by the day of the week for PLDs usage. For listening level, which is a pivotal factor for hearing loss [8], about a third of the middle and high school students selected more than 70 dB as PLL. However, considering that the PLL was measured in a quiet environment in this study, it is expected that most adolescents expose to loud noise level during daily life. The mean PLL in this study were lower than results from Malaysia adolescents using in-ear earphones [22]; and Israel girls with ear-bud earphones [10]. The difference among studies may reflect the actual listening level, but it might be related to the difference in earphone type. PLL decreased significantly as the location of the earphones was far from the eardrum, in the order of headphones, ear-bud earphones, and in-ear earphones [33].

Among the listening belief constructs, perceived severity showed the highest and perceived barriers were the lowest for both middle and high school students, which was the similar order to the previous study in the United States [21]. That is, adolescents strongly agree that hearing loss will make life uncomfortable. By school level, high school students showed higher perceived susceptibility, perceived barriers, as well as lower perceived benefits and perceived self-efficacy than middle school students. Students with severer hearing symptoms (ear pain, tinnitus, and hearing loss) are known to have more concern about their hearing and negative attitude toward the noise [34]. In this study, those who have a history of ear diseases and perceived change in hearing are higher in high school students than middle school students, which seems to be related higher perceived susceptibility in high school students. In addition, high school students became accustomed to loud levels of PLDs with prolonged use, but they have little

chances to learn how to prevent MIHL because of lack in educational programs on hearing conservation [35]. According to the serial mediation approach to Health Belief Model, those with exposure to campaign or education to prevent MIHL may perceive fewer barriers, those who perceive fewer barriers may perceive more benefits to prevent MIHL, and those who perceive more benefits may participate in healthy listening behaviors to prevent MIHL [36]. Meanwhile, this study participant felt more susceptible to MIHL than US adolescents in a Portnuff et al.'s study [21], which may be related to cultural difference. Adolescents in the United States expose more diverse noise sources not only music and leisure activities but also shooting/use of firearms and lawn mowing [37], and may feel less susceptible to hearing loss because of listening to music. However, considering the poor internal consistency of perceived susceptibility in this study, and small sample size (n = 26) in Portnuff et al.'s study [21], further studies are recommended to identify the consistency of the findings.

About one in four adolescents perceived change in hearing after PLDs use, which shows higher hearing impairment compared to the 15.6% of health examination in 2016 [11]. However, this study finding depends on the subjective responses, there may be information bias. By school level, high school students had twice as much perceived change in hearing as middle school students. Considering that mean PLL is similar in both groups, it is thought that high school students have been exposed to PLDs for a longer period than middle school students. Regardless of the school level, perceived change in hearing was consistently related to perceived barriers to MIHL. Those who perceive higher barriers to prevent MIHL showed a higher possibility to experience a decrease in hearing after PLDs use. Perceive barriers as one of the components of the Health Belief Model has been used to explain the relation to health behaviors [19,20], and it has been reported that perceived barriers to prevent MIHL is related to PLL in adolescents [21]. In a study with adolescents in Sweden, the barriers to prevent hearing loss can affect the hearing protective behaviors such as use of hearing protector devices [38]. In four meta-analyses assessing the relation between the constructs in the Health Belief Model and health behaviors, perceived barriers have consistently shown as one of the most powerful single related factors to preventive health behaviors [36], and also known to be a related factor to PLL among adolescents [21]. However, few studies have directly investigated the relationship between perceived barriers and a health problem such as hearing loss. As health behaviors are well known to be important to prevent health problems, we can assume that perceived barriers affect health behavior, which in turn affects health problem. That is, the higher adolescents perceive barriers to prevent MIHL, a the lower they do preventive health behaviors such as safe listening level or short-term listening to music, which may result in decrease in hearing. Therefore, hearing conservation programs should include educational interventions to inform them how to overcome the barriers to prevent MIHL. That is, when students were not sure about how to keep their listening level safe in noisy places, they can learn the knowledge and skills on how to overcome barriers through education and apply them in noisy places.

Meanwhile, perceived susceptibility also is one of the important factors of preventive health behaviors [36], and it is known that as the perceived susceptibility increases, the likelihood of taking preventive actions increases [19]. However, in this study, as perceived susceptibility increases, the likelihood of decrease in hearing increases, which is opposite to what we can expect based on the relationship between perceived barriers and change in hearing. This finding may be explained that adolescents who had a higher level of susceptibility to MIHL perceived the change in hearing well. Or, adolescents who have already experienced a decrease in hearing because of listening to loud music perceived the vulnerability to MIHL more than their counterparts [34,39].

Strength and limitations

To the best of our knowledge, studies to investigate PLDs usage habits, listening belief, and their relation to change in hearing among adolescents are currently very limited both domestically and abroad. In particular, this study was

the first attempt to measure listening belief using tools that are systematically developed based on the Health Belief Model [19,21] and how it related to perceived change in hearing among adolescents in Korea. And, as we tried to subgroup analysis by school level, these findings can provide basic data to understand their PLDs usage habits and prepare effective interventions for middle and school students. PLL was measured by selecting a volume setting during listening to music. This measurement may have more accurate than other subjective method using a 10-point visual analog scale that the participants experienced difficulties in using during pilot tests. However, this study has several limitations, and needs to have a careful approach in interpreting the results. First, as this study collected data by self-reported questionnaire, it was possible for them to respond in a positive direction. However, it may be minimized by explaining confidentiality during acquiring assent, and by answering a questionnaire individually in a quiet environment. Second, the listening time was intended to improve the accuracy of the answers by presenting a picture of a clock and displaying the time when listening to PLDs, but the risk of recall bias remains. In addition, the listening time per week was calculated as the product of listening days per week, and listening hours per day, which were measured the average amount of time spent listening to PLDs every day for the past week. Although the listening time of adolescents may be different between weekdays with school and weekends without school, we could not adjust this difference to measure the listening time per week. Third, PLL was measured subjectively and in a quiet environment where the background noise was from 45 to 53 dB. So PLL may be less accurate than objective measurements and the actual listening levels may be underestimated. Last, the participants recruited in one region have limitations in generalizability to adolescents in other regions. Last, as this study was performed by a cross-sectional design, it is hard to confirm the temporality and a causal relationship.

Clinical implications

Several interventions such as education, use of hearing protection, and noise control have been identified as components of hearing conservation programs in occupational settings, education is the first step and one of the most important parts of hearing conservation programs for adolescents [34]. Danhauer et al. [40] addressed a hearing conservation program such as hearing health and safe PLDs use for high school students and stated that it should be mandatory education during health classes to prevent hearing loss due to MP3s in the United States. However, considering that none of the contents of the high school health textbooks, developed after the 2015 revised curriculum in Korea, were related to hearing protection [35], the results of this study remind us of the need for hearing protection training for adolescents and are expected to help in preparing effective educational interventions.

Conclusion

The majority of adolescents are exposed to PLDs from their early teens and about a quarter experienced a decrease in hearing after PLDs use. In particular, high school students experience decrease in hearing twice more than middle school students. Therefore, educational programs on hearing conservation are required to start as early as in various levels of schools from elementary to high schools. Particularly, as adolescents with higher perceived barriers to prevent MIHL show higher likelihood of decrease in hearing, knowledge, and skills to overcome barriers should be emphasized in educational programs.

Conflict of interest

The authors declare no conflicts of interest.

Characteristics	Categories	n(%) or mean ± SD	X^2/Z^a	p

Total (n = 416)	Middle school students (n = 183)	High school Students (n = 233)	General characteristics			
Gender	Boys	203 (48.8)	93 (50.8)	110 (47.2)	0.53	.465
Girls	213 (51.2)	90 (49.2)	123 (52.8)			History of ear diseases
	335 (80.5)	135 (73.8)	200 (85.8)	9.52	.002	PLD use habits
Type of PLDs	Smartphone	404 (97.1)	179 (97.8)	225 (96.6)	0.57	.450
(multiple responses)	Laptop/Desktop	162 (38.9)	64 (35.0)	98 (42.1)	2.17	.141
	Tablet PC	69 (16.6)	32 (17.5)	37 (15.9)	0.19	.662
	MP3 player	24 (5.8)	13 (7.1)	11 (4.7)	1.07	.301
Number of PLDs	Mean ± SD	1.58 ± 0.66	1.57 ± 0.67	1.59 ± 0.66	−0.38	.713
First time to use PLDs	Before ES	32 (7.7)	11 (6.0)	21 (9.0)	17.75	<.001
	ES 1 to 3	160 (38.5)	75 (41.0)	85 (36.5)		
	ES 4 to 6	187 (44.9)	92 (50.3)	95 (40.8)		
	Middle school	37 (8.9)	5 (2.7)	32 (13.7)		
Period of PLDs use (years)	Mean ± SD	5.06 ± 2.48	3.52 ± 1.86	6.26 ± 2.22	−11.10	<.001

Place of PLDs use	On the road	238 (57.2)	98 (53.6)	140 (60.1)	1.79	.181
(multiple responses)	At school	93 (22.4)	21 (11.5)	72 (30.9)	22.28	<.001
	At home	367 (88.2)	162 (88.5)	205 (88.0)	0.03	.865
	Others	173 (41.6)	70 (38.3)	103 (44.2)	1.50	.221
Headphone type	In-ear	341 (82.0)	147 (80.3)	194 (83.3)	0.81	.666
	Over-ear	48 (11.5)	24 (13.1)	15 (6.4)		
	Earbud	27 (6.5)	12 (6.6)	24 (10.3)		
Listening time (hours per week)		18.00 ± 17.08	15.34 ± 14.92	20.14 ± 18.42	−2.50	.012
Preferred listening level	≤70	277 (66.6)	125 (68.3)	152 (65.2)	1.61	.448
(dB)[b]	>70, <85	114 (27.4)	50 (27.3)	64 (27.5)		
	≥85	25 (6.0)	8 (4.4)	17 (7.3)		
	Mean ± SD	70.13 ± 8.01	70.57 ± 6.55	69.79 ± 9.00	1.73	.083
Listening belief						
Perceived susceptibility to MIHL		5.18 ± 1.12	5.02 ± 1.15	5.31 ± 1.07	−2.78	.005
Perceived severity of MIHL		6.44 ± 0.86	6.44 ± 0.79	6.44 ± 0.91	−1.39	.165
Perceived benefit to prevent MIHL		5.86 ± 0.87	5.98 ± 0.82	5.77 ± 0.90	−2.10	.036
Perceived barriers to prevent MIHL		3.40 ± 1.52	3.02 ± 1.39	3.70 ± 1.54	−4.35	<.001

Perceived self-efficacy to prevent MIHL		5.48 ± 1.09	5.65 ± 1.02	5.34 ± 1.12	2.89	.004
Outcome variable						
Perceived change in hearing	No change	315 (75.7)	157 (85.8)	158 (67.8)	18.03	<.001
	Decreased	101 (24.3)	26 (14.2)	75 (32.2)		

Characteristics		Total (n = 416) n (%) or mean ± SD		X^2/Z^a	p	Middle school students (n = 183) n (%) or mean ± SD		X^2/Z^a	p	High school students (n = 233) n (%) or mean ± SD	X^2/Z^a	p
No change	Decreased	No change	Decreased	No change	Decreased	General characteristics						
Gender	Boys	163 (51.7)	40 (39.6)	4.51	.034	82 (52.2)	11 (42.3)	0.88	.349	81 (51.3)	29 (38.7)	3.24	.072
	Girls	152 (48.3)	61 (60.4)			75 (47.8)	15 (57.7)			77 (48.7)	46 (61.3)		
History of ear diseases		246 (78.1)	89 (88.1)	4.90	.027	113 (72.0)	22 (84.6)	1.84	.175	133 (84.2)	67 (89.3)	1.11	.292
PLDs use habits													

Number of PLDs	1.57 ± 0.66	1.64 ± 0.67	−1.10	.270	1.55 ± 0.66	1.73 ± 0.72	−1.28	.202	1.58 ± 0.66	1.61 ± 0.66	−0.41	.686
Period of PLDs use (yrars)	4.84 ± 2.49	5.72 ± 2.33	−3.09	.002	3.48 ± 1.91	3.77 ± 1.56	−0.84	.400	6.20 ± 2.25	6.40 ± 2.17	−0.68	.499
PLDs use on the road	174 (55.2)	64 (63.4)	2.06	.151	81 (51.6)	17 (65.4)	1.71	.192	93 (58.9)	47 (62.7)	0.31	.579
In-ear type headphone	255 (81.0)	86 (85.1)	0.91	.340	125 (79.6)	22 (84.6)	0.35	.553	130 (82.3)	64 (85.3)	0.34	.560
Listening time (h/wk)	17.21 ± 16.49	20.45 ± 18.69	−1.53	.126	14.36 ± 13.31	20.71 ± 21.37	−1.32	.187	20.04 ± 18.75	20.36 ± 17.82	−0.37	.709
Preferred listening level (dB)[b]	69.58 ± 7.67	71.85 ± 8.81	−2.19	.029	70.31 ± 6.37	72.10 ± 7.45	−1.17	.241	68.86 ± 8.74	71.76 ± 9.27	−2.29	.022
Listening beliefs												
Perceived susceptibility to MIHL	5.09 ± 1.17	5.47 ± 0.87	−2.66	.008	4.95 ± 1.19	5.45 ± 0.78	−1.98	.048	5.24 ± 1.14	5.47 ± 0.91	−1.30	.194

Perceived severity of MIHL	6.45 ± 0.90	6.41 ± 0.71	−1.60	.109	6.44 ± 0.83	6.44 ± 0.45	−1.23	.219	6.46 ± 0.98	6.40 ± 0.78	−1.47	.141
Perceived benefit to prevent MIHL	5.92 ± 0.89	5.69 ± 0.80	−2.54	.011	6.00 ± 0.87	5.85 ± 0.49	−1.44	.151	5.84 ± 0.91	5.63 ± 0.87	−1.66	.097
Perceived barriers to prevent MIHL	3.12 ± 1.49	4.26 ± 1.27	−6.49	<.001	2.85 ± 1.36	4.07 ± 1.10	−3.92	<.001	3.40 ± 1.55	4.33 ± 1.32	−4.27	<.001
Perceived self-efficacy to prevent MIHL	5.62 ± 1.05	5.03 ± 1.08	−4.55	<.001	5.69 ± 1.05	5.45 ± 0.82	−1.30	.194	5.55 ± 1.05	4.89 ± 1.13	−4.06	<.001

Characteristics	Total (n = 416) OR (95% CI)			Middle school students (n = 183) OR (95% CI)			High school students (n = 233) OR (95% CI)		
Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	Step 1	Step 2	Step 3	General characteristics
Boys	0.65 (0.41–1.02)	0.64 (0.40–1.03)	0.67 (0.40–1.12)	0.74 (0.32–1.74)	0.56 (0.20–1.55)	0.68 (0.23–2.03)	0.61 (0.35–1.07)	0.57 (0.32–1.01)	0.61 (0.33–1.14)
History of ear diseases	1.95 (1.00–3.79)*	1.73 (0.87–3.42)	1.41 (0.67–2.96)	2.01 (0.65–6.26)	1.85 (0.57–5.97)	1.74 (0.45–6.75)	1.52 (0.65–3.56)	1.51 (0.63–3.63)	1.30 (0.50–3.36)
PLDs use habits									

Number of PLDs		1.09 (0.77–1.54)	1.12 (0.76–1.63)		1.22 (0.65–2.27)	1.23 (0.62–2.43)		1.08 (0.70–1.67)	1.08 (0.68–1.71)
Period of PLDs use (yr)		1.11 (1.01–1.23)*	1.09 (0.98–1.22)		0.95 (0.73–1.24)	0.93 (0.69–1.26)		1.02 (0.89–1.16)	1.06 (0.92–1.23)
PLDs use on the road		1.18 (0.71–1.95)	1.19 (0.69–2.06)		1.50 (0.59–3.83)	1.51 (0.53–4.30)		1.19 (0.63–2.22)	1.12 (0.56–2.22)
In-ear type headphone		1.08 (0.57–2.08)	1.03 (0.51–2.08)		0.96 (0.27–3.36)	0.88 (0.22–3.63)		1.08 (0.49–2.38)	1.05 (0.45–2.44)
Listening time (h/wk)		1.00 (0.99–1.02)	1.00 (0.99–1.02)		1.02 (0.99–1.05)	1.02 (0.99–1.05)		0.99 (0.98–1.01)	1.00 (0.98–1.01)
Preferred listening levels (dB)[a]		1.03 (1.00–1.06)*	1.01 (0.98–1.05)		1.03 (0.96–1.11)	1.01 (0.94–1.08)		1.04 (1.01–1.07)*	1.02 (0.98–1.06)
Listening belief									
Perceived susceptibility to MIHL			1.83 (1.36–2.47)***			1.99 (1.15–3.45)*			1.65 (1.14–2.39)**
Perceived severity of MIHL			0.69 (0.48–0.98)*			0.67 (0.31–1.45)			0.73 (0.48–1.11)
Perceived benefit to prevent MIHL			0.88 (0.63–1.23)			0.82 (0.41–1.65)			0.94 (0.63–1.39)

Perceived barriers to prevent MIHL			1.58 (1.30–1.93)***			2.05 (1.37–3.01)***			1.35 (1.06–1.72)*
Perceived self-efficacy to prevent MIHL			0.77 (0.58–1.01)			0.95 (0.55–1.66)			0.70 (0.50–0.97)*
Nagelkerke R^2	.03	.08	.26	.02	.08	.28	.03	.06	.21

DETAILS

Subject:	Music; Smartphones; Ear diseases; Leisure; Hearing protection; Questionnaires; Variables; Girls; Tinnitus; Listening; Noise; Middle school students; Children &youth; Middle schools; Medical screening; Secondary schools; Secondary school students; Teenagers; Hearing loss
Business indexing term:	Subject: Smartphones
Identifier / keyword:	adolescent; auscultation; behavior; hearing loss
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Psychological Resilience of Second-Pregnancy Women in China: A Cross-sectional Study of Influencing Factors

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ABSTRACT (ENGLISH)

Purpose

The aim of the study was to evaluate the status of psychological resilience among women in their second pregnancy and to investigate the possible influencing factors.

Methods

A total of 275 women in their second pregnancy and who met the criteria were surveyed from two public hospitals in China from July 2018 to January 2019. The instruments included the General Self-designed Questionnaire, Connor–Davidson Resilience Scale, Social Support Rate Scale, and 36-item Pregnancy Stress Rating Scale.

Results
The total psychological resilience score of second-pregnancy women was relatively low. Multivariate regression analysis identified five factors associated with psychological resilience: intimacy with husbands, social support utilization, gender of the first child, high-risk pregnancy of the first child, and the stress caused by worrying about the health and safety of the mother and fetus.
Conclusion
Women in their second pregnancy represent a unique population, and their low psychological resilience score deserves attention. Identification of factors contributing to decreased psychological resilience may enable us to design prevention and intervention strategies and to deliver specific psychological supports to pregnant women at high risk of developing negative psychology.

FULL TEXT

DETAILS

Subject:	Parents &parenting; Physiology; Womens health; Maternal &child health; Social support; Stress; Mental disorders; Families &family life; Mental depression; Mental health; Pregnancy complications; Family structure; Pregnancy; Anxiety
Location:	China
Identifier / keyword:	factor analysis, statistical; pregnancy; psychology; resilience, psychological
Publication title:	Asian Nursing Research; Seoul
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The Adaptation of the Buddhist Death Acceptance Scale for Vietnamese Persons with Cancer

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ProQuest document link

ABSTRACT (ENGLISH)

Purpose

This study reports on selected psychometric properties of the adapted Buddhist Death Acceptance Scale (BDAS) for Vietnamese persons with cancer.

Methods

The original 13-item BDAS was developed based on Buddhist perspectives toward death and life and was translated from Thai into Vietnamese. Item content checking with five Vietnamese local experts suggested three items of the original BDAS were irrelevant in Vietnamese culture and hence should be excluded. Psychometric properties of the 10-item BDAS Vietnamese version were tested using a convenience sample of 193 Vietnamese Buddhists with cancer.

Results

The internal consistency coefficient of the scale was found to be 0.73. Exploratory factor analysis showed that the 10 items of the BDAS Vietnamese version constituted 2 factors, explaining 51.1% of the variance of death acceptance. The first factor was “acceptance of natural process of death” and the second was “preparing for death.” Both factors reflected explicitly Buddhist viewpoints toward death acceptance and were consistent with the original Thai BDAS.

However, although similar factors were found, some items in the Vietnamese BDAS did not load to same factors as in the Thai BDAS.

Conclusions

The BDAS Vietnamese version provides an initial suitable measurement for death acceptance among Vietnamese Buddhists. Its availability will enable cross-cultural research to investigate death acceptance among Buddhist patients with cancer in Vietnam. However, the differences in item loadings between the Thai and Vietnamese scales suggest that further conceptual and empirical works to refine the measurement are needed.

FULL TEXT

DETAILS

Subject:	Cancer; Patients; Buddhists; Quantitative psychology; Buddhism; Nurses; Death &dying
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Effects of Mind–Body Programs on Infertile Women: A Systematic Review and Meta-analysis of Randomized Controlled Trials

Ju-Young, Ha; Seon-Hwa Ban

ABSTRACT (ENGLISH)

summaryPurpose

This study was to systematically review randomized controlled trials and conduct a meta analysis. The results of randomized controlled trials were integrated and analyzed to assess the effects of mind-body programs on anxiety, depression, quality of life, and pregnancy rate in infertile women.

Methods

Using electronic databases (i.e., Research Information Sharing Service, Korean Studies Information Service System, Korean Medical Database, National Digital Science Library, Cochrane Library, PubMed, EMBASE, Cumulative Index to Nursing and Allied Health Literature, and PsycARTICLES), 10 of 2,259 studies were included for meta-analysis. To estimate the effect size, a meta-analysis of the studies was performed using RevMan 5.3.

Results

The mind–body program was effective in relieving anxiety [standardized mean difference (SMD) = −3.44; 95% confidence interval (CI) = −5.94, −0.95; p = .007; I2 = 69%] and depression (SMD = −5.79; 95% CI = −10.36, −1.22; p = .010; I2 = 86%). Furthermore, it was effective in enhancing the quality of life (SMD = 7.40; 95% CI = 2.92, 11.88; p = .001; I2 = 53%) and pregnancy rate (SMD = 2.06; 95% CI = 1.08, 3.95; p = .030; I2 = 73%). The mind–body program was found to relieve anxiety and depression in infertile women and improve their quality of life, thereby positively affecting the pregnancy rate.

Conclusion

The mind-body program was found to relieve anxiety and depression in infertile women and improve their quality of life, thereby positively affecting the pregnancy rate. The mind-body program needs to be considered to a wider audience for positive effects on emotions and pregnancy outcomes of infertile women.

FULL TEXT

Introduction

While 12.1% of 10,625 married women aged 15–49 years in Korea experienced infertility [1], the number of women diagnosed with infertility increased from 178,000 in 2007 to 198,000 in 2010 and 221,000 in 2016 [2]. In addition to the increase in the number of infertile women, the cost of medical treatment for infertility has more than doubled from 43.42 billion in 2017 to 115.03 billion in 2018 [3]. Despite the increase in the cost of infertility treatment, Korea has a low birth rate, with a total pregnancy rate of 0.92 in 2019 [4].

The emotions that infertile women experience include depression, anxiety, and stress [5], and the increase in these negative emotions can cause a threat to their quality of life [6]. In particular, infertility treatment is a major stressor, comparable with death in the family or divorce [7], and if the procedure fails, depression and anxiety increase to a higher level, remaining high even after 6 months of treatment [8]. Furthermore, because the stress and anxiety experienced by infertile women have a significant effect on their pregnancy rate after fertility treatment [9], it is necessary to take care of these negative emotions actively; this may contribute to enhancing their pregnancy rate.

To alleviate the negative emotions of infertile women and improve their quality of life, various psychosocial interventions have been conducted, including counseling interventions, focused educational interventions, and comprehensive educational programs [10]. The effects of these interventions on anxiety and depression, but not on women's pregnancy rates, were confirmed [10]. However, studies applying the mind–body program for infertile women such as those by Domar et al [11,12] have shown results with significant impact on improvement on pregnancy rate and alleviation of negative emotions. Since then, many countries such as Turkey, China, Iran, Brazil, and Israel are applying the mind–body program for treating infertile women. Mind–body interventions are defined as practices that focus on the interactions among the brain, mind, body, and behavior, with the intent to use the mind to affect physical functioning and promote overall health [13]. As per the National Center for Complementary and Integrative Health, it compasses a large group of therapies such as meditation, tai chi, yoga, and relaxation techniques (progressive relaxation, guided imagery, biofeedback, self-hypnosis, deep breathing exercises, and autogenic training) [14]. Hypnosis, meditation, yoga, biofeedback, tai chi, and visual imagery, which are included in the mind–body program, induce relaxation and enhance the mind's interaction with bodily function, which are considered to positively affect the cognitive, psychological, and physiological aspects in infertile women by causing relaxation in the relationship among the brain, mind, body, and behavior [15,16].

Hämmerli et al [17] conducted a meta-analysis by combining a total of 21 studies including cognitive behavioral therapy, mind–body intervention, counseling, education, and supportive therapy as psychosocial intervention and reported that these interventions did not have any significant effect on alleviation of negative emotions such as anxiety and depression [17]. On the other hand, Frederiksen et al [18] conducted a meta-analysis by combining a total of 39 studies including counseling, cognitive behavioral therapy, mind–body intervention; meditation, hypnosis, breathing, and muscle relaxation; psychoeducation, supportive therapy, and writing intervention as psychological intervention and reported that these interventions caused a significant effect on alleviation of negative emotions such as anxiety and depression, hence showing contrasting results [18] from those of the study by Hämmerli et al [17]. Moreover, both studies conducted by Hämmerli et al [17] and Frederiksen et al [18] targeted both infertile women and men and conducted an analysis by combining various types of psychosocial interventions apart from the mind–body program and also included not only randomized controlled trials (RCTs) but also non-RCTs for analysis. Recently, systematic literature reviews [19] about mind–body intervention for infertile women have been conducted, but as RCTs, non-RCTs, and uncontrolled trials were analyzed altogether, a strict control of confounding variables has not been implemented. In addition, as only the individual effect size of each study is suggested, grasping the synthesized effect size and difference of the studies included in the analysis is limited.

Therefore, this study defined the mind–body program as mediation that includes hypnosis, meditation, yoga, biofeedback, tai chi, and imagery, which have been mentioned in the definition of the mind–body program, or practices with confirmed relaxation effects such as relaxation and breathing techniques and qigong, and this study systematically reviewed RCTs in which mind–body programs were conducted for infertile women. Furthermore, a

meta-analysis was performed to assess the effects of mind–body programs on alleviating negative emotions such as anxiety and depression in infertile women and improving their quality of life, along with their effect on pregnancy rates in infertile women, which is expected to provide a basis for possible interventions for infertile women.
The specific objectives are as follows: (1) assess the effect of mind–body programs on anxiety, depression, and quality of life in infertile women and (2) assess the effect of mind–body programs on pregnancy rates in infertile women.

Methods

This is a systematic literature review and meta-analysis, wherein the results of RCTs are integrated and analyzed to investigate the effects of mind–body programs on anxiety, depression, quality of life, and pregnancy rate in infertile women.

Core questions

This study used a PICO-SD (Participants, Intervention, Comparison, Outcomes, Study Design) tool as follows: (1) Population (P), infertile women; (2) Intervention (I), mind–body programs [16,19] (i.e., interventions including meditation, yoga, relaxation and breathing techniques, tai chi, qigong, hypnosis, and biofeedback); (3) Comparison (C), no treatment control group or a placebo group or an alternative group; (4) Outcome (O), anxiety, depression, quality of life, and the pregnancy rate; and (5) Study Design (SD), RCTs.

Search strategy and study selection

Data search was conducted from January 1, 2020, to April 1, 2020, and data were collected for the purpose of analyzing the effectiveness of mind–body programs in infertile women. Using a search engine, domestic studies were searched in the following databases: Research Information Sharing Service, Korean Studies Information Service System, Korean Medical Database, and National Digital Science Library. In addition, entire journals were searched using the websites of nursing-related societies such as the Korean Society of Nursing Science, Korean Society of Adult Nursing, Korean Society of Women Health Nursing, and Korean Academy of Community Health Nursing. International studies were searched in the Cochrane Library, PubMed, EMBASE, Cumulative Index to Nursing and Allied Health Literature, and PsycARTICLES. Keyword selection and search included both medical subject headings (MeSH) and life science term indexes (EMBASE TREE; EMTREE). The target keywords included “Infertility” [MeSH], “Infertile women,” “infertile*,” “Sperm Injections,” “Intracytoplasmic” [MeSH], “ICSI,” “Intracytoplasmic sperm injection,” “Fertilization in Vitro” [MeSH], “IVF” “In vitro fertilization,” “Infertility treatment,” “Assisted reproductive technologies,” and “ART.” Intervention keywords included “Mind-body,” “Body-Mind-Sprit,” “Mindfulness,” “Mindful*,” “Yoga.” “Meditation,” “Relaxation,” “Psychological” [MeSH], “Psycho-social,” “Breathing,” “Tai chi,” “Qigong,” “Hypnosis,” and “Biofeedback.” Outcome variables included “Depression” [MeSH], “Depress*,” “Anxiety” [MeSH], “Anxiety,” “Stress,” “Emotion,” “Quality of life,” “Wellbeing,” “Psycho*,” “Psychia*,” and “Pregnancy rate” or “pregnant,” along with the AND connector for each subject. To search all the researched studies, there was no limit set for the research period, but the studies were limited to human participants, and the language was limited to Korean and English. For domestic studies, the keywords included “Infertility,” “In vitro fertilization,” “Body and mind treatment,” “Mindfulness,” “Yoga,” “Meditation,” “Depression,” “Anxiety,” “Stress,” “Quality of life,” “Well-being,” “Psychology,” and “Emotion.”
The inclusion criteria for the literature were as follows: (1) intervention studies conducted using a mind–body program for infertile women, (2) RCTs, and (3) studies published in English or Korean in a peer-reviewed journal. The exclusion criteria were as follows: (1) unpublished theses, (2) case studies, (3) literature reviews, and (4) pilot studies that were not followed by main studies.
In this study, articles were selected based on core questions and the inclusion and exclusion criteria listed previously. The selection process was described step by step using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart [20]. In the first search, 3,726 studies published in English were found in PubMed (619), Cochrane Library (82), Cumulative Index to Nursing and Allied Health Literature (2,943), and EMBASE (82), but Korean studies on the subject were not found, although searches were made in Research Information Sharing Service, National Digital Science Library, Korean Studies Information Service System, and

Korean Medical Database. In total, 1,467 duplicates were excluded through RefWorks, resulting in a total of 2,259 studies. Subsequently, after they were reviewed with a focus on the title and abstract based on the data inclusion and exclusion criteria, 1,745 studies whose topics were not appropriate for the research topic and 406 duplicated studies were excluded. After a careful reading of the full text of the article in detail, 91 studies and seven reviews did not meet the inclusion criteria, which led to the final inclusion of 10 studies (Figure 1).

Two researchers conducted data selection and review, and they also checked the results after their respective reviews. In case of disagreement between the researchers in this process, a research meeting was convened so that the study in question could be reviewed together.

Quality assessment of the selected studies

The quality of the selected studies was evaluated using a revised tool for assessing risk of bias (RoB) 2.0 (The Cochrane Collaboration, England, London) [21] (Figure 2). RoB 2.0 consists of five domains: “randomization process,” “deviations from intended interventions,” “missing outcome data,” “measurement of the outcome,” and “selection of the reported result,” which are evaluated as “low risk of bias,” “high risk of bias,” or “some concerns” [22]. Studies were graded as follows: (1) “low risk of bias” when a low risk of bias was determined for all domains, (2) “some concerns” if at least one domain was assessed as raising some concerns but not at high risk of bias for any single domain, or (3) “high risk of bias” when high risk of bias was reached for at least one domain or the study judgment included some concerns in multiple domains [22]. The evaluation of the quality of the selected studies was assessed independently by two researchers, and regarding the categories that were not in agreement, the relevant studies were evaluated together until a consensus was reached to draw a conclusion and entered into RevMan (The Cochrane Collaboration, England, London) to present the evaluation results for the risk [23].

Data analysis

The characteristics of the studies included in the systematic literature review were analyzed, and data were selected based on the author, the year of publication, the country of publication, the number of samples, the method used and number of interventions for experimental and comparative groups, and the outcome variables.

The effect size and homogeneity of the interventions in the selected studies were analyzed using RevMan 5.3 version of the Cochrane Collaboration. Heterogeneity for the main variables was tested using the Chi-square null hypothesis test. When I^2 is 0%, it means no heterogeneity; when I^2 is 30–60%, it means moderate heterogeneity, and when I^2 is ≥75%, it means high levels of heterogeneity [21]. In this study, quality of life with a heterogeneity of 0% was analyzed using a fixed-effects model. Variables with a heterogeneity of >60%, including anxiety, depression, and pregnancy rates, were analyzed using a random-effects model. A forest plot was used to confirm the direction of the effect and the confidence interval (CI), and the effect size of the result value was represented by standardized mean difference in case of continuous data such as anxiety, depression, and quality of life and by odds ratio, which is the ratio between the occurrence and nonoccurrence of specific events between groups, in case of binary data such as pregnancy rate. The statistical significance level for effect size was .05, and the CI was set at 95%. Fixed-effects and random-effects models were compared for each variable to conduct sensitivity analysis. Analysis was conducted to identify the differences in results, excluding studies with a large effect size or larger weights compared with other studies included in analysis. Finally, funnel plot analysis was used to examine publication bias to test the validity of the entire study. Egger's regression test was carried out to evaluate the relationship between the effect size and the standard error [24] to check the significance of asymmetry. Regarding the suspicion of publication bias, the trim-and-fill method [25] was used to reanalyze the method to verify its severity. It can eliminate nonsymmetric effect sizes from funnel plot analysis. Afterward, it fills the left and right sides of polled effect sizes symmetrically [25].

Results Characteristics of the selected studies

The characteristics of the studies are indicated in Table 1.

A total of 10 studies were included, and the countries wherein these were conducted are as follows: Israel, four (40%) studies; China, two (20%) studies; Iran, two (20%) studies; and Brazil and Taiwan, one (10%) study, each. The publication years of the studies are as follows: 2000–2010, four (40%) studies and 2010 onward, six (60%) studies. With regard to the number of samples, there were two studies (20%) with ≤100 participants, were six (60%)

studies with 100–200 participants, was one (10%) study with 200–300 participants, and was one (10%) study with >300 participants. In terms of the number of interventions, there were two (20%) studies with 14 interventions, four (40%) with 10 interventions, two (20%) with eight interventions, and two (20%) with four interventions. With regard to the forms of intervention provision, there were eight (80%) studies with groups and two (20%) with individuals. In the measurement variables, there were five (50%) studies on anxiety, four (40%) on depression, five (50%) on pregnancy rates, and two (20%) on quality of life. In all the ten studies, the control groups received routine care.

Quality assessment of the selected studies

The methodological quality evaluation of the ten studies using RoB 2.0 indicated seven (70%) studies that had a low risk of bias with an appropriate method of random assignment. Relevant information on the proper methods of random assignment was not identified in three (30%) studies. There were five (50%) studies in which the assignment order was concealed through sealed envelopes, random numbers, and computer programs, and for the remaining five studies (50%), the appropriateness could not be identified because no clear method was described for concealing the assignment order. All ten studies evaluated baseline differences between intervention groups, which did not matter in the randomization process. Based on the aforementioned results, five studies were evaluated as “low risk of bias” in the randomization process and five studies were evaluated as “some concerns.”

Regarding the area of “deviations from intended interventions,” none of the studies clearly indicated blinding of the research participants and researchers, and ten (100%) studies did not explicitly state the blinding of the participants and researchers. There were five (50%) studies that described the blinding of the result evaluator and five (50%) that did not clearly indicate the blinding of the evaluator.

It was not possible to determine whether blinding of participants, researchers, or evaluators affected the results owing to unclear blinding or whether bias occurred in the study. Based on the aforementioned results, all ten studies were evaluated as “some concerns” in “deviations from intended interventions.”

In the domain of “missing outcome data,” five studies showed no missing data and were evaluated accordingly as “low risk of bias,” and five studies were evaluated as “some concerns” because it was not possible to obtain clear information on whether data excluded from analysis such as missing data affected the existence of bias.

In terms of “measurement of the outcome,” methods of measuring the outcome were appropriate in all ten studies, and measurement or ascertainment of the outcome did not show any difference between intervention groups, which led to an evaluation of all ten studies as “low risk of bias.”

In terms of “selection of the reported result,” all ten studies were analyzed based on a prespecified analysis plan and evaluated as “low risk of bias.”

The overall risk of bias generally corresponds to the worst risk of bias in any of the domains [22]. Considering the aforementioned results together, all ten studies were evaluated as “some concerns” in terms of the overall risk of bias.

Effects of the mind–body program Effects of the mind–body program on anxiety

For five studies that reported anxiety in the experimental and control groups participating in the mind–body program, the homogeneity test showed Q (Chi-square) = 12.81, df = 4 (p = .010), and I^2 = 69%. The effect size of anxiety was −3.44 (95% CI: −5.94, −0.95), and the anxiety between the experimental group and the control group showed a statistically significant difference (Z = 2.70, p = .007).

Effects of mind–body programs on depression

Based on our examination of four studies reporting depression in the experimental and control groups participating in the mind–body program, the homogeneity test showed the following results: Q (Chi-square) = 21.30, df = 3 (p 2 = 86%. The effect size of depression was −5.79 (95% CI: −10.36, −1.22), and the difference in depression between the two groups was statistically significant (Z = 2.48, p = .010).

Effects of mind–body programs on quality of life

For two studies that reported the quality of life of the experimental and control groups participating in the mind–body program, the homogeneity test showed Q (Chi-square) = 2.13, df = 1 (p = .140), and I^2 = 53%. The effect size of quality of life was 7.40 (95% CI: 2.92, 11.88), and the quality of life between the two groups showed a statistically

significant difference (Z = 3.24, p = .001) (Figure 3).

Effects of mind–body programs on pregnancy rate

For five studies that reported the pregnancy rate of the experimental and control groups participating in mind–body programs, the homogeneity test showed Q (Chi-square) = 14.87, df = 4 (p = .005), and I^2 = 73%. The effective size of the pregnancy rate was 2.06 (95% CI: 1.08, 3.95), and there was a statistically significant difference between the experimental and control groups (Z = 2.19, p = .030).

Sensitivity analysis

Comparison of random-effects models that form the wider CI with a fixed-effects model to conduct sensitivity analysis revealed that the results of anxiety, depression, quality of life, and pregnancy rates showed no significant difference. The analysis was conducted with studies that analyzed anxiety except for the study by Chan (2006) [A2], with the largest weight among five studies. It showed that the effect size increased from −3.44 to −4.42, and the mind–body program was found to be significantly effective in relieving anxiety (p p = .008). Analysis except for that by Kalhori (2020) [A10], which had the largest effect among four studies that analyzed depression, showed that the effect size decreased from −5.79 to −3.58, and the mind–body program was significantly effective with regard to depression (p = .010). Analysis except for that by Domar (2000b) [A5], which had the largest effect among five studies that analyzed pregnancy rates, showed that the effect size decreased from 2.06 to 1.46, and the mind–body program was effective with regard to pregnancy rates (p = .040). It follows from this sensitivity analysis that the result of meta-analysis conducted in this study shows robustness (Figure 3).

Publication bias

Egger's regression test was conducted to objectively test the publication bias. The results showed that depression (p = .824) and the quality of life (p = .144) had no publication bias. However, anxiety (p = .009) and pregnancy rate (p = .003) posed the risk of publication bias. Therefore, the trim-and-fill method was carried out. Because three additional studies were added, the adjusted effect size of anxiety was −1.14 (95% CI: −1.92 to −0.37). The adjusted effect size of the pregnancy rate was 0.31 (95% CI: 0.11–0.52), while there was no additional study. The 95% CI for the adjusted effect size was statistically significant for both variables, so it can be interpreted that they were not errors that could affect the results of this study.

Discussion

A systematic review and meta-analysis were conducted to investigate the effects of mind–body programs on anxiety, depression, quality of life, and pregnancy rate in infertile women. Based on the results of systematic literature review, 10 RCT studies that were conducted in China, Taiwan, Iran, Israel, and Brazil were included in the analysis. At least one relaxation technique was confirmed to have been included in each program in all of the 10 selected studies, and the relaxation techniques used included meditation, breathing technique, tai chi exercise, hypnosis, biofeedback, yoga, and autogenic training. The most commonly included relaxation technique was meditation, and mindfulness meditation, in particular, was being used most commonly in intervention. Based on the evaluation of quality of the literature, explanations about concealment of allocation order and randomized allocation were not clear. Thus, evaluating the relevance of the concealment was often impossible, and explanation about blinding researchers and participants was also unclear, indicating the possibility of performance bias. Therefore, future RCT studies must deal with this aspect for improving the quality of the literature.

The results showed that mind–body programs were found to have a significant effect on anxiety, depression, quality of life, and pregnancy rate in infertile women. Regarding anxiety, mind–body programs selected for analysis in this study included relaxation techniques. These relaxation techniques were found to be effective in relieving anxiety in some meta-analyses [26,27] and also had a significant effect on anxiety in this study. Anxiety is a typical negative emotion in infertile women, and it persists until after pregnancy through successful *in vitro* fertilization [8]; hence, an intervention is needed because anxiety increases the chance of uterine artery resistance, leading to negative outcomes, such as childbirth with low birth weight [28]. Therefore, it is necessary to continuously provide a mind–body program that includes relaxation techniques from before pregnancy through pregnancy to relieve anxiety and bring about a positive pregnancy outcome in infertile women.

With regard to depression, the mind–body program is an integrated intervention that affects cognitive, emotional, and physiological factors; mindfulness meditation, which is included in the mind–body program, strengthens cognitive reappraisal [29], promoting the resolution of negative emotions such as depression [30]. Thus, it was found that mind–body programs reduced depression in infertile women. Depression is associated with proinflammatory conditions during pregnancy [31], and depression during pregnancy may increase the chances of preterm delivery [32]. Therefore, to maintain a physically healthy state during pregnancy and prevent high-risk delivery, it is necessary to provide a mind–body program that includes techniques such as mindfulness meditation so that pregnant women can actively use it to relieve their depression.

The results of this study confirm that mind–body programs implemented for infertile women are effective in improving their quality of life. In a meta-analysis wherein the effect of a mind–body program on quality of life in patients with Parkinson disease was assessed, it was found to have a significant effect on improving quality of life [33], similar to our results. In the study by Kim and Shin [34], in which a model of quality of life was developed for infertile women, depression was the most influential factor affecting the quality of life of infertile women [34]. Because this study showed a significant reduction in depression through mind–body programs, this effect might have positively affected their quality of life. However, there were very few studies in the literature selected in this study that measured quality of life as an outcome variable, and studies that measured quality of life using subjective well-being tools were included. Thus, future studies must investigate the effect of the mind–body program on the quality of life of infertile women.

The results of this study showed that mind–body programs have a significant effect on the actual pregnancy rate and subjective emotions such as anxiety, depression, and quality of life. The increase in depression in infertile women is associated with a low pregnancy rate [35]. Therefore, there is a significant difference in depression between women who are successful and those who are not after *in vitro* fertilization [36]. Relieving negative emotions seems to influence women's pregnancy rate. In addition, the quality of life of infertile women was found to be significantly related to the success rate of *in vitro* fertilization procedures [37], so the improvement of quality of life in infertile women through the mind–body program seems to have affected their pregnancy rate. However, in the literature included in the present study, it was difficult to identify the actual effects of anxiety, depression, and quality of life on pregnancy rate; therefore, there is a need for future studies in this area.

On the other hand, infertility is a highly sensitive issue depending on the cultural context. For Chinese women, maternal instinct plays an essential role in the awareness of self, social status, and identity [38]. In China, carrying on an ancestral name alongside the preference of sons still exists today [38]. Thus, it leads to pressuring women to hide infertility issues from others [39]. Infertile women in North America understand infertility as a secret stigma or an abnormal condition [40]. In Arabian culture, pregnancy is considered an essential task of women, which leads to a lot of pressure for women, thus causing them to want to hide infertility [41]. In addition, in Nigeria, infertility is considered to be entirely an issue of women [42]. Not only in the cultural context but also in developed countries and developing countries, infertility has different meanings. In developing countries, owing to their patriarchal family structures, not having children is considered to be largely an issue of women's social responsibility regardless of the cause of infertility, while the value and identity of women are threatened [43] and criticized [44]. This is due to the fact that children are directly related to the problem of financial survival in later years. Infertile couples end up not participating even in family gatherings or religious events [45]. In a comparative study of Austrian and Moslem immigrants who were diagnosed with polycystic ovarian syndrome, the female Moslem immigrants were reported to have a significantly higher psychological pressure about pregnancy than the Austrian immigrants [46]. Therefore, in developing and applying interventions for Korean infertile women, attention should also be paid to ensure that they are in line with the sociocultural characteristics of Korea.

This study is meaningful in that it has established a basis for interventions for infertile women by verifying the contradictory results of previous meta-analysis studies that have identified the effects of mind–body programs on anxiety and depression in infertile women and by identifying their effect on women's quality of life and pregnancy rates. However, it is difficult to determine the causality because there are not many RCT studies that have

conducted mind–body programs for infertile women. In addition, because none of the included studies were conducted in Korea, it is hard to make implication for Korean infertile women. However, because this study confirmed the significant effects of the mind–body program on anxiety, depression, quality of life, and pregnancy rate, it may be necessary to develop a mind–body program suitable for Korean culture and provide it to Korean infertile women. Therefore, it will be necessary to develop mind–body intervention programs for Korean infertile women and conduct RCT studies, examining the effects of the programs on their anxiety, depression, quality of life, and pregnancy rate, in future. Moreover, it will be beneficial to perform meta-analysis studies. In addition, based on the results of this study, improved quality of life and pregnancy rate for infertile women who visit infertility centers or public health centers are expected by providing medical treatment alongside the mind–body program, which includes meditation, relaxation and breathing, tai chi, yoga, and hypnosis. Consequently, it is expected to provide mind–body programs to infertile women who use infertility centers and public health centers and to test their effectiveness. Moreover, based on the results, they can be continuously used in clinical practice.

Conclusion

In the present study, the effects of the mind–body program on anxiety, depression, quality of life, and pregnancy rate in infertile women were found to have a significant effect on all outcome variables. As the effects of a mind–body program could be improved when participants with low physical and psychological risks actively participate, positive effects on pregnancy results and emotions of infertile women could occur if nurses at Korean health centers and infertility centers could provide a mind–body program using various relaxation techniques. Furthermore, this is expected to lead to reduced budget for government support for infertile couples' medical expenses, which dramatically increase annually, and a cost-efficient management of the issue.

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Conflict of interest

The authors declared no conflict of interest.

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None.

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Author, year, country	Group (n), mean age (yr)	Intervention	Format	Outcomes (tool)

Type of treatment	Number of sessions	Intervention duration (weeks)	Session duration (hours)	Abedi et al., 2016, Iran	Experimental group (30); control group (30)	Mindfulness-based program• Mindfulness meditation (eating, body scan, breathing)•Awareness (body, thought, feeling)	8

8	-	Group	Depression (GHQ28); anxiety (GHQ28)	Chan et al., 2006, China	Experimental group (69), age = 36; control group (115), age =	EBMS intervention •Tai chi exercises• Relaxation training (meditation, breathing technique)• Ancient Chinese philosophical writings• Education	4

					35		

4	3	Group	Anxiety (STAI); pregnancy rate	Chan et al., 2012, China	Experimental group (141), age = 34; control group (110), age	EBMS intervention •Relaxation training (breathing exercises, body scan, meditation) •Ancient Chinese philosophical writing• Group activities	4

					= 34	(singing, journal writing, drawing)	

4	3	Group	STAI (anxiety)	Domar et al., 2000a, Israel	Experimental group (20), age = 33; control group (14), age =	Mind–body program• Relaxation training• Cognitive restructuring• Emotional expression• Education (nutrition, exercise)	10

					35		

10	2	Group	Depression (BDI); anxiety (STAI)	Domar et al., 2000b, Israel	Experimental group (47), age = 33; control group (48), age =	Mind–body program• Relaxation training (meditation, progressive muscle relaxation, imagery, autogenic training)• Yoga• Cognitive restructu	10

					35	ring• Education (nutrition, exercise)	

10	2	Group	Pregnancy rate	Domar et al., 2011, Israel	Experimental group (46), age = 34; control group (51), age =	Mind–body program• Cognitive therapy• Relaxation training• Negative health behavior modification •Social support	10

					34		

10	-	Group	Pregnancy rate	Domar et al., 2015, Israel	Experimental group (70), age = 34; control group (59), age =	Cognitive coping relaxation intervention •Positive reappraisal• Relaxation training (diaphragmatic breathing, breath focus meditation, autog	14

					35	enic training)	

2	-	Individual	Anxiety (STAI); quality of life (FertiQol); pregnancy rate	Lee, 2003, Taiwan	Experimental group (64), age = 31; control group (68), age =	Nursing crisis intervention program.• Self-hypnosis• Muscle relaxation training• Cognitive behavioral counseling	14

					32		

7	-	Individual	Anxiety (STAI); depression (SDS)	Nery et al., 2018, Brazil	Experimental group (62), age = 37; control group (37), age =	Mindfulness-based program• Mindfulness meditation• Relaxation training (autogenic training, guided imagery, biofeedback)	10

					37		

10	2	Group	Depression (BDI); quality of life (PGWBI)	Kalhori et al., 2020, Iran	Experimental group (45), age = 30; control group (45), age =	Mindfulness-based program• Mindfulness meditation (breathing, body scan) •Awareness of breathing and body• Emphasizing the perceptio	8

					29	on of how to react to thoughts, feelings, and body sensations	

DETAILS

Subject:	Research; Womens health; Information services; In vitro fertilization; Intervention; Biofeedback; Pregnancy; Reproductive technologies; Infertility; Information sharing; Emotions; Yoga; Counseling; Quality of life; Medical databases; Hypnosis; Society; Clinical trials; Behavior modification; Meditation; Sperm; Libraries; Nursing; Meta-analysis; Anxiety
Business indexing term:	Subject: Information sharing
Company / organization:	Name: Cochrane Library; NAICS: 519210
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Document URL:	https://www.proquest.com/scholarly-journals/effects-mind-body-programs-on-infertile-women/docview/2532536990/se-2?accountid=211160

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Lived Experiences of Korean Young Adults After Heart Transplantation: A Phenomenological Approach

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ABSTRACT (ENGLISH)

Purpose

This study aimed to explore and describe the lived experience of young adult heart transplant recipients in Korea.

Methods

Fifteen young adult heart transplant recipients participated in this qualitative study. Data were collected from March to August 2019 through in-depth individual interviews and analyzed using Colaizzi's phenomenological method.

Results

Their experiences about the arduous journey of heart transplant surgery and life after surgery were captured in four themes: (1) unwelcome rebirth without vitality, (2) facing unreachable ordinary tasks in life, (3) lifestyle bordering between burdensome and self-valued, and (4) finding the true meaning of a newly given life.

Conclusion

Young adult heart transplant recipients struggled with the burdens of their health problems, which impacted their employment and relationships. The participants' lifelong challenges and psychological turbulence identified in this study provide guidance for health-care providers to understand this population.

FULL TEXT

Introduction

A heart transplant (HT) is the standard treatment for patients with end-stage heart failure. The cases of HT surgery are increasing in Korea owing to improved surgical techniques and immunosuppressive agents, legislation that recognizes brain death as death, and changes in the public's perception of brain death [1,2]. Over the last 10 years, the number of domestic HTs has increased more than 10 times [3].

In terms of age, the number of young adult recipients aged 19–34 years who have undergone HT has increased by approximately 15% over the past 5 years [3]. However, inadequate immunosuppression after transplantation still leads to complications including rejection, infections, malignancies, and chronic kidney disease, and maintaining a balanced immune status remains an important challenge [4]. As a result, HT recipients must take medication for their entire life to prevent rejection after transplantation and require comprehensive health care including infection prevention, lifestyle changes such as exercise and dietary improvements, and regular outpatient visits [5–7].

Studies have shown that HT recipients aged 60 years and older have low levels of negative emotions such as anxiety and depression, mental problems, and stress as well as high levels of social support, which suggests that they adjust well to their lives after HT [8,9]. However, studies have shown that younger recipients do not appear to adjust well after HT [10,11]. Recipients of an HT in their early adulthood experienced fatigue and lethargy owing to the side effects of immunosuppressive medications taken after the cardiac transplant, during the most active period of life [10].

In general, people in their young adult years are the healthiest and reach various social milestones such as marriage, childbirth, employment, and promotion. However, HT recipients do not fully experience these milestones because they are focused on their health [12]. For young people, HT is a major life challenge that causes difficulties in carrying out major life tasks and often requires adjustments in daily living.

Thus far, studies on HTs have mainly focused on the quality of life of the recipients [8], experience with the side effects of immunosuppressants [10], and medication adherence [13], and these studies have used quantitative methods to analyze these factors. Although previous studies have used qualitative methods to examine life experiences of HT recipients in their twenties [11] and older than 50 years [9,14], these studies failed to fully portray the life experiences including various social milestones such as marriage, childbirth, and employment of young adult HT recipients. Therefore, the purpose of this study was to explore and describe the lived experiences of young adult HT recipients.

Methods Study design

This study is a qualitative study using the phenomenological methodology proposed by Colaizzi [15] to understand the lived experiences of young adult HT recipients. The phenomenological methodology is a research method used to understand the meaning and essence of participants' experiences in a specific situation.

Setting and participants

Participants were HT recipients between the age of 19 and 34 years, which was defined as young adulthood [3,16]. Participants were selected as per specific criteria that included those who underwent HT surgery at least 3 months before the study, fully understood the purpose of the study, and voluntarily agreed to participate in the study. The exclusion criteria were those who could not communicate in in-depth interviews or had psychiatric diseases.

The participants were recruited from an outpatient HT clinic in a tertiary hospital in a city. The researchers approached patients in the clinic and determined whether each patient was eligible for the study or not. Those who were eligible and agreed to participate were explained in detail about the study, and informed consent was provided. In addition, more participants were recruited using a snowball technique, through which the participants introduced new patients to the study.

A total of 15 HT recipients participated in this study: seven women and eight men. In terms of diagnosis before HT, 12 patients had dilated cardiomyopathy, two patients had valve diseases, and one patient had congenital heart disease. The average postoperative period was 7.1 years (range: 1.6–13.7 years). The average age of participants at the time of the interview was 31.33 years (range: 25–34 years). Eleven participants were single, and four were married; eight participants were unemployed (Table 1).

Ethical considerations

This study was approved by the institutional review board of the Asan medical center, which the researcher is affiliated to (Approval no. 2019-0217). Before beginning the study, the researcher informed the participants about the purpose, procedures, goal, and plans for disseminating the results; thereafter, they provided written consent. Before the interview, the participants were informed that the interview would be recorded and were provided an accurate explanation of their confidentiality and the intended use of the collected data. Recorded data and transcribed manuscripts were used purely for research purposes and stored in a double-locked secured location. These were shredded and discarded after completion of the study.

Data collection

Having clinical experience as nurses in the cardiology and open-heart surgery units, the researchers had rich experience and knowledge about caring for HT recipients. In addition, the researchers are experts in qualitative research, and their works having been published in peer-reviewed journals. Considering the expertise in cardiology nursing and qualitative research methodology, we tried to elicit and illustrate the vivid experience of the participants as HT recipients.

We collected data from 15 participants from March 12 to August 31, 2019 (Table 1). We created the interview questions based on the previous literature [9,11] and clinical experience. After beginning with a basic question about the participant, the researchers asked semistructured questions such as “Please tell me about your lived experience of pre- and post- HT surgery,” to rule out potential researcher biases during the interview. The main questions were related to life before and after HT, changes in daily living or lifestyle, physical symptoms, current health status, the ways to overcome difficulties, any meaning derived from post-HT life, and so on. The types of interview questions ranged from general questions to specific ones, overall experience to personal ones, and factual observations to subjective inferences. The order of the questions varied to suit the natural flow of the interview (Table 2). Data collection for this qualitative study was conducted until no new information was obtained about a phenomenon, that is, when the content was saturated [17].

We conducted interviews at a time and place that was suitable for each participant. Interviews were conducted at a seminar room in the chosen hospital or a café selected by the participant. We conducted one in-depth interview with each participant individually. Each interview lasted approximately 60–90 minutes. All interviews were digitally recorded and then transcribed.

Data analysis

Following the phenomenological methodology suggested by Colaizzi [15], data collection and analysis were conducted simultaneously. First, to analyze the data, the participants' experiences were described, and we read the participants' descriptions several times to understand the flow of each experience. Second, we found meaningful statements from the participants and listed them. Third, we tried to discover what was hidden in each significant statement and formulated meanings. Fourth, similar meanings, subtopics, were classified, and the main concepts, derived from meaningful phrases and sentences, were identified to derive the final theme. Finally, we validated this study by asking the participants if the findings captured the essence of their experience. During the analysis, we received feedback from two participants.

Rigor of the research

To ensure the qualitative rigor of this study, we aimed to improve credibility, fittingness, auditability, and confirmability as per four evaluation criteria suggested by Sandelowski [18]. To secure credibility, the transcripts were checked for accuracy by comparing recorded interviews with transcripts. In addition, the interview transcripts were confirmed by each participant for precision. For fittingness, two clinical nurses in HT wards and one nursing professor reviewed the interview transcripts and confirmed the experience of the participants that possibly occurred. Third, to improve auditability, the entire process of the study was recorded in detail as audit trails. Finally, to maintain confirmability, we attempted to eliminate bias during the analysis process and held regular data analysis meetings and received feedback from each other.

Results

In this study, 21 meaning units were extracted from the interview data of 15 participants, and these statements were integrated into four themes and ten subthemes (Table 3). Four themes were derived as follows.

Theme 1: unwelcome rebirth without vitality

The young adult participants had difficulty breathing because of their nonfunctional hearts. After surgery, the participants did not feel any immediate changes except their breathing. However, the chest scars, appearance changes, fatigue, and lethargy due to immunosuppressants have deprived them of their vitality. The participants' recovery after HT did not meet their expectations, given that they are young adults in the prime of their lives. The participants were unaware that the way they dress, eat, and sleep was different from their peers and that their appearance and energy were different before the surgery.

Lower expectations from new life

Before surgery, the participants had some physical symptoms such as shortness of breath, inability to run, general fatigue, and so on. The participants believed that an HT would be a turning point that would change their lives forever without those symptoms. However, they were frustrated that their health did not improve as expected in terms of the level of vitality and continued symptoms.

Although they longed for an ordinary life after HT, they encountered new kinds of symptoms owing to HT surgery and immunosuppressants. They could not eat foods they wanted to or sleep comfortably because of the timing of administering immunosuppressants. Their expectations of being able to live as vigorously as normal people were not met. *"I thought there would be a reversal of life, but I was mistaken. At my age, heart transplants are really a challenge. It is hard to accept that you have to worry about your health when you need it most. I miss the daily routine of eating, wearing clothes that I wanted, and playing with others before the surgery."* (Participant 3 –female –25 years –single)

Incompatible with physical and emotional changes from drug side effects

The participants experienced side effects such as lethargy, acne, swelling, and hair loss caused by daily consumption of immunosuppressants, which were necessary to maintain their health after HT. The participants found it difficult to cope with large scars on the chest and changes in their appearance after surgery and found themselves withdrawn. *"I want to study or work more, but when I try, I get tired and I cannot concentrate. Do you know what it is like to feel your mind and body sinking below the surface? My whole being runs out of energy; therefore, it is hard to start a new job or make it persistent."* (Participant 4 –male –34 years –single) *"I also was a*

leader among my friends, but I think my personality changed a lot after surgery. After surgery, my face was getting bigger, and I was getting ugly and had hair loss, body swelling, scar on my chest, and especially acne on my face and back, so I cover my face with a mask when I go outside, or I do not go out." (Participant 15 –male –30 years –married)

Theme 2: facing unreachable ordinary tasks in life

The participants had a difficult time achieving life tasks smoothly such as relationships, employment, marriage, and childbirth. When they do meet their friends, they cannot drink or smoke, and they cannot eat any food between lunch and dinner so as to maintain an empty stomach for an evening immunosuppressant. In addition, the participants found it difficult to return to work because they felt they were not fully recovered. When they attempted to work, they were not successful. Even for participants with a job, they were unable to maintain economic stability.

Feeling of alienation in social relationships

The participants reported that many of their relationships had changed owing to their lifestyle changes, such as being unable to drink and smoke. After the transplant, friends were divided into two groups: those who understood them and those who did not. They complained that they could not meet with their friends because they had to take immunosuppressants at fixed times every day and had to fast for a period after dosing to maximize the drug's effectiveness.*"When I meet my friends, I have to eat, drink and play like other people, but after HT, I cannot drink alcohol and eat raw food like a sashimi. In addition, based on the time to take immunosuppressant, fasting time is required. Especially when I need to fast in the evening, it is very difficult to make an appointment with friends."* (Participant 6 –male –34 years –single)

High barrier to job switch

The participants reported that the hardest thing after HT was searching for a job. They needed enough recovery time—as little as 6 months to as much as 2 years—after cardiac surgery, which forced them to take a break from their preoperative career. This break in career resulted in a decrease in the participants' peer group. In particular, a male participant who received an HT at a young age had difficulty finding employment because of HT. Even if participants were lucky enough to obtain a job, they often reported unfair treatment or poor working conditions.*"I took a year off from work and it was not easy to get back to work. It is about two years since I got a transplant, so I feel better. It is nice to go back to my old job, but I am worried that my physical condition will change and I will need to change my job. It is hard for me to find a new job because I have to go to the hospital on a regular basis."* (Participant 9 –male –31 years –single)*"I did not go to the army and I got a transplant, so I was often rejected from employment. When I got a job, I began my work with a memorandum that I would not demand any compensation because of my health problems."* (Participant 5 –male –29 years –single

Ambivalence to marriage and childbirth

The female participants reported that they wanted to get married but could not afford it. The Korean culture associates marriage with childbearing, and some reported that their boyfriend's parents opposed to marrying a woman after an HT because of her risk of infertility. Many single female participants said that even if the HT had no significant effect on pregnancy, they were hesitant about marriage and childbirth owing to concerns about passing on the heart disease to their children.*"I have been broken several times so far. [My boyfriend's] parents were opposed to me because of my health condition …I want to get married and have children, but I cannot, so I have to give it up realistically. Even if I am married, I will worry about my child's health. If there is any chance of a genetic factor, I would give up getting married and having a child."* (Participant 10 –female –30 years –single)*"I want to have more children …there are few cases of childbirth in South Korea after transplant, and I think it is impossible to have more children without it threatening my life."* (Participant 13 –female –28 years –married)

At the same time, the male participants were less constrained than female participants in marriage and childbirth, and they experienced no real difficulties creating their own families.*"Luckily, I got a job, got married, and even had a baby. There are many young people around who have had a hard time with the transplant. Fortunately, I was less worried about pregnancy than women because I am a man."* (Participant 14 –male –34 years –married)

Theme 3: lifestyle bordering between burdensome and self-valued

The life participants gained after HT, somewhere between healthy living and being disabled, often confused the participants. Paradoxically, the participants reported that they felt both relief and fear. They felt relief that they were alive due to HT and fear that they might die unexpectedly despite their HT. Officially, disability is categorized into five levels [ranging from 1 (most severe) to 5 (mildest)], and Korea's HT recipients are diagnosed with having Disability Level 5. The participants wished to return to their normal lives after HT, but they struggled with their poor physical and mental condition.

Focusing on negative aspects

The participants pretend that they are enjoying life with their family and friends, but they know they are not like their friends. The participants envy ordinary lives such as getting a job, getting married, and raising children. They often feel worse now than before the transplant, and they have a hard time finding the way to live now. The participants reported that they were sad or depressed because they were unable to live a life similar to others. *"There is no job, no marriage, no hope, no fun in life. I feel like I live in a tunnel where there is no end every day. Others say I have a new life because I got a new heart, but I thought to myself sometimes it was better to die rather than live this difficult life. I think it is a shame now, but I have been taken to the emergency room after taking all the immunosuppressant at home, because I tried to commit suicide."* (Participant 1 –female –33 years –single)

The participants thought they were healthy after an HT but could not stop thinking about death. They reported trying to avoid thoughts of death, and some even became reluctant to attend funerals or visit hospitals. *"I am heart-transplanted and healthy, but waking up in the morning, I often feel anxious that today is my last day of living. Especially the days that I do not feel good, I am worrisome all day. My depressed feeling is passed on to my family and they feel sad too."* (Participant 14 –male –34 years –married)

Focusing on my own life

Over time, the participants recognized that they were physically and emotionally different from others and had to cope with reality. Moreover, the participants tried to focus on good things about their life after an HT and live positively. *"I hated being different from other people in my early twenties. I do not know why I was so obsessed with living like others. I feel that because I am making a living these days, I do not have to suffer from the gaze or social perspective of others."* (Participant 10 –female –30 years –single) *"Having an HT does not mean that I am disabled, so it is important that I lead my life actively with my own identity."* (Participant 7 –female –32 years –single)

Theme 4: finding the true meaning of a newly given life

The participants explained that the process of adapting back to their daily lives after an HT was complicated and difficult, but they are happy to breathe and live their lives. They reported that they had learned to value the small moments of happiness with their families, which they had overlooked before surgery. They recognized that because of someone else's unfortunate events, a person's heart was transplanted into them, and they wanted to appreciate that benefit. Furthermore, some of the participants wanted to provide a positive example for other patients undergoing the post-transplant adaptation process.

Recognizing the value of the family

The participants said that having a family to support them was significant for a successful recovery. The parents, husbands, wives, and children who had taken the participants for granted were grateful for their existence. Participants who created a new family after transplant reported feeling happiness as an unexpected gift. *"If I had not had a heart transplant, I would still live my life like a jerk, doing whatever I wanted to, drinking and smoking. The best thing about the transplant is that I became mature, got married, and had children, and now I have my family. Living happily with my family is the main reason why I live now."* (Participant 15 –male –30 years –married)

Being satisfied with the life given

The participants said they were fiercely competitive, such as in terms of money or honors, before the HT, but realized that without health, everything was meaningless. In addition, after an HT, they realized that they were satisfied with their lives. *"I always thought to be happy, you have to make a lot of money and have a better economic status. But now I know that it is best to live happily in the condition given to me instead of wasting my emotions on useless things."* (Participant 5 –male –29 years –single)

Taking a step further into a worthy life

Some participants said they wanted to be a mentor or role model for young transplant recipients who are struggling after transplantation, by learning how to live confidently despite discrimination and difficulty. *"There are many young people who are still struggling in the adaptation stage who are having difficulty with their identity, health and marriage. I want to be a role model to share my experience and encourage them. I want to live a valuable life and share the life I have been endowed with in some way."* (Participant 12 –male –29 years –single)

Discussion

This study explored the lived experiences of recipients of an HT at a young age and describes in detail how HT affects all aspects of their young adult life. Based on the 15 individual in-depth interviews, four themes have been identified: (1) unwelcome rebirth without vitality, (2) facing unreachable ordinary tasks in life, (3) lifestyle bordering between burdensome and self-valued, and (4) finding the true meaning of a newly given life.

Theme 1, "unwelcome rebirth without vitality," is contrary to the findings of previous studies [9], which also found participants' focusing on the joy of rebirth and expectation of a new life. Life satisfaction was reduced owing to lethargy, fatigue [10,19], and changes in appearance [20], which are typical side effects of continuous use of the immunosuppressant required to maintain new heart function after transplantation. As per a study by Massey et al. [21], young transplant recipients reported a 65% compliance rate for immunosuppressants, suggesting that the reason for lack of compliance may be due to these side effects.

The participants in this study were aware of the importance of immunosuppressants, which critically affected their life after transplant. Although the medication side effects are similar to those seen in previous studies [8–10], these participants, who are in their most energetic stage of life, were not satisfied with such effects, which may be tolerated better by older patients. For young adults, these side effects may be unacceptable and shocking [11,20,21], and thus, it is necessary to provide patients with information on the side effects of immunosuppressants and to observe and consult with them periodically. In particular, the degree of fatigue that interferes with daily life should be assessed, and effective intervention should be applied to help patients manage their fatigue [19]. In addition, multidisciplinary approaches are required in the pretransplantation and post-transplantation treatment process to minimize cosmetic changes such as acne and scars on the chest.

Concerning Theme 2, for young HT recipients in this study, many life tasks were unreachable for them. In fact, young adult recipients' happiness was closely related to timely achievement of their capacity, autonomy, and social and mental development [21–23]. Family members and close friends play important roles in supporting HT recipients. Interpersonal relationships facilitate coping with stress and promote an optimistic outlook [24,25]; in particular, a spouse has positive effects on the overall health of a transplant recipient, including survival advantage, medical compliance, management of comorbidities, and emotional support [26]. Therefore, the health-care provider needs to strengthen social support for young HT recipients to have hope in achieving their life tasks.

Most participants stated that employment was a very important goal, similar to the results of previous studies [11,27]. For health reasons, such as supporting their immune systems after HT, participants with high-stress or high-intensity jobs were forced to switch jobs [28]. The participants in this study learned to be satisfied with obtaining any kind of job, given the difficulties in job search and unfair treatment in the employment process.

In Korea, which has a traditional Confucian ideology [29], it is considered impossible to marry a sick woman who may not be able to give birth. Most female participants reported that marriage became difficult after surgery, given the childbirth issue. However, a previous study [30] on pregnancy and childbirth after a liver transplant showed that it was a life-threatening pregnancy, but through that difficult process, childbirth eventually led to life satisfaction by having a family. Deshpande et al. [31] found that successful pregnancy outcomes are possible among all organ transplant recipients. Nevertheless, potential fetal side effects such as premature birth and low birth weight delivery and recipient side effects such as hypertensive disorders and graft rejection [31,32] are expected; thus, patients should be monitored closely by their health-care providers to ensure a safe pregnancy. HT recipients can have successful pregnancies by maintaining a stable organ function via multidisciplinary care support.

Regarding Theme 3, the participants were found to have adjusted to a "lifestyle bordering between burdensome and

self-valued." This was a prominent problem in the early stages after transplantation. This is in contrast to findings that old-aged HT recipients have a positive outlook on life [8,9]. However, it is consistent with a previous study that found young adults were more isolated from their peers than older patients, resulting in less compliance with treatment [8,22].

This seems to be due to the uncertainty of life and their trauma of facing a fatal heart disease at a young age [11]. After a long wait, their HT was a miracle, but they continue to live in fear and under the shadow of the uncertainty of death [33]. Given their conflicting feelings, social support is necessary to help young adult HT recipients deal with negative emotions, and health-care providers should provide periodic counseling to allow them to express such emotions.

In a study by Waldron et al. [11], young adults were described as undergoing a life transition and that they yearned for "normal;" thus, they considered that they would return to normal life only when their social roles were properly achieved. Health identity in young adulthood is the driving force to endure life [11,23], so health-care providers and families should pay attention and help them to have an unshakable identity and positive attitude toward life.

For Theme 4, through trial and error and persevering despite difficulties, the participants accepted their new life, "finding the true meaning of a newly given life." Previous studies [8,34] on the quality of life of post-transplant recipients showed improved quality of life after transplantation, especially in terms of overall health, social functioning, and vitality. The findings of Theme 4 is consistent with a previous study [35] that HT recipients can achieve a satisfactory life by thinking positively, living in a stable family, and friendships, while avoiding strong negative emotions, overwork, and stress [24,35]. Therefore, HT recipients' physical and psychological well-being can be improved by following medical recommendations to protect the new heart and by promoting an optimistic attitude toward life.

Through this study, moving past the symbolic meaning that an HT is a gift of new life [9], young adult recipients have been able to expand their lives through their experience with fatal heart disease, rigorous procedures of transplantation, and medication side effects after surgery. They showed how they struggled through a series of stages to overcome difficulties [14]. However, most of the problems they face now have no fundamental solution, and they are living in a state of uncertainty without proper preparation for their future. Based on the findings of this study, health-care providers should have a deeper understanding of young adult HT recipients to provide tailored care before and after transplantation and effective interventions for adapting to life after transplantation.

Health-care providers need a multifaceted approach to help recipients accept and adapt to changes in life after HT. In particular, pre- and post-HT education needs to be developed to effectively manage the post-HT life. The education should comprise medication administration, information about appearance change, social relationship change, and infection control due to taking immunosuppressive drugs. In addition, health-care providers need to play an important role as information providers and active advisors to prevent young HT recipients from being dismissed as disabled and deprived of opportunities in their social life.

This study has several limitations. First, because this study's participants were enrolled from one tertiary hospital in a city, there should be caution for generalizability. Repetitive study on the given topic from different patient backgrounds is necessary. Second, the purpose of this study was to recruit young adult HT recipients; however, the results found that the post-HT duration varied from 1.6 years to 13.7 years. Further qualitative study is necessary to determine if there are any differences in the experience of HT based on the length of post-HT duration.

Conclusion

This study revealed young adult HT recipients' lived experiences within the Korean context. HT was a major challenge in young adult HT recipients' lives. HTs have hampered the completion of important life tasks, such as employment, marriage, and childbirth, and diminished their confidence in life. However, they gradually tried to embrace their new life rather than viewing themselves within the dichotomous norms of normal and abnormal. Furthermore, they felt gratitude for family and everyday moments and learned how to be satisfied in life. The results of this study will improve the understanding of young adult HT recipients and lay the groundwork for developing practical solutions to address employment and childbirth problems after transplantation.

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Conflict of interest

The authors declared no conflict of interest.

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No.	Gender	Age (years)	Diagnosis	Duration of transplantation (months)	Religion	Marital status	Education	Occupation	Main income
1	F	33	DCMP	132	Yes	Single	University	None	Pension
2	M	34	DCMP	18	Yes	Married	University	None	Parents
3	F	25	DCMP	60	Yes	Single	High school	None	Parents
4	M	34	DCMP	118	Yes	Single	University	None	Parents
5	M	29	Congenital	50	Yes	Single	High school	Insurance planner	Himself/herself
6	M	34	DCMP	164	None	Single	University	None	Parents
7	F	32	DCMP	75	None	Single	University	Service industry	Parents
8	F	34	DCMP	165	Yes	Single	University	None	Parents
9	M	31	DCMP	20	None	Single	University	None	Parents
10	F	30	DCMP	118	Yes	Single	University	None	Parents
11	F	29	DCMP	36	Yes	Single	University	Public officer	Himself/herself

12	M	29	Valve	85	None	Single	High school	Self-employed	Himself/herself
13	F	28	DCMP	30	None	Married	High school	Housewife	Spouse
14	M	34	DCMP	96	None	Married	University	Public officer	Himself/herself
15	M	30	Valve	110	None	Married	High school	Service industry	Himself/herself

Type	Questions
Opening	Please tell me about your lived experience of pre and post HT surgery.
Details	Do you have any changes in daily living or lifestyle?a)If so, what were those changes?b)How do you feel about those changes?Have you ever struggle with any physical or psychological difficulties?a)If so, what were they?b)How was your coping with difficulties?c)Has anyone been providing support resources?Have your relationships with your family, friends or spouse/lover changed after HT?a)If so, how have you coping with those changes?b)What kind of support resources would you want?Do you have happy or sad memorable experiences in your life after HT?a)If so, what were those experiences?b)How do you feel about those experiences?Do you have advantages or disadvantages in your life after HT?a)If so, what are they?b)How do these affect your life?Do you have current fears in your life?a)If so, please specify them.b)What is the ways to overcome the fears?Do you need any help to improve quality of your life?a)If so, what specific help do you need?What does HT mean to the young adult HT recipient?
Ending	Is there anything you would like to add?

Themes	Subthemes	Meaning units
Unwelcome rebirth without vitality	Lower expectations from new life	Frustration with an incomplete physical condition Longing for an ordinary life
Incompatible with physical and emotional changes from drug side effects	Lowered confidence due to appearance changes Feeling powerlessness with loss of vitality	Facing unreachable ordinary tasks in life

Feeling of alienation in social relationships	Burdens of having a limited lifestyle Having troubles in taking immunosuppressants regularly	High barrier to job switch
Disappointed with the unfavorable employment system Unfair employment opportunities due to HT history	Ambivalence to marriage and childbirth	Distress from indelible wound caused by people who oppose marriage Internal anguish on passing heart disease to children
Lifestyle bordering between burdensome and self-valued	Focusing on negative aspects	Obsession about being different from peers Feeling of being stuck in a tunnel of continued symptoms Constant fear of death
Focusing on my own life	Living a self-confident life without being dominated by others' presence Acceptance of life's changes	Finding the true meaning of a newly given life
Recognizing the value of the family	Family as a driving force of life Gratitude for the existence of the family	Being satisfied with the life given
Realizing the importance of health Awakened deeper happiness never felt before	Taking a step further into a worthy life	Wishing to be a role model of hope Getting to know the meaning of sharing

DETAILS

Subject:	Patients; Young adults; Data collection; Fatigue; Data analysis; Research methodology; Transplants &implants; Heart; Brain death; Surgery; Interviews; Cardiology; Qualitative research; Heart transplants
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Level of and Related Factors to Diabetes Awareness among Diabetic Adults by Gender: Based on Data from the Korean National Health and Nutrition Examination Survey

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ABSTRACT (ENGLISH)

Purpose

This study aimed to determine the level of awareness about diabetes mellitus (DM) and identify the associated factors among diabetic adults in Korea by sex, using data from most recent nationwide representative survey.

Methods

Secondary data analysis was conducted using data obtained from the Korean National Health and Nutrition Examination Survey VII (2016–2018). In total, 2,026 participants (1,049 men, 977 women) aged ≥30 years with DM were included. Data were analyzed using a complex sample analysis considering the combined sampling weight for 3 years. Odds ratios and 95% confidence intervals were calculated using stepwise multiple logistic regression analysis to identify the association between DM awareness (DA) and sociodemographic and health-related factors.

Results

Researchers observed that 60.2% of men and 68.4% of women had DA. DA levels in both men and women were higher in those who were older, less educated, had normal weight, had hypertension and/or dyslipidemia, and had a family history of DM than in their counterparts. Having undergone a health screening in the past 2 years was associated with DA levels in men, whereas glycated hemoglobin levels of 5.7–6.4% were associated with higher DA levels in women.

Conclusion

The level of DA is unsatisfactory. Although the DA level is slightly higher in women than in men, it needs to be improved regardless of gender. Most of the factors associated with DA levels are similar in both men and women. Nurses in the community setting should provide health education, conduct campaigns, and promote referral to medical services by targeting the high-risk groups with lower DA identified in this study.

FULL TEXT

Introduction

Diabetes mellitus (DM) is characterized by hyperglycemia owing to the loss or dysfunction of β-cells in the pancreas and causes long-term metabolic disorders and complications if not treated well [1]. According to the Korean National Health and Nutrition Examination Survey (KNHANES), the prevalence of DM in adults aged ≥30 years was 12.4% in 2017, which represents a significant increase from the value of 9.7% in 2007 [2]. The longer an individual has DM and uncontrolled blood sugar levels, the greater is the risk of vascular complications [3]. Therefore, it is important for people to monitor their blood sugar levels and initiate appropriate treatment based on a diagnosis by a physician as early as possible to reduce the risk of DM complications.

DM awareness (DA) is defined as the recognition of DM by being diagnosed with a doctor [2]; it influences DM treatment and control [4]. Unfortunately, there are few studies on DA in Korea, and one study using data from the National Sample Cohort Database of the National Health Insurance Service reported a DA level of 61.8% [5]. However, it is difficult to identify the current DA level, given that the data in the previous study were collected in 2013. The Korea Ministry of Health and Welfare continues to make efforts to increase the DA level as one of the strategies for preventing and managing cardiovascular diseases via public health centers [6], and the National Health Insurance system in Korea supports health screening every 2 years to promote early detection of various diseases including DM [7]; thus, the recent DA level may have changed from that in 2013. Moreover, although the cohort database used in the previous study is known to be representative and accurate, there was a difference in health screening participation rates by socioeconomic status, which may have increased the risk of selection bias [5]. Therefore, studies conducted using more representative data that are less affected by socioeconomic status are needed. In most studies on DA, including previous domestic studies, DM diagnosis was based only on fasting blood sugar levels [5,8–13]. Considering that the glycated hemoglobin (HbA1c) level is widely used for the diagnosis of DM [1], HbA1c and fasting blood sugar levels should be measured for the diagnosis of DM.

With regard to the factors associated with the DA level, socioeconomic factors such as age; gender; educational

level; current employment status; household income; health-related factors such as smoking status, physical activity, body mass index (BMI), hypertension, and dyslipidemia; and family history of DM have been investigated [5,8–13]. Some socioeconomic and health-related factors have shown inconsistent results or have been considered in limited studies. For example, some studies reported that the education level was related to the DA level [9,11,12], while some studies did not report this relationship [8,10,13]; some studies reported that the education level was not related to the DA level [5]. Most national and foreign studies have identified factors associated with the DA level regardless of sex [5,9–13], but it may be necessary to identify whether factors affecting the DA level differ by sex because some studies have reported that the DA level differs by sex [5,11,12]. Based on a literature review, we aimed to identify the DA level and factors associated with DA among Korean adults by gender, using data from most recent nationwide representative survey.

Methods Aims

This study aimed to evaluated the level of DA and identify the associated factors among Korean adults with DM, using data from the KNHANES VII (2016–2018), the most recent and Korea representative survey.

Participants

This study analyzed KNHANES VII data, which had been collected by the Korea Centers for Disease Control and Prevention from 2016 to 2018. The KNHANES is a biennial, nationwide cross-sectional survey that assesses the health and nutritional status of the general population in Korea [2]. The sample of KNHANES VII was selected using a two-stage stratified cluster sampling method for enumeration districts and households, and a health survey, health screening, and nutrition survey were conducted to appropriate household members. Among 31,689 members of the target population, total 24,269 participated in the KNHANES VII (2016-2018) survey (average response rate: 76.6%). The inclusion criteria for this study were as follows: no missing data for sampling weight, over the age of 30, those with DM, and no missing data for the variables associated with DA. DM was defined as satisfying at least one of the following three criteria, based on American Diabetes Association [1]: (1) self-reporting of history of diagnosed DM, (2) a fasting plasma glucose of ≥126 mg/dL, and (3) A1C of ≥6.5%. Total 2,026 participants (1,049 men, 977 women) met those inclusion criteria (Figure 1).

Variables and definitions

The variables in this study included the sociodemographic and health-related factors that have been reported to affect the DA level in previous studies [5,8–13], and the DA. Sociodemographic factors included gender, age, educational level, currently working, and household income. Collected data were reclassified based on the objectives of the study. Age was categorized as “30–39 years”, “40–49 years”, “50–59 years”, “60–69 years”, and “70 years or older”. However, due to the small sample size of “30–39 years” group, we incorporated “30–39 years” and “40–49 years” group to “30–49 years”. Educational level categories were “elementary school and below”, “middle school”, “high school”, and “college and above”. Currently working was categorized as “yes” or “no” based on the current employment status. Household income was categorized by quartile as “low” (less than 1 million won per month), “lower-middle” (between 1 million and 2 million won), “upper-middle” (between 2 million and 3 million won), and “high” (more than 3 million won).

Health-related factors included a health screening in the past two years, current drinking, current smoking, physical activity, BMI, comorbidity (hypertension, dyslipidemia), A1C level, and family history of DM. Current risk behaviors were defined in two stages. First, drinking and smoking were categorized as “never”, “former”, and “current” based on response to the survey question on drinking status or smoking status. Second, they were recategorized as “neither”, “drinking only”, “smoking only” and “both” based on whether or not they currently drink or smoke. Physical activity was categorized as “yes” or “no” based on “pa-aerobic” variable built by KNHANES team, which was defined as moderate intensity activity for at least two and half hours or high intensity activity for at least one hour 15 minutes, or combined activity a week [2]. BMI was calculated with the formula body weight (kg)/height^2 (m^2). Based on the classification of the Korean Society for the Study of Obesity [14], BMI was categorized as “underweight (BMI 1].

Family history of DM was defined as any of the parents or siblings' affirmative responded to the survey question on history of diagnosed DM. The DA was defined as the proportion of individuals who showed affirmative response to

the survey question on history of diagnosed DM among all individuals with DM [[5]].

Statistical analysis

The data were analyzed with SPSS 23.0 statistical software (IBM Corp., Armonk, NY, USA) using a complex sample analysis, and the combined sampling weight of two years was calculated by multiplying weight by the ratio of the number of survey units by year according to the KNHANES manual [[2]]. Statistical significance was set at *p* 15]. Meanwhile, a sensitivity analysis was done to check the robustness of the findings on the DA level and factors associated including those who were excluded because of missing in explanatory variables. That is, we compared the characteristics of between those who were included in this study and excluded because of missing in explanatory variables using χ^2 test, and all characteristics were significantly different each other except A1C among women (Supplementary Tables 1 and 2).

Ethical considerations

This study was conducted after receiving permission for the use of data from the website of the National Health and Nutrition Survey, and approval of exempt review (Approval no. 05-2019-053) from the Institutional Review Board of the Pusan National University Hospital.

Results Sociodemographic and health-related characteristics of the participants

Table 1 presents the sociodemographic and the health-related characteristics of the participants by gender in the KNHANES VII study. Among 1,049 men, mean age was 57.48 years, and most of them were educated above high school level (68.0%), and in the upper-middle and high income group (54.2%), had undergone a health screening within the past two years (73.5%), and 22.8% had history diagnosed hypertension and dyslipidemia. Among 977 women, mean age was 62.66 years, and 45.5% of them were elementary school and below, 40.1% were currently working, and 34.6% had history diagnosed hypertension and dyslipidemia. Men showed significantly different from women in characteristics except BMI, A1C level, and family history of DM.

The level of and factors associated with DA

The overall DA level was 63.7%, and significantly higher in women (68.4%) than in men (60.2%) (Table 1).

According to Table 2, the DA level in men was significantly different by age, educational level, currently working, household income, receiving health screening in the past two years, current drinking and smoking, BMI, comorbidity, and family history of DM. As a result of a multiple logistic regression analysis, the DA level was higher in men aged 50 years or older than in reference group under the age of 49 years, in men with elementary school and less (OR = 1.76), or high school (OR = 1.66) education than men with college and above education, in men with health screening in past two years than men without (OR = 1.89), with BMI of 22.9 or less than men with BMI of 25 or more (OR = 1.77), with either hypertension or dyslipidemia than without both of them, and with family history of DM than men without (OR = 2.23).

According to Table 3, the DA level in women was significantly different by age, educational level, currently working, BMI, comorbidity, A1C level and family history of DM. As a result of a multiple logistic regression analysis, the DA level was higher in women aged 70 years or older than in reference group under the age of 49 years (OR = 2.15), in women with elementary school and less than women with college level and above education (OR = 1.82), with BMI of 22.9 or less than women with BMI of 25 or more (OR = 1.70), with either hypertension or dyslipidemia than without both of them, with family history of DM than women without (OR = 1.91), and showed higher in women with A1C of 5.7-6.4% (OR = 2.63) than under 5.7%.

Sensitivity analyses

According to a sensitivity analysis, the DA level was 61.6% in men and 69.7% in women, and the factors associated with the DA level showed the similar trends to the results when using only those who met the inclusion criteria among both men and women. However, educational level was not significantly related with the DA level among women although those who were elementary school or less showed the highest level of DA (Supplementary Tables 3 and 4).

Discussion

DA is critical for the positive treatment and control of DM [[4]]. This study determined the DA level and identified factors associated with DA using data from a recent nationwide representative survey. The overall DA level in this

study was slightly improved compared to the value of 61.8% in a previous study conducted in Korea [5], but the DA level still needs improvement, especially in men. However, a direct comparison between the two findings should be made carefully considering the differences in data sources, inclusion criteria based on age, and definitions of DM.

The DA level was higher in women than in men in this study, which supports the findings of several previous studies performed in Korea [5], the Southern Cone of Latin America [8], and China [11]. Considering that the risk of complications is predicted to be high in men because the high prevalence of DM [5,16], the need to improve the DA level is more urgent in men than in women.

The DA level was associated with age, educational level, BMI, comorbidities such as hypertension and dyslipidemia, and a family history of DM in both men and women. Higher DA levels were seen in those who were older, especially those aged ≥50 years among men and ≥70 years among women; less educated; had normal weight (BMI ≤22.9 kg/m^2); had comorbidities such as hypertension and dyslipidemia; and had a family history of DM, regardless of sex. These findings have several implications. First, the DA level increased with age, as observed in many previous studies [5,8–13]. Elderly people are more concerned about their health conditions, more interested in health-promoting behaviors [17], and more willing to gain awareness of their medical conditions than younger people who are less aware of their health risks [13]. Among people in their 40s and those aged p Supplementary Table 5). As mentioned previously, because of the high DA level among those aged ≥70 years, it seems that the DA level was high in people with an elementary school or lower education level. Therefore, health education programs and campaigns about regular blood glucose tests and doctor consultation should be further emphasized among young adults and adults with a high level of education in Korea. Such health programs could be started in universities as a part of the health-related curriculum [13] or at workplaces as health promotion programs.

People with obesity (BMI ≥25 kg/m^2) are less likely to be aware of their hyperglycemic condition, which supports the findings of a previous study in Korea [5]. However, several studies on the DA level did not show a significant relationship between obesity and the DA level [11,13], and this difference may be related to the BMI criteria considered for classifying obesity. A BMI ≥25 kg/m^2 is considered to indicate obesity in Korea [14], but a BMI ≥28 or ≥30 kg/m^2 was considered to indicate obesity in previous studies in China [11] and Malaysia [13], respectively. Obesity is well known to be associated with DM [18–20]; thus, people with obesity should be aware of their hyperglycemic condition. However, people with obesity with a BMI ≥25 kg/m^2 was even lower than that of people with a BMI ≤22.9 kg/m^2 (normal weight), regardless of sex. Nurses should arrange “know my blood sugar level” time as a part of weight control programs for people with obesity and emphasize the importance of regular blood glucose tests and awareness of their hyperglycemic condition during the program.

People with hypertension or dyslipidemia showed above-average DA levels and were more likely to be aware of their hyperglycemic condition than people without these conditions, as observed in previous studies [9,10]. Considering that hypertension and dyslipidemia are well-known risk factors for DM [21,22] and that people at high risk of DM should be aware of their hyperglycemic condition, this finding is encouraging. However, only approximately 4 in 10 people without both hypertension and dyslipidemia were aware of their DM status, and thus, it is important to educate adults who do not have underlying diseases such as hypertension and dyslipidemia to be mindful of their health conditions and undergo regular health screening.

People with a family history of DM showed significantly higher DA levels regardless of gender, which is consistent with the findings of previous studies [5,11,13]. People with a family history of diseases perceive themselves to be more vulnerable and susceptible to diseases [23] and undergo screening more often than those without a family history of diseases [23], which may lead to an increase in disease awareness. To increase the level of DA among people with no family history of DM, efforts should be made to educate them that DM occurs in conjunction with genetic and environmental risk factors [24].

Having undergone health screening in the past 2 years was associated with the DA level only in men, while the HbA1c level was associated with the DA level only in women. As undergoing health checkups is known to lead to an increase in the DA level [25], the higher participation in health checkups in men than in women may have contributed to findings observed in this study. In 2017, the rate of participation in national health screening was 79.7% among

men, which was higher that the value of 77.2% among women [26]. Women with prediabetes (HbA1c levels of 5.7–6.4%) showed the highest DA level. Surprisingly, only two-thirds of women with HbA1c levels above 6.5% were aware of DM, which was not significantly different from that in those with a normal glycemic condition. As HbA1c is an index of long-term glycemic control [27], people with a high level of HbA1c are vulnerable to diabetic complications. Therefore, it is necessary to establish a system at the national level and to inform people through campaigns that dietary management and regular blood sugar tests are needed in the prediabetes stage.

Household income was not related to DA levels in both men and women. Findings on household income levels and DM have been inconsistent across studies: either a proportional relationship [9] or no relationship [10]. Findings from another study indicated that those with very low or very high household income levels showed higher DA levels than the others [13]. As people in Korea have more opportunities for checking their blood glucose levels every 2 years via a free health screening [28] or by visiting clinics or public health centers (levels can be assessed at a low cost under the National Health Insurance Program), they can be aware of their hyperglycemic condition regardless of their economic status. Smoking status, drinking status, and physical activity were not related to DA levels in both men and women. The results for the relationship between smoking status and DA levels were consistent with those of previous studies [8,11,13]. The results of the relationship between drinking status and DA levels were inconsistent in previous studies: no relationship [8] or negative correlation [11]. In addition, the results for the relationship between physical activity and DA levels were inconsistent in previous studies: no relationship [11,13] or the relation of high DA levels with low physical activity levels [8]. Therefore, it is necessary to further investigate the relationship between drinking status and physical activity and DA.

This study has several strengths. First, to the best of our knowledge, this is the first study to identify the level of DA and associated factors according to gender using the most recent nationwide community-based data in Korea and to show sex-specific findings. In particular, the KNHANES involved nationally representative data and was conducted using a standardized questionnaire in accordance with a standardized protocol by trained investigators, which increases the generalizability and validity of our findings. Second, we used both fasting blood glucose test results and HbA1c test results for selecting people with DM. DM in previous studies was defined based only on fasting blood glucose test results [5,8–13], even though HbA1c is widely used by healthcare professionals to diagnose DM [1]. Third, we confirmed the robustness of the findings through a sensitivity analysis including those who were excluded because of missing in explanatory variables. Therefore, the findings of this study may be applied to those aged ≥30 years with DM.

However, caution must be exercised when interpreting our results because of the following limitations: First, we could not use the data of the oral glucose tolerance test (OGTT) to select people with DM because it was not performed during the KNHANES. If OGTT data had been included, the number of patients with DM would most likely have been higher, which could affect the level of DA. Second, in this study, BMI was classified according to guidelines from the World Health Organization (in its publication, the Asia-Pacific Perspective) and the Korean Society for the Study of Obesity; therefore, caution should be exercised when generalizing these results to other populations, even to Westerners. Third, those who had missing values on explanatory variables (sociodemographic and health-related factors) among subjects aged ≥30 years with DM were excluded from this study. Finally, because this was a cross-sectional study, it may be necessary to conduct studies with longitudinal data to avoid reverse causation bias.

Conclusion

Approximately 60.2% of men and 68.4% of women aged ≥30 years with DM are aware of their DM status; these values need to be improved in both men and women. Except for two factors, namely, participation in health screening in the past 2 years and HbA1c levels, all factors associated with DA levels were similar in both men and women. The level of DA was particularly low in those aged ≤49 years, with a higher level of education, with obesity, and without both hypertension and dyslipidemia, regardless of sex. Therefore, nurses in the community setting should identify high-risk populations with lower DA levels based on the present study findings, provide health education and conduct campaigns using mass media and social networks, and promote the use of medical services

for people to become aware of their hyperglycemic condition.

Funding source

None.

Conflict of interest

The authors declared no conflict of interest.

Appendix A Supplementary data

The following is/are the Supplementary data to this article:**Multimedia component 1**Multimedia component 1

Appendix A Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anr.2021.01.003.

Characteristics		Men (N = 1,049)	Women (N = 977)	p
n (%)†	n (%)†	Age (yrs)	30–49	198(25.8)
123(15.4)	<.001	50–59	258(31.6)	202(25.8)
60–69	305(25.0)	278(24.8)	≥70	288(17.6)
374(34.0)	mean ± standard error	57.48 ± 0.44	62.66 ± 0.46	Educational level
Elementary school or less	234(16.9)	479(45.5)	<.001	Middle school
167(15.1)	164(15.9)	High school	353(35.3)	242(28.7)
College or higher	295(32.7)	92(9.9)	Currently working	Yes
699(73.7)	376(40.1)	<.001	Low	273(21.3)
384(35.9)	<.001	Household income (in quartile)	Lower-middle	271(24.5)
253(25.8)	Upper-middle	263(28.1)	190(21.2)	High

242(26.1)	150(17.1)	Ever health screening in past 2 yrs	Yes	770(73.5)
646(65.0)	.001	Current drinking and smoking	Neither	185(15.2)
526(50.9)	<.001	Drinking only	499(48.4)	421(46.1)
Smoking only	66(6.0)	8(1.0)	Both	299(30.4)
22(2.0)	Physical activity	Yes	413(41.8)	292(32.3)
<.001	Body mass index (kg/m^2)	≤22.9 (normal)	265(23.9)	236(23.4)
.360	23–24.9 (overweight)	267(25.0)	226(22.2)	≥25(obesity)
517(51.1)	515(54.4)	Comorbidity	Neither	383(40.4)
226(25.1)	<.001	Hypertension only	293(24.6)	238(22.5)
Dyslipidemia only	127(12.2)	165(17.8)	Both	246(22.8)
348(34.6)	Glycated hemoglobin (%)	<5.7 (normal)	54(4.8)	34(3.5)
.421	5.7–6.4 (prediabetes)	248(24.0)	240(25.2)	≥6.5 (diabetes)
747(71.2)	703(71.3)	Presence of family history of DM	Yes	416(42.9)
440(45.0)	.417	Awareness of DM	Yes	678(60.2)

Characteristics		DA (n = 678) n (%)†	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)	p
Age (yrs)	30–49	74(34.7)	1		1	
50–59	157(60.9)	2.92(1.94–4.39)	<.001	2.32(1.47–3.64)	<.001	60–69
223(73.0)	5.07(3.29–7.82)	<.001	4.14(2.44–7.02)	<.001	≥70	224(77.9)
6.61(4.24–10.31)	<.001	5.52(3.03–10.05)	<.001	Educational level	Elementary school or less	177(74.3)
3.33(2.22–4.90)	<.001	1.76(1.03–3.02)	.039	Middle school	123(69.5)	2.62(1.62–4.24)
<.001	1.63(0.92–2.90)	.097	High school	227(62.0)	1.87(1.31–2.67)	.001
1.66(1.08–2.54)	.020	College or higher	151(46.5)	1		1
	Currently working	Yes	422(56.7)	1		1
	No	256(70.0)	1.78(1.30–2.44)	<.001	0.96(0.63–1.46)	.861
Household income (in quartile)	Low	201(68.5)	1.59(1.07–2.38)	.023	0.92(0.54–1.57)	.750
Lower-middle	166(55.7)	0.92(0.62–1.36)	.673	0.72(0.44–1.16)	.174	Upper-middle
168(60.0)	1.10(0.73–1.66)	.660	1.14(0.72–1.79)	.575	High	143(57.7)

1		1		Ever health screening in past 2 yrs	Yes	523 (64.2)
1.87(1.36–2.55)	<.001	1.89(1.33–2.66)	<.001	No	155(49.0)	1
	1		Current drinking and smoking	Neither	139(70.5)	2.23(1.38–3.60)
.001	1.42(0.79–2.55)	.238	Drinking only	327(61.4)	1.48(1.05–2.09)	.025
1.09(0.74–1.60)	.666	Smoking only	45(65.9)	1.80(0.94–3.45)	.077	0.97(0.45–2.07)
.931	Both	167(51.8)	1		1	
Physical activity	Yes	255(59.4)	0.95(0.71–1.28)	.737		
No	423(60.7)	1				BMI (kg/m^2)
≤22.9 (normal)	187(68.1)	1.88(1.29–2.75)	.001	1.77(1.11–2.80)	.016	23–24.9 (overweight)
183(66.8)	1.78(1.22–2.60)	.003	1.37(0.89–2.11)	.156	≥25(obesity)	308 (53.2)
1		1		Comorbidity	Neither	172 (39.4)

1		1		Hypertension only	207(65.6)	2.93(2.02–4.26)
<.001	2.42(1.61–3.64)	<.001	Dyslipidemia only	103(81.9)	6.96(3.78–12.82)	<.001
6.57(3.32–13.00)	<.001	Both	196(79.2)	5.85(3.84–8.92)	<.001	5.87(3.74–9.22)
<.001	Glycated hemoglobin (%)	<5.7 (normal)	32(55.6)	1		
	5.7–6.4 (prediabetes)	150(55.9)	1.01(0.49–2.11)	.977		
≥6.5 (diabetes)	496(61.9)	1.30(0.67–2.50)	.436			Presence of family history of DM
Yes	296(64.7)	1.39(1.03–1.89)	.033	2.23(1.57–3.18)	<.001	No

Characteristics		DA (n = 684) n (%)[†]	Unadjusted OR (95% CI)	p	Adjusted OR (95% CI)	p
Age (yrs)	30–49	53(48.6)	1		1	
50–59	135(64.8)	1.94(1.15–3.27)	.013	1.27(0.69–2.34)	.444	60–69

200(70.3)	2.49(1.53–4.07)	<.001	1.31(0.67–2.56)	.432	≥70	296 (78.6)
3.88(2.32–6.47)	<.001	2.15(1.04–4.47)	.040	Educational level	Elementary school or less	367 (74.8)
2.56(1.51–4.34)	<.001	1.82(1.00–3.30)	.049	Middle school	119(69.6)	1.98(1.10–3.57)
.023	1.78(0.94–3.37)	.076	High school	151(62.5)	1.44(0.86–3.43)	.165
1.61(0.94–2.77)	.084	College or higher	47(53.6)	1		1
	Currently working	Yes	239(62.0)	1		1
	No	445(72.6)	1.63(1.20–2.22)	.002	1.35(0.94–1.92)	.102
Household income (in quartile)	Low	291(72.6)	1.49(0.93–2.38)	.101		
Lower-middle	179(67.3)	1.16(0.70–1.90)	.572			Upper-middle
124(65.9)	1.09(0.65–1.81)	.754			High	90(64.1)
1				Ever health screening in past 2 yrs	Yes	464 (70.9)
1.39(0.99–1.95)	.057			No	220(63.6)	1

			Current drinking and smoking	Neither	392(72.9)	1.39(0.41–4.68)
.598			Drinking only	270(63.0)	0.88(0.26–2.94)	.833
		Smoking only	6(85.2)	2.96(0.36–24.13)	.310	
	Both	16(66.0)	1			
Physical activity	Yes	205(70.2)	1.14(0.80–1.62)	.465		
No	479(67.5)	1				BMI (kg/m^2)
≤22.9 (normal)	177(71.6)	1.37(0.92–2.03)	.124	1.70(1.08–2.66)	.022	23–24.9 (overweight)
169(73.5)	1.51(1.02–2.23)	.039	1.55(0.97–2.48)	.069	≥25(obesity)	338(64.8)
1		1		Comorbidity	Neither	106(45.2)
1		1		Hypertension only	177(74.6)	3.55(2.26–5.57)
<.001	2.98(1.77–5.02)	<.001	Dyslipidemia only	132(80.4)	4.95(2.92–8.38)	<.001

4.94(2.86–8.54)	<.001	Both	269(75.0)	3.62(2.46–5.33)	<.001	3.25(2.05–5.17)
<.001	Glycated hemoglobin(%)	<5.7 (normal)	18(51.1)	1		1
	5.7–6.4 (prediabetes)	184(75.2)	2.90(1.21–6.96)	.017	2.63(1.02–6.82)	.046
≥6.5 (diabetes)	482(66.8)	1.92(0.86–4.30)	.111	2.18(0.93–5.13)	.074	Presence of family history of DM
Yes	332(73.7)	1.58(1.15–2.17)	.005	1.91(1.33–2.74)	<.001	No

DETAILS

Subject:	Comorbidity; Sample size; Diabetes; Womens health; Socioeconomic factors; Family medical history; Regression analysis; Body mass index; Gender; Hypertension; Sociodemographics; Nutrition; Variables; Family income; Medical screening; Fasting; Households; Health insurance
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Development and Validation of the Happiness Scale for Middle-Aged Women Based on Existence, Relation, and Growth Theory

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ABSTRACT (ENGLISH)

Purpose

This study aimed at developing a happiness assessment scale for middle-aged women (HAS-MW) in Korea.

Methods

Preliminary items for the scale were drafted from the results of literature review and personal interviews and open-ended questions with women in the community. The interviews were based on the theory of existence, relatedness, and growth. After validating a preliminary scale, we analyzed the validity and reliability of the new scale items, and model fit. We surveyed 600 women aged 40 years to 64 years for exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Valid data were divided into 352 for EFA and 174 for CFA by multiplies of number 1 to 3.

Results

Using exploratory and confirmatory factor analyses, we extracted four primary factors—self-value, positive thinking, self-care, and family relationship—and with a total of 24 items for HAS-MW. The fit of the final model was evaluated as good showing $\chi 2/df = 2.10$, goodness of fit index = .80, comparative fit index = .85, root mean square error of approximation = .08, standardized root mean residual = .05. The HAS-MW had a significant positive correlation with the Oxford Happiness scale and showed a significant negative correlation with the Hwa-Byeong Scale. Cronbach's α for the new scale was .91, and the Spearman-Brown half coefficient was .93. The new scale used a five-point Likert scale with higher scores indicating greater happiness.

Conclusion

The HAS-MW is a reliable and valid one. It can be used to measure the level of happiness for middle-aged women. In addition, it might be applied to find low women and to evaluate the effect of intervention program related to happiness in woman of middle age.

FULL TEXT

Introduction

Women in middle age (approximately 40–64 years old) may face emotional crises, feeling psychologically low or worthless as menopause lowers estrogen levels [1]. However, it is also the period when they mature by looking back on their lives. Furthermore, middle-aged women's happiness also affects their families [2,3], as many enjoy sharing time with others with the clear perspective of those with accumulated experiences. Thus, middle age can be interpreted as the pinnacle of a new direction, not a downward curve in life. This period of adulthood can be made happy by actively embracing various internal and external changes and maintaining a positive balance in life [2,4].

The Korean Dictionary defines happiness as “a state of pleasure and contentment in life” [5]. The concept of happiness has three common yet diverse characteristics. First, it is subjective; second, it reflects active and positive aspects of life; finally, it involves an overall assessment of life [6]. The Subjective Happiness Scale measures overall subjective happiness based on the respondent's perspective [7]. Individuals' definitions of “happiness” may vary. Some may judge happiness in the moment; others may answer looking back on a year or their whole life. Thus, it is difficult to measure individual happiness with a simple question [8].

In addition, culture influences “happiness” conceptualization [9], as Westerners emphasize intrapersonal or internal experiences, whereas Chinese culture emphasizes the interpersonal or external. Furthermore, it is not certain that subjective well-being constitutes all the dimensions of happiness in Korean culture, such as positive relationships with others, self-acceptance, family identity, personal growth, love, academic concern, life purpose, responsibility for one's own life, sense of purpose, life goals or mission, health, and financial success [6].

The theoretical definition for happiness is “physical comfort and emotional pleasure related to satisfying personal needs in a specific social and cultural environment” [9]. It depends on personal characteristics and cognitive evaluation of the external situation. Furthermore, achievement of life goals means ultimate self-realization and

meaningful outcomes in human relationships [10]. Among the happiness-related theories, such as Maslow's hierarchy of needs, self-determination theory, modernization and freedom of choice, and positive psychology, Alderfer condensed 3 dimension of the Existence, Relatedness, Growth (ERG) theory [11] from Maslow's 5 needs [12]. Specifically, existence needs include all material and physiological desires. Relatedness needs encompass social and external esteem; relationships with significant others such as family, friends, coworkers, and employers. Growth needs internal esteem and self-actualization; these impel a person to make creative or productive effects on himself and the environment. This ERG theory supports individual specific objectives depend on the uniqueness of each person ultimately [11]. The Happiness Index for Korean that renamed the Korean Happy Life Inventory [6] did not include the continuous interaction between women and the surrounding environment. A happiness assessment scale for middle-aged women (HAS-MW) in Korea should include internal external needs and the continuous interaction with surrounding environment to understand happiness for middle-aged women.

The next important factor to objectively measure happiness is the criteria for “happiness.” These criteria depend on the economic, political, social, and cultural environments to which individuals belong [13] that lead to their perception of happiness [14]. Happiness has a positive effect on many parts of our lives. In particular, the happiness of middle-aged women is a subjective perception affecting not only their own lives but also their families and communities [3]. The use of abstract happiness as a measurement criterion requires an objectively measurable indicator (or something interpreted as an objective indicator) [15]. A scale for measuring happiness must reflect the subject's characteristics to ensure the subjective measurement method is valid and reliable. However, the only tool for measuring the happiness of middle-aged Korean was developed for all adults, regardless of gender [6, 16]; few tools have been developed by identifying the original characteristics and components of happiness based on perspectives of middle-aged women. It is required to develop a happiness assessment scale reflecting characteristics or attributes of happiness in middle-aged women to consider gender and age.

Therefore, the first step in developing a happiness-measurement instrument is understanding the components of happiness for the target population. We identified nine components that comprise happiness for women in middle age [17], reflecting existence, relations, and growth needs of ERG theory [11]. Accordingly, we sought to develop a happiness-measurement tool reflecting middle-aged Korean women's physical, psychological, and sociocultural characteristics—based on nine components of their happiness [17]—to be used as the primary scale for evaluating happiness for women of this age. This HAS-MW will be first scale in Korea based on ERG theory for women in middle age and different from other happiness scales.

The conception of and sources of well-being or happiness may be different in collectivist cultures that emphasize harmony in relationships with others rather than individualism [13]. Thus, subjective well-being consists of three components: life satisfaction, presence of positive affect/absence of negative affect, and psychological well-being, based on the intensive integration of several theoretical domains including life span developmental perspectives, mental health, and clinical psychology [18].

Hence, we aimed to understand happiness for middle-aged women according to ERG theory [11] and to develop a HAS-MW. To verify that the scale would have a sufficiently empirical foundation, a previously published first phase of the instrument's development [17] involved concept analysis of in-depth interviews with middle-aged women. The results of that previous study yielded nine extracted components of happiness [17]. The present article describes phase two of our research: developing and validating the new scale, the HAS-MW, to be used to assess and evaluate happiness of women in middle age in a comprehensive and multidimensional way using physical, psychological, and social traits.

Methods Study design

This methodological study included a cross-sectional survey to develop a HAS-MW. The framework of the conceptual model in this study is Alderfer's ERG theory [11]. Scale development process are shown in Figure 1.

Participants and data collection

Data were collected from February 1 to March 23, 2018, from middle-aged women aged between 40 and 64 years. Participants were assigned based on the population census—Statistics Korea 2015 [19] to Seoul metropolitan and six

Korean provinces. Inclusion criteria were middle-aged (40-64 years) women in community. Women those who admitted in the facilities such as hospital or nursing home were excluded. A total of 600 questionnaires were distributed by mail or personal contact; 567 were collected (response rate = 94.5%). A total of 526 copies (92.8%) were used for final analysis; 41 were excluded owing to insufficient data (7.2%).

Participants provided their informed consent to participate, verifying that they understood the purpose and content of the study. The sample size needed was more than 300, or 5–10 times the number of items for exploratory factor analysis (EFA), and five times the number of items for confirmatory factor analysis (CFA) [20]. According to the previous explanation, sample size was decided to be 600 in total for EFA and CFA. Multiples of 1 and 2 were determined by the EFA group, and multiples of 3 were determined by the CFA group. In addition, data of participants were 352 for EFA and 174 for CFA exclusively by and these data were satisfied minimum requirement of sample size for EFA and CFA.

Ethical consideration

This study was approved by the Institutional Review Board of the Soonchunhyang University (Approval no. 1040875-201706-SB-02-2). Participants were informed of the purpose of the survey and agreed to answer our questionnaire.

Scale development

This scale development was conducted in accordance with reference of scale development [21].

Generate an item pool and format for measurement

Literature reviews were performed after searching PubMed, EMBASE, CINHAL, and KMBASE, KISS, KoreaMed, DBpia, Riss, and the National Assembly Library database. The publication period searched was January 1, 1980 to August 31, 2017, because research on well-being, life satisfaction, and quality of life was published after 1980. The literature review of 133 articles and one-hour interviews with 25 middle-aged women revealed the attributes of middle-aged women, related factors, and components of happiness [17]. Women were asked to talk about main questions such as “How do you think about happy person as a middle-aged woman?”, “When do you feel happy?”, “What are you doing to be happy?”, and so on. Through literature review and analysis of interviewed contents, we extracted a total of 80 initial items, composing 9 components of physical function factor, economical factor, appearance factor, family relations, social relations, self-esteem, mind control, positive thinking, and leisure life based on ERG theory.

Item formats for assessment of happiness is a Likert scale. Because Likert scaling is widely used in instruments measuring opinions, beliefs, and attitudes. Likert scale response options are a 5-point scale (1: Absolutely disagree. 2: Mostly disagree 3: Moderate 4: Mostly agree 5: Absolutely agree).

Item pool reviewed

Extracted items were reviewed by one professor and 25 middle-aged women. Twenty-five participants completed pooled items. It was also considered an average time to response and understandability.

Inclusion of validation items

Inclusion for validation items was performed by six experts. For validation items, based on established guidelines [22]. As a next step, pilot test was conducted using a 5-point Likert scale to 30 participants in 3 provinces.

Scale evaluation Administering items to middle-aged women

Nunnally suggests that 300 people is an adequate number [19]. Tabachnick and Fidell reports that the sample size needed was more than 300, or 5–10 times the number of items for exploratory factor analysis (EFA), and five times the number of items for confirmatory factor analysis (CFA) [21]. To prevent pitfall of small sample size, five times of survey items and about 20.0% drop rate, 600 in total were recruited, 400 for EFA, and 200 for CFA.

Evaluate the items

Descriptive statistics and reliability and validity tests were performed with SPSS Statistics 24.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to determine frequency, range, mean, and standard deviation of the sample's demographic and clinical characteristics. All other tests were two-tailed, and a *p*-value of less than 5.0% was considered statistically significant.

To evaluate the performance of the individual items, analysis was conducted for item means, item variances, skewness and kurtosis, and item-scale correlations. The item performance, absolute values of skewness, and kurtosis were normally distributed: all absolute values satisfied with values less than 3.0 for skewness and less than 7.0 for kurtosis. Furthermore, confirmed item-scale correlations (≥.30) [21,23].

For construct validity, we performed EFA using IBM SPSS 24.0 and CFA using IBM SPSS AMOS 20.0 (IBM Corp., Armonk, NY, USA). Researchers used principal components analysis as the factor extract model to minimize information loss from minimum-factor prediction, and varimax rotation to know structures of independent factors by maximizing the sum of factor-loading variance [23], the Oxford Happiness Questionnaire (OHQ) was evaluated with principal component analysis and varimax rotation [24]. First, to confirm the appropriateness of materials for EFA, Kaiser-Mayer-Olkin (KMO) test, and Bartlett's test of sphericity were evaluated [25]. Bartlett's test of sphericity confirmed patterned relationships among the variables, as seen in the correlation matrix (*p*

For extracting factors through EFA, the number of factors was determined by the following criteria: eigenvalue of 1 or above, factor loading (≥.40) [25], and accumulative variance of 50–60.0% [21,26]. For CFA model verification, the goodness of fit coefficients, Normed χ2 (χ2/df), the goodness of fit index (GFI), standardized root mean residual (SRMR), root mean square error of approximation (RMSEA), Tucker-Lewis index (TLI), and comparative fit index (CFI) were verified. In addition, the HAS-MW criterion validity and discriminant validity were compared.

For criterion validity, the OHQ [24] was used. Because it has been used as golden standard world wide, it was selected. Pearson's correlation coefficient was applied to determine the criterion validity of the HAS-MW's and the OHQ-Korean [27] scale. The twelve negative items among the 29-item OHQ were reverse-scored. The sum of the item scores was the overall measure of happiness, with higher scores indicating greater happiness. Cronbach's α of this study was .87, whereas the original version reported Cronbach's α of .90 [24].

For discriminant validity, Pearson's correlation coefficient was calculated for the HAS-MW and the Hwa-Byung Scale [28]. Hwa-Byung is a culture-related anger syndrome in Korea. And higher in the degree of hwa-byung, higher in depression or anger. Therefore, this scale is thought to be negatively related to happiness [29]. The Hwa-Byung scale comprises 15-items related to emotional and physical symptoms evaluated on a 5-point Likert scale. Cronbach's α at development was .92 [28]; Cronbach's α was .93 in this study.

Results Participants' characteristics

Researchers used data of 352 of 526 participants for EFA. The participants' mean age was 50.6 (±7.17), and most of the women were married (84.4%), 53.7% had education levels of college or above, 74.7% had one or two children, 72.4% held jobs outside the home, 71.9% was religious, 68.5% had no diseases, and 58.2% had not ended their menstrual cycles. On the other hand, participants for the CFA were 174, and their mean age was 49.9 ± 7.51. Of them, 81.6% was married, 60.3% had an education level of college or higher, 33.3% finished high school. Of the participants, 73.0% had one or two children, 33.3% had some form of disease, and 37.9% had ended their menstrual cycles (Table 1).

Scale development Generation of item pool and item selection

Generated 80-item pool was reviewed by one professor and by 25 middle-aged women. In this step, 3 items were excluded owing to redundancy.

Six experts (two psychologists with doctoral degrees, three psychiatrists, and one doctor of women's studies) verified item content for valid item selection to measure a happiness for women in middle age. Ten items (I-CVIs

Item evaluation for adequacy

As a next step, item evaluation for adequacy as a scale was conducted using a 5-point Likert scale to 30 participants in 3 provinces. 30 participants completed 59-item questionnaire in an average of 8 minutes; the mean of understandability was 3.20–3.70 (from four scores), indicating the participants found the questionnaire easy to understand. Item mean (±SD) for 59 items showed 3.57 (±0.35) and internal consistency was Cronbach's α .93. In this step, Bartlett's value was χ^2 = 8191.02 (*p* **Scale evaluation**

In the scale evaluation step, using IBM SPSS 24.0 and AMOS 20.0 (IBM Corp., Armonk, NY, USA), exploratory factor analysis identified categories of similar statements and extracted 4 factors. Also validity was tested with the

Korean version of OHQ [27] for criterion validity, and with Hwa-Byung [28] for discriminant validity. Item mean (±SD) for 59 items showed 3.44 ± 0.38 (minimum 2.29, maximum 4.68) with 352 participants. Through confirmatory factor analysis for model fit, the reliable and valid 24-item HAS-MW was developed.

Exploratory factor analysis Number of factors

The number of factors was determined by the following criteria: eigenvalue of 1 or above, factor loading (≥.40) and accumulative variance of 50–60.0%. Ten items (having item-total correlation coefficients Fig. 2a].

Item reduction

During four times of EFA, 6 items with loading lower than .40 and 8 items with one factor one item were removed (reduced to 35 items). Three redundant items were rejected after comparison with other items in the same factor and 32 items were extracted.

In the fifth EFA, all items' factor loadings were satisfactory (>.40). Through review of items (factor loading > .40), 4-items (Q31, Q49, Q52, Q56) were deleted that not fit any factor or show different meaning from other items. Finally, four factors, 28 items including three dimensions of ERG (existence, relation, and growth) theory were produced. These 28-items explained 53.2% of the variance for happiness in middle-aged women (Table 2, Fig. 2b).

Confirmatory factor analysis Model fit

For CFA model verification of 4-factor, 28 items scale, we used the data not used in the EFA (n = 174). To improve model fit, we performed an analysis requesting modification indices. At first, for the estimates of CFA, identifying four items (Q6, Q10, Q33, Q42 in Table 2) with a critical ratio of 1.96 (*p* Table 3). Second, the modified model fit resulted in a final scale of 24 items reflecting happiness in middle-aged women. Critical ratio was 4.809–10.040 (*p* Table 3). Model fit indices for the scale with four factors, 24 items were χ^2 = 517.63 (*p* 2 is sensitive to sample size, so we performed further examination. GFI was .80, which is thought to indicate a comparatively good model fit. The RMSEA was .08, and the SRMR was .05, indicating satisfactory model fit [25]. The fit of the final model was verified to be good, having χ^2/df = 2.10, GFI = .802, AGFI = .758, NFI = .749, IFI = .850, TLI = .829, CFI = .848, RMSEA = .080, and SRMR = .05 (Table 3). Based on the above CFA, the four-factor 24-item of the HAS-MW was considered as valid (Supplement 1).

Factor naming

Four factors composed of 24 items were extracted after CFA [Fig. 2b]. Factors were named as ‘Self-value’, ‘Positive thought’, ‘Self-management’, and ‘Family relations’ based on their content: Factor 1 included eight items (Q29, Q30, Q32, Q34, Q36, Q37, Q38, and Q40) meant “to be loved and be accepted as valuable by oneself” and was named ‘Self-value’. Factor 2 included eight items (Q39, Q44, Q45, Q46, Q47, Q48, Q54, and Q55) meaning positive thought and joyful feeling and was named ‘Positive thought’. Factor 3 included five items (Q5, Q8, Q57, Q58, and Q59) related to the physical/psychological leeway to do something and was named ‘Self-management’. Factor 4 included three items (Q18, Q19, and Q21) related to interaction among family members and was named ‘Family relations’ (Table 3, Fig 2b).

Criterion validity and discrimination validity

Criterion validity was confirmed with the OHQ-Korean version [27]; the correlation coefficient between HAS-MW and the OHQ was r = .84 (*p* 28], and the correlation coefficient between HAS-MW and Hwa-Byung was r = −.51 (*p*

Reliability

The internal consistency of HAS-MW was also evaluated using Cronbach's α and the Spearman-Brown half coefficient. Cronbach's α of the final 24-item scale was .91 for all items and Cronbach's α for component factors (Factor 1, 2, 3, 4) were .88, .81, .80, and .76, respectively. The Spearman-Brown split-half parallel reliability coefficient was .93. Hence, the. HAS-MW was considered reliable for measurement of happiness for middle-aged women.

Finalizing scale

Through confirmatory factor analysis, 24 items were verified as HAS-MW reliable and valid. Mean (±SD) for scale was 86.74 (±10.45) (range: 44~108). Item mean (±SD) was 3.61 ± 0.43. One professor of Korean language education confirmed text of final scale and it was translated [S1].

Discussion

A growing number of social scientists are examining humans' more positive aspects, such as subjective well-being, psychological well-being, life satisfaction, happiness, and quality of life [13, 14, 30]. Also, researchers have tried to measure the achieved happiness, personality, attitude and value, and life-style domains of happiness as they have come to be defined in the literature. In this study, we tried to understand happiness for middle-aged women based on ERG theory [11] and developed the HAS-MW in Korea. Our findings suggest that the HAS-MW shows good psychometric properties. In this section, we discuss about internal consistency and validity, and components of a scale.

First, in the validity, criterion-related validity of this scale showed high correlation with the OHQ [24], the gold standard happiness measurement. The OHQ focuses on life satisfaction and emotional experience [24]. However, it does not include leisure, family relationships, self-achievement, or self-development, while the HAS-MW includes attributes of happiness in middle-aged women. In addition, people's literacy diminishes as they grow older [31], so we aimed to use the fewest items possible and make them easy to answer [27]. The HAS-MW composed of positive wording questions. Pooled item of HAS-MW included negative questions, but those kind of items were excluded naturally. The study excluded negative wording items of the OHQ and raised convenience [32] and positive wording might prevent potential response errors [33]. Furthermore, the HAS-MW has discriminant validity, showing a negative correlation with the Hwa-Byung Scale [28]. When compared with the results of the more severe Hwa-Byung, which includes items that negatively affect quality of life [34], the HAS-MW we developed has confirmed discriminative validity.

Second, the reliability of the HAS-MW in this study was established: Cronbach's α was 91, and the Spearman-Brown split-half reliability was .93. It has a reliable scale based on the standpoint that Cronbach's α is .60 or higher indicates good reliability of newly developed psychological and social scales [35]. Furthermore, the HAS-MW fits uses a five-point Likert scale, the most reliable scale for a subject-centered approach [36].

Third, the “happiness” components we included support the ERG theory [11]. The HAS-MW comprises four factors, among which “family relationship” corresponds to the relatedness needs in ERG theory; the others, “self-value,” “positive thinking,” and “self-management,” correspond to the growth needs in ERG theory, which represent the desire for growth and achievement [11]. This feature of middle age expresses as a process of re-recognizing the value of oneself and discovering the value and life's meaning through internal reflection [4], suggesting the importance of growth to the happiness of middle-aged Korean women. Some attributes of the HAS-MW differ from the Koreans' Happiness Scale of Life [6], although it is also based on the ERG theory and the Maternal Happiness Scale [37]; they share common traits but the factors that are most important vary depending on participants' characteristics. The factors of HAS-MW (See Supplement 1, [S1]) include self-value (self-worth), with eight items (Q1–Q8) that are important determinants of happiness. Prior researchers have identified these values which relate to being recognized by oneself and others [38]. Such recognition increases subjective happiness because self-esteem rises when one feels validated as an important and indispensable individual [39]. The Korean version of the Mental Health Continuum-Short Form [40] also recognizes self-value for happiness. Inclusion of the self-value factor items may signify a cultural shift from traditional values of collectivism to a modern values of individualism, reflecting the attitudes of middle-aged women who are actively moving toward becoming the center of their own lives, as individuals, and away from being submissive and passive wives or mothers in a male-centered society. This result also supports the thinking that individualistic and collectivistic cultures rely on different sorts of information in making life satisfaction judgments [41].

The second factor, positive thinking, comprises eight items (Q9–Q16) that strongly relate to happiness based on appreciation. Positive thinking relates positively to psychological well-being, life satisfaction, and the use of positivity to maintain psychological stability in everyday life [41]. The positive thinking factor also reflects how meaning in women's lives depends on their degree of acceptance of menopause [42]. That is, happiness in middle-aged women can be evaluated and experienced differently by different generations or individuals [13, 14, 43].

The third factor, self-management, expressed in five questions (S1: Q17–Q21), included factors related to leisure

activities in life. The importance of leisure has been the focus of several studies of happiness in people of middle age [44]. The pleasant experience associated with a life of leisure reduced depressive symptoms, making it an important source of life in middle-aged and older adults [43]. In this factor of self-management, there are items that are different from the OHQ in Korean [27]. That is, items such as “I have a healthy and well-balanced diet” and “I have my own way of relieving stress” are expressed in specifically positive language for self-management in the HAS-MW. On the other hand, the OHQ is composed of pleasurable life, meaningful life and engaging life, does not include self-management.

Finally, the fourth factor, family relationship, comprises three items (S1: Q22–Q24). This factor was included in the Happiness index for Koreans [6] but not the Korean Youth Happiness Index [45]. This concept refers to how happiness depends on individuals and how they prioritize it in their lives in terms of their family relationships, which are seen as particularly important for middle-aged women. A stable and strong bond or meaningful relationship can invoke positive feelings and make women feel happy [9,43,46]. In particular, this study revealed the importance of family relations to the happiness of Korean middle-aged women, as evidenced by the items “We have a good family relationship (including parents, siblings)”, “We care about each other (including parents, siblings),”and “We make important decisions through discussions (including parents, siblings)”. This attribute is consistent with research that emphasizes emotional stability as a major dimension of happiness in women's happiness [43,47]. Hence, we suggest that the family relations factor should be considered for development programs to support women emotionally in the future.

The HAS-MW developed in this study is the first scale in Korea with its reliability and validity expressed in empirical language that reflects the attributes and properties of happiness in middle-aged women. It is meaningful to develop a scale that directly explores and checks the components of happiness in middle-aged women. The 4 factors are related to each other, yet are independent and reflect individual and collectivist cultural characteristics [13,41].

A few limitations should be considered when interpreting the HAS-MW. This study did not provide a cut-off score for happiness. In general, to show a cut-off point, the golden standard must be used as the appropriate reference point. However, we used the OHQ [24] as the golden standard but it does not provide a cutoff point. Furthermore, happiness is relative based on individual differences [13,48]. Thus, it is difficult to conclude that a person with a low HAS-MW score is absolutely unhappy. Furthermore, since the factors that make contribute to great happiness vary by individual; the scores depend on the person rather than the tool used. The objective cut-off point should be decided through a careful and complex process which should be determined by a common consensus of experts. Also, model fit indices of CFI and TLI (>.80) are permitted, but it is not great (>.95). Further validation study is necessary to be reanalyzed and improve model fit.

In addition, the study only involved women in Korea; therefore, its validity in other cultures is unknown. Future research may use this scale as a basis for versions to fit various cultures globally. Despite limitations, it is expected that the HAS-MW would be useful for individuals and counselors to evaluate happiness-related factors of middle-aged women and to contribute to the creation of a bright and healthy society by improving their positive well-being. The newly developed HAS-MW may also be useful in clinical assessment, where the happiness score might reflect recovery from psychological conditions such as anxiety, stress and depression. Also it could be used for women with low scores of HAS-MW to get counseling or treatment. It is required to explore the gender effects in happiness in middle-aged men and women and cultural impacts for multicultural background. Finally, under conditions of COVID-19, happiness needs to be reevaluated to see the change in middle-aged women who worked more for their families than before COVID-19.

Conclusions

This study developed the HAS-MW, considering their pursuit of happiness, and it measures happiness based on the fulfillment of ERG needs. It is a significant development in illuminating and measuring positive aspects of happiness, particularly for Korean women in middle age.

The HAS-MW is a reliable and valid scale to measure happiness in middle-aged women and is composed of four factors, “self-value,” “positive thinking,” “self-management,” and “family relationship,” comprising 24 items.

Happiness is measured using 5-point Likert scores, and higher scores indicate happier women. This scale may also be useful in clinical assessment for psychological conditions such as anxiety, stress, and depression. It is required to show the similarity and difference from the attributes for happiness in middle-aged men. We suggest future studies not only women with diseases and those with multicultural backgrounds but also middle-aged men.

Conflict of interest

All authors declare no potential conflicts of interests.

Acknowledgment

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Appendix A Supplementary data

The following is the Supplementary data to this article:**Multimedia component 1**Multimedia component 1

Appendix A Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anr.2020.12.002.

Characteristics	Categories	Total (n = 526)	EFA (n = 352)	CFA (n = 174)
M ± SD or n (%)	M ± SD or n (%)	M ± SD or n (%)	Age (yrs)	
50.3 ± 7.17	50.6 ± 7.17	49.9 ± 7.51	Marital status	Single
33 (6.3)	18 (5.1)	15 (8.6)	Married	438 (83.3)
297 (84.4)	142 (81.6)	Divorced	24 (4.6)	16 (4.6)
8 (4.6)	Bereaved	19 (3.6)	13 (3.7)	6 (3.5)
Remarried	9 (1.7)	8 (2.3)	1 (0.6)	Others
3 (0.6)	0 (0.0)	3 (0.6)	Education	Elementary school
11 (2.1)	9 (2.6)	2 (1.2)	Middle school	30 (5.7)
21 (5.9)	9 (5.2)	High school	191 (36.3)	133 (37.8)
58 (33.3)	Over college	294 (55.9)	189 (53.7)	105 (60.3)
Number of children	0	25 (4.8)	9 (2.6)	16 (9.2)
1–2	390 (74.1)	263 (74.7)	127 (73.0)	≥3
78 (14.8)	62 (17.6)	16 (9.2)	Job	No
145 (27.6)	97 (27.6)	48 (27.6)	Yes	381 (72.4)

255 (72.4)	126 (72.4)	Religion	No	158 (30.0)
99 (28.1)	59 (33.9)	Yes	368 (70.0)	253 (71.9)
115 (66.1)	Disease	No	357 (67.9)	241 (68.5)
116 (66.7)	Yes	169 (32.1)	111 (31.5)	58 (33.3)
Menopause	No	313 (59.5)	205 (58.2)	108 (62.1)

Item No. (Total items = 28)	Communality	Factors			
F1	F2	F3	F4	Q33[+]	.80
.73	.64	.26	−.02	Q32	.74
.66	.29	.14	.07	Q34	.66
.66	.12	.28	−.04	Q38	.69
.65	.39	.05	.17	Q36	.68
.64	.38	.04	.32	Q30	.65
.62	.28	.08	.35	Q29	.67
.55	.40	.17	.17	Q37	.70
.55	.46	−.03	.31	Q40	.60
.53	.41	.27	.15	Q46	.67
.13	.80	−.05	−.01	Q47	.55
.21	.70	−.03	.03	Q45	.56
.33	.58	.13	.18	Q44	.58
.00	.57	.09	.08	Q48	.53
.21	.57	.18	.16	Q39	.53

.40	.56	.04	.10	Q55	.71
.26	.51	.15	.21	Q42+	.59
.16	.47	.16	.04	Q54	.69
.33	.44	.21	.14	Q10+	.63
−.05	.13	.72	.02	Q58	.76
.36	−.04	.70	−.03	Q6+	.66
.41	.05	.68	−.12	Q59	.72
−.11	.23	.67	.19	Q57	.72
.31	.04	.65	.16	Q5	.56
.17	.02	.61	.22	Q8	.62
.14	.38	.54	.14	Q18	.72
.11	.06	.10	.79	Q19	.72
.15	.22	.14	.76	Q21	.63
.10	.13	.12	.74	Eigen value	
9.16	2.58	1.72	1.45	Explained variance (%)	
16.39	15.74	12.38	8.71	Cumulative explained variance (%)	

Factors	No	Items	Unstandardized regression weight	SE	CR	Standardized regression weight
Self-value	Q32	I think life is a constantly changing and growing process for me.	1.00			.70

Q36	I am a worthy person.	.94	.10	9.80	.82	Q29
I have a lot of strong points.	.93	.10	9.07	.73	Q38	I think positively about myself.
.91	.09	9.92	.82	Q30	I value myself.	.90
.10	9.31	.76	Q40	I am satisfied with myself.	.83	.11
7.98	.65	Q37	I'm the one that others need.	.82	.10	8.45
.69	Q34	I spare no cost about learning.	.73	.11	6.52	.52

Positive thought	Q47	I try to see others as they are.	1.00			.66
Q55	As I experience difficulties I think it is an opportunity to learn.	.99	.14	7.25	.62	Q44
I focus on what I can do well.	.96	.14	7.03	.63	Q45	I am satisfied with the result I effort
.93	.13	6.94	.63	Q39	I have a good personality.	.92

.14	6.83	.57	Q48	When I talk to other person, I focus on them.	.81	.13
6.94	.63	Q46	I am thoughtful others around me.	.78	.12	6.52
.60	Q54	I think experience of menopause leads to a deeper understanding of life's meaning.	.73	.15	4.91	.41
Self-management	Q59	I do a hobby that I want.	1.00			.87
Q58	I travel whenever I want.	.88	.09	10.04	.76	Q57

I have enough spare time to enjoy my own time.	.60	.08	7.16	.58	Q8	I have my own way of relieving stress.
.48	.09	5.61	.45	Q5	I eat a healthy and well-balanced diet.	.39

.08	4.81	.39	Family relations	Q19	We care about each other (including parents, siblings).	1.00

		.87	Q18	We have a good family relationship (including parents, siblings).	.86	.10

9.02	.74	Q21	We have decided important things with discussions (including parents, siblings).	.79	.09	8.51

DETAILS

Subject:	Womens health; Likert scale; Happiness; Culture; Literature reviews; Middle age
Identifier / keyword:	factor analysis, statistical; female; happiness; middle aged; validation study
Publication title:	Asian Nursing Research; Seoul
Volume:	15
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Publication date:	May 2021
Section:	Research Article
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Development and Validation of the Humanistic Practice Ability of Nursing Scale

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ABSTRACT (ENGLISH)

Purpose

The purpose of this study was to develop a Humanistic Practice Ability of Nursing (HPAN) scale adapted to China and validate its psychometric properties.

Methods

The original HPAN scale was revised through a literature review. Sixteen experts who met the inclusion criteria were consulted 2 rounds by the Delphi method. According to their suggestions and opinions, the structure, content, and semantics of each item of HPAN were modified, and a HPAN scale was preliminarily developed. The HPAN scale was validated through item analysis, exploratory factor analysis, convergent validity, and reliability. The data came from 406 first-class hospital nurses.

Results

A 5-dimension, 29-item HPAN scale demonstrated satisfactory fit with significant factor loadings. The split-half reliability coefficient of the scale was .98, the split-half reliability coefficient of each dimension was .86–.99, Cronbach's α coefficient was .96, and the Cronbach's α coefficient of each dimension was .87–.98. The model fit of the scale was good, and the items of the scale showed convergent and discriminant validity.

Conclusion

The HPAN scale indicated that the reliability and validity were good. It is easy to imply factors of HPAN. This scale can be used to assess the HPAN.

FULL TEXT

DETAILS

Subject:	Patients; Behavior; Nursing education; Colleges &universities; Ethics; Legal medicine; Communication; Nursing theory; Nurses; Nursing care; Adjustment; Clinical nursing
Location:	China
Identifier / keyword:	factor analysis; statistical; humanism; nurses; psychometrics
Publication title:	Asian Nursing Research; Seoul
Volume:	15
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Source type:	Scholarly Journal
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DOI:	https://doi.org/10.1016/j.anr.2020.12.003
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Comparison of Bleeding, Hematoma, Pain, and Discomfort After Bone Marrow Examination With or Without Sandbag Compression

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ABSTRACT (ENGLISH)

SummaryPurpose

A safe and effective hemostatic care is necessary after bone marrow examination to minimize bleeding, pain, and discomfort. However, a standardized hemostatic care protocol following bone marrow examination has not been established. The purpose of this study was to investigate the differences in bleeding, hematoma, pain, and discomfort by the hemostatic method used following bone marrow examination.

Methods

This study was carried out with a pre-test/post-test nonequivalent control group design. Sixty-four patients undergoing bone marrow examination at the hemato-oncology ward in a tertiary hospital in South Korea were assigned to an intervention (n = 30) and comparison group (n = 34). The intervention group was treated using a compression dressing alone, while the comparison group received a compression dressing followed by sandbag compression. Both groups received two hours of bedrest. Bleeding, hematoma, pain, and discomfort were measured at one and two hours after the biopsy.

Results

No significant differences in the occurrence of bleeding between the groups at one and two hours after bone marrow examination were observed, and no participant developed hematoma. The intervention group had significantly lower pain than the comparison group two hours after the bone marrow examination as well as lower discomfort one hour and two hours after the bone marrow examination (p < .05).

Conclusion

Applying only compression dressing after a bone marrow examination is effective in reducing pain and discomfort without measurable differences in bleeding and hematoma, suggesting that compression dressings alone could be effective in lowering pain and discomfort following bone marrow examination.

FULL TEXT

Introduction

Patients with hematologic disorders often undergo bone marrow aspiration or bone marrow aspiration and biopsy to obtain an accurate diagnosis and to identify the etiology of the disease [1–3]. Owing to population aging, changes in dietary patterns, and environmental changes, blood disorders have increased in recent years [4], and bone marrow biopsy is becoming increasingly common in South Korea. From 2010 to 2017, there was a 21.0% increase from 17,349 to 21,003 biopsies [5], suggesting that better management of patients undergoing bone marrow biopsy may be required.

Bone marrow examination is an invasive procedure in which bone marrow samples are typically obtained from the iliac crest, anterior iliac crest, or sternum using a needle. Hence, bleeding prevention at the puncture site is important [1]. Because the incidence of bleeding two hours following a bone marrow examination is 16.0% and four hours after the bone marrow examination is 5.3% [6], appropriate hemostasis is crucial. Discomfort around the puncture site has been reported to have an average rating of 3.12 (out of 10) two hours after the bone marrow examination and 5.90 four hours after the bone marrow examination, suggesting that patient discomfort rose with increased periods of bedrest [6]. Fifty-nine percent of patients during the procedure of bone marrow examination reported experiencing moderate discomfort [7]. Furthermore, 17.0% of the patients after 10 minutes and 64.0% after 1 day following bone marrow examination reported experiencing moderate pain [7]. The pain level after bone marrow examination was 1.98 on a 0–5 scale [8], which also showed moderate pain after bone marrow examination. Given these findings, safe and effective hemostatic care is needed after bone marrow examination both to minimize bleeding and to promote the patient's comfort.

However, the lack of a standardized hemostatic care protocol following bone marrow examination, such as the lack of recommendations of a hemostatic method (whether sandbag is applied or not) and absolute bedrest time, has led hospitals in South Korea and abroad develop and implement their own protocols [9–22]. Existing hemostasis protocols of other countries after bone marrow examination have recommended applying pressure for two minutes until bleeding stops, compressing with gauze and Elastoplast [12], applying pressure to the biopsy site with the patient lying on their back for 10–60 minutes until the bleeding stops, and then adhering a bandage [10,13–18]. Bedrest should be taken within an hour after compression on the biopsy site following a bone marrow examination in the USA, Japan, Vietnam, Singapore, and Canada. While it is the current practice not to use sandbags in other countries, some Korean nurses still practice applying sandbags after the bone marrow examination for 1 to 6 hours.

In South Korea, the guidelines for hemostatic care following a bone marrow examination, such as duration of absolute bedrest and the use of a sandbag, have shown variations by academic society, nursing associations, and hospitals. South Korean hospitals and the Korean Nurses Association guidelines currently instruct patients to place a sterile gauze and sandbag on the biopsy site while the patient lies in the supine position for 1–2 hours [19] or 4–6 hours [20,21]; applying manual pressure to the biopsy site for 5–10 minutes, applying a dressing, and having the patient lie on his or her back for 90 minutes [11]; applying pressure with a sterile bandage over it and having the patient lie down quietly until their vital signs are normalized [22]. One notable difference between the South Korean and international guidelines is that existing South Korean guidelines suggest bedrest with a sandbag lasting from several minutes to several hours.

Particularly, patients who have received a hemostatic method involving a sandbag after a bone marrow examination have reported that pain and physical discomfort from the bedrest in a fixed position for a prescribed length of time are greater than the discomfort from the biopsy [6]. If there is no increase of bleeding complication without a sandbag and the bedrest time is shortened, patients' pain, discomfort, complaint, and toileting self-care deficit from the sandbag and immobility will be reduced [6]. Needs for nursing care for those patients' problems will be reduced furthermore. With consensus from evidence-based nursing practice, educating a revised protocol and applying it to nursing practice are necessary to increase the satisfaction of patients and the nursing efficiency. Exploring nursing interventions that effectively prevent bleeding while minimizing pain and discomfort in patients who undergo a bone marrow examination is needed to improve patient care. Therefore, we explored if the bedrest time can be reduced to 1 or 2 hours, even without sandbag application.

Objectives

The purpose of this study was to compare the effects of hemostatic methods with and without a sandbag on the incidence of bleeding and hematoma, pain, and discomfort following a bone marrow examination. First, we hypothesized that there would be no difference in the occurrence of bleeding between the intervention group that used a compression dressing alone and the comparison group that used both a compression dressing and sandbag (Hypothesis 1). Second, we hypothesized that there would be no difference in the incidence of hematoma between the intervention group that used a compression dressing alone and the comparison group that used both a compression dressing and sandbag (Hypothesis 2). Third, we hypothesized that the intervention group that used a compression dressing alone would report less pain than the comparison group that used both a compression dressing and sandbag (Hypothesis 3). Fourth, the intervention group that used a compression dressing alone would have less discomfort than the comparison group that used both a compression dressing and sandbag (Hypothesis 4).

Methods Study Design

The study used a pre-test/post-test nonequivalent control group design to examine the effects of hemostatic methods using a sandbag on bone marrow examination complications.

Participants and Setting

Patients who were admitted to a single tertiary hospital in Cheongju, South Korea for a bone marrow examination were identified for potential enrollment in this study. We recruited participants of the outpatient department who were scheduled to undergo bone marrow examination. We explained the study to the patients prior to their consent. To be eligible for participation, the inclusion criteria included the following: being aged 19 or older; having a diagnosed blood disease; being hospitalized for a bone marrow examination; no current spinal disease with low back pain; a platelet count ≥10 × 10^3/μL; intact cognition; alert consciousness; ability to communicate; ability to understand and respond to the survey; and being willing to sign an informed consent to participate in the study. The exclusion criteria were those who were unable to stop antithrombotic and anticoagulant agents, were cognitively impaired, or had a mental illness that would hinder study participation [23].

The sample size was computed using the G*Power program (Heinrich Heine University Dusseldorf, German). For an independent *t*-test with a power of .80, a significance of .05, and an effect size of .80 [24], the minimum sample size per group was found to be 26. Anticipating a 30.0% attrition rate, we attempted to recruit 34 participants for each group. Four patients in the intervention group were dropped because of their refusal to complete the questionnaire; the final analysis included data from 34 patients in the comparison group and 30 patients from the intervention group.

Instruments Demographic and Clinical Characteristics

The survey included the demographic characteristics of participants' gender, age, education level, religion, marital status, and occupation. Diagnosis, history of bone marrow examination, underlying disease, bleeding in the past month, and blood test results (platelet count and prothrombin time) were collected as clinical characteristics.

Bleeding and Hematoma

The amount of bleeding was measured based on the area (length × width) of blood on one 10 × 10 cm gauze after one hour and two hours of biopsy. Bleeding after two hours was measured by including the area of bleeding measured at one hour without replacing the compression dressing [25]. Hematoma refers to a collection of blood, and its presence was determined based on visual inspection and palpation [26]. Hematoma was categorized dichotomously as "present" or "absent" [27].

Pain

Pain is defined by the International Association for the Study of Pain [28] as an unpleasant sensory and emotional experience related to tissue damage. Pain associated with bone marrow examination was assessed with a numerical rating scale (NRS) [29]. We assessed pain using the one-item NRS for pain presented by Korea's National Cancer Information Center [3]. The ratings ranged from 0–10 with a higher score indicating more severe pain. The scores were categorized as *mild pain* for 0–3, *moderate pain* for 4–6, and *severe pain* for 7–10.

Discomfort

Ashkenazy and DeKeyser Ganz defined discomfort as an unpleasant feeling resulting in a natural avoidance or reduction of the source of the feeling [30]. Discomfort related to applying a sandbag after the procedure was measured with a self-reported questionnaire developed by Park et al. [25,31]. We assessed discomfort using the discomfort scale developed by Lee [32] and modified and adapted by Park et al. [33] The scale consists of 16 items rating psychological (3 items), environmental (1 item), and physical discomfort (12 items). For this study, we selected seven relevant items from the 12 items assessing physical discomfort, and the content validity was verified by three hemato-oncology nurses, one oncology nurse specialist, and one hematologist-oncologist. All seven items had a CVI of .80 or higher, so all were selected. The discomfort scale was rated on a four-point Likert scale (1 = *No*; 2 = *Mild*, 3 = *Moderate*, and 4 = *Severe*). The total score ranged from 7–28, where a higher score indicated a higher level of discomfort. The Cronbach's α of physical discomfort was reported to be .71 by Park et al. [33] and .84 in this study.

Study Intervention

In this study, for hemostasis, a sandbag was applied following the use of a compression dressing for the comparison group, while a compression dressing alone was applied for the intervention group. To prevent the diffusion effect, participants were initially assigned to the comparison group first, and then participants were assigned to the intervention group.

The bone marrow examination took about 30 minutes. An analgesic (meperidine 25 mg) was intravenously injected 5 minutes prior to the biopsy for both groups. There was no adverse effect from the medication. A bone marrow examination needle of 11 gauge (TrokaBone, PAJUNK GmbH Medizintechnologie; thickness 3 mm, length 100 mm) was used. After removing the biopsy needle, the compression dressing and sandbag were applied for the comparison group and the compression dressing alone was applied for the intervention group for hemostasis. Hemostasis following a bone marrow examination was performed as follows with the reference to the hemostasis protocols after a bone marrow examination used in hospitals [10,13–19]. Countries except Korea apply less than 1-hour bedrest [10,13–18], and at least two hospitals including the one in this research were applying the 2-hour bedrest method [19].

First, for the compression dressing, manual compression was performed for 2–3 minutes until bleeding from the puncture site stopped, with an additional 2–3 minutes of compression if the bleeding did not stop. Next, a 10 × 10 cm gauze was folded into one-fourth size and placed over the puncture site with some pressure, and the patient was instructed to lie on a bed for two hours. For sandbag compression, a 1.8 kg sandbag (25 cm × 16 cm × 2.5 cm) was fixed over the iliac crest (puncture site) such that it did not drop to one side following the compression dressing, after which the patient was prescribed bedrest for two hours. For both groups, another hour of bedrest was ordered after two hours of bedrest when the blood on the gauze did not turn brown and pinkish blood was still observed. Two patients in the intervention group had another hour of bedrest after two hours of bedrest.

Data Collection

Data were collected from April 20, 2017 to December 20, 2017, for the comparison group, and from December 22, 2017 to September 2, 2018, for the intervention group. Two oncology nurse specialists participated in data collection: one for the questionnaire survey and medical record collection and the other for measuring bleeding, pain, and discomfort at the patient's bedside. All the measurements were done by one specialist, inter-measurer variability was not a concern. Baseline data were collected by an oncology nurse specialist in the education and counseling room in the hemato-oncology ward. The oncology nurse specialist distributed a structured questionnaire to the patients prior to the bone marrow examination, and patients completed the questionnaire containing items about their demographic and clinical characteristics. The questionnaire took about 2–3 minutes. Information about prothrombin time and platelet count, which may affect bleeding, was collected by an oncology specialist nurse from the patients' medical records after they completed the survey. Another oncology specialist nurse measured post-procedural bleeding, hematoma, pain, and discomfort at the patient's bedside one hour and two hours after the bone marrow examination. Hematoma was examined during an additional outpatient follow-up visit one week after the

bone marrow examination.

Data Analysis

The collected data were analyzed using the SPSS 24.0 software (IBM Corp., Armonk, NY, USA). Demographic and clinical characteristics were analyzed with the frequency and percentage or mean and standard deviation, and the baseline differences between the two groups were examined using an independent *t*-test, Chi-square test, and Fisher's exact test. The effects after treatment in both groups were analyzed with independent *t*-tests and Chi-square tests.

Ethical Consideration

This study was approved by the institutional review board at the study hospital (Approval No. 2017-03-018-002), and written consent was obtained from the participants after informing them of the purpose and procedure of the study.

Results Homogeneity Among Participants Demographic Characteristics

There were no significant differences between the two groups with regards to gender, age, education, religion, marital status, and occupation (Table 1). Of the 64 participants (30 in the intervention group and 34 in the comparison group), 40 (62.5%) were men and 24 (37.5%) were women. The mean age of participants was 57.63 years (*SD* = 14.58) in the intervention group and 61.27 years (*SD* = 17.02) in the comparison group.

Clinical Characteristics

The most common diagnosis was acute leukemia, with 12 in the intervention group (40.0%) and 13 in the comparison group (38.2%) having this diagnosis. There were no significant differences in past bone marrow exam history, underlying disease, bleeding history, and blood test results (platelet count and prothrombin time; Table 2).

Group Comparisons Amount of Bleeding

There were no significant differences in the occurrence of bleeding between the intervention group and the comparison group one hour ($t = 0.84$, $p = .403$) and two hours ($t = 0.69$, $p = .491$) after the bone marrow examination, supporting Hypothesis 1 regarding the lack of differences in the occurrence of bleeding between the two groups. The mean values of bleeding at one hour and two hours after a bone marrow examination were 0.86 cm^2 (*SD* = 1.12) and 1.41 cm^2 (*SD* = 1.65), respectively, in the intervention group and 1.14 cm^2 (*SD* = 1.53) and 1.75 cm^2 (*SD* = 2.22), respectively, in the comparison group (Table 3).

Incidence of Hematoma

None of the participants in both groups developed a hematoma one hour, two hours, and one week after the bone marrow examination, supporting Hypothesis 2 regarding the lack of difference between the two groups in the incidence of hematoma (Table 3).

Level of Pain

There was no significant difference in pain one hour ($t = 1.58$, $p = .120$) after a bone marrow examination, but there was a statistically significant difference in pain two hours ($t = 2.90$, $p = .006$) after a bone marrow examination between the two groups. Hypothesis 3 regarding decreased pain in the intervention group compared to the comparison group was partially supported. The mean pain scores at one hour in the intervention and comparison groups were 0.33 (*SD* = 0.76) and 0.79 (*SD* = 1.49), respectively, and those at two hours were 0.33 (*SD* = 0.66) and 1.32 (*SD* = 1.87), respectively, showing lower pain scores in the intervention group (Table 3).

Level of Discomfort

There were significant differences in discomfort between the two groups at one hour ($t = 2.00$, $p = .049$) and two hours ($t = 3.09$, $p = .003$) after a bone marrow examination, which supported Hypothesis 4 which predicted that the intervention group would have lower levels of discomfort compared to the comparison group. The discomfort scores at one hour in the intervention and comparison groups were 1.32 (*SD* = 0.36) and 1.51 (*SD* = 0.41), respectively, and those at two hours were 1.43 (*SD* = 0.41) and 1.79 (*SD* = 0.49), respectively, showing lower discomfort scores in the intervention group (Table 3).

Discussion

Although bedrest and restricted movement following a bone marrow examination is viewed as being essential for the prevention of bleeding complications, the exact extent of allowable movement has not been clearly defined, and

discomfort and pain, owing to remaining in a fixed, supine position for a prolonged period, pose a challenge for patients [31,34]. This study examined differences in the incidence of bleeding and hematoma as well as pain and discomfort levels by a hemostatic method following a bone marrow examination.

One of the major adverse events following a bone marrow examination is hemorrhage resulting from injuries to surrounding organs from the insertion of a biopsy needle [35]. Our results showed that there were no differences in the incidence of bleeding and hematoma between the comparison group that used a sandbag and compression dressing and the intervention group that used compression dressing only. This finding is consistent with a previous study that showed the lack of significant differences in the incidence of complications following cardiac catheterization between the group that used a sandbag and the group that did not [36]. Furthermore, these findings are consistent with results demonstrating that patients who did not use a sandbag after coronary angiography showed no increased incidence of hemorrhagic complications [37]. Accordingly, it appears that compression dressing alone without the use of a sandbag for hemostasis is effective.

In our study, the comparison group that used a sandbag showed significantly higher pain scores two hours after a bone marrow examination compared to the intervention group that only received a compression dressing. While the pain score one hour after a bone marrow examination was not different between the two groups, the intervention group showed a little change in pain scores over time, unlike the comparison group that showed a higher pain score at two hours compared to one hour. Similar results were found in previous research where the patients' pain scores increased with more weight of the sandbag or over time in patients who underwent transcatheter arterial chemoembolization [38]. Overall, these results indicate that prolonged bedrest with a sandbag increases pain.

As patients need to lie down in a fixed posture with their knees straight for a prolonged time following a bone marrow examination [39], 70.0% of patients who underwent a bone marrow examination experienced moderate to severe (VAS ≥ 30 mm) pain due to immobilization and bedrest [7]. To mitigate such pain, analgesics and sedatives can be administered [40]. In our study, an opioid analgesic was administered immediately prior to the biopsy, and the participants showed low levels of pain (0.33 in the intervention group and 0.79–1.32 in the comparison group). In a previous study, applying acupressure after a bone marrow examination reduced the pain score from 7.9 out of 10 to 4.9 out of 10 [41], while applying massage therapy reduced the pain scores from 5.75 out of 10 to 4.00 out of 10 [42]. Furthermore, the intervention group that was treated using a classical Turkish Music intervention showed a significantly lower pain score (1.55 out of 10) compared to the control group (3.36 out of 10) [43]. In our study, administering an opioid analgesic and abstaining from the use of a sandbag led to the lowest pain score among patients.

In our study, the comparison group that used a sandbag showed significantly higher discomfort scores one hour and two hours after a bone marrow examination compared to the intervention group that was only treated with a compression dressing. Although we cannot compare our results directly with previous findings due to a lack of studies examining discomfort after a bone marrow examination, our results are consistent with previous findings that suggest that patients who used a sandbag had greater discomfort six hours after a cardiac catheterization than patients who did not use a sandbag [36]. Furthermore, whereas the discomfort score increased by 0.11 over time in the intervention group, it increased by 0.28 in the comparison group. This is like previous results that reported decreased discomfort in patients whose duration of bedrest with a sandbag was shortened from 4 to 2 hours following cerebral angiography [44].

Applying sandbag for the hemostatic method following a bone marrow examination is not used in other countries. However, some Korean nurses have used a sandbag for 1–6 hours to prevent bleeding from bone marrow examination. This appears to be just a convention passed on from generation to generation. In this study, there was no bleeding complication in the intervention group with less bedrest time and without a sandbag alongside a reduction of patients' pain and discomfort. The satisfaction and safety of patients will be increased if nurses do not apply sandbag compression with shorter bedrest. Without sandbag application and with the reduction of immobility, nursing care for the discomfort, toileting, and transferring patients to the examination room will be reduced. No additional staff will be necessary for another medical examination during the bedrest [6]. In addition, nursing activity,

such as changing the sterile drape of sandbags to prevent infection, will be no more necessary. Revision of the nursing protocol based on the evidence will increase productivity and satisfaction of nursing. Therefore, empirical evidence suggests that omitting the use of a sandbag and minimizing bedrest after a bone marrow examination could effectively improve the quality of nursing care on bone marrow examination.

Limitations

This study was a single-center study that could not completely control exogenous variables owing to the nonrandomized assignment to prevent the diffusion of intervention. Measurement on bleeding and hematoma was done by a nurse. It will be better if bleeding and hematoma were measured by two nurses independently and their measurements were averaged. Moreover, we could not control the potential impact of the clinician on the outcomes of the procedure. Hence, we recommend that future research includes a randomized controlled experimental design to adjust confounding factors. In order to find out whether the bedrest time can be reduced, the study on the comparison of bleeding and discomfort according to 30, 60, 90, and 120 minutes is necessary.

Conclusions

Bone marrow examination is an invasive procedure needed to diagnose a blood disease and determine a patient's prognosis. We found no differences in bleeding and the presence of hematomas between the group that used both compression dressing and sandbag and the group that had compression dressing alone for hemostasis after a bone marrow examination. The intervention group showed significantly lower pain and discomfort compared to the comparison group. In conclusion, applying compression dressing with a two-hour bedrest could be an appropriate hemostatic intervention following a bone marrow examination.

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None.

Conflict of interest

The authors declare no conflict of interest to disclose.

Acknowledgments

None.

Variables	Categories	Intervention Group (n = 30)	Control Group (n = 34)	χ^2 or t (p)
n (%) or M (SD)	n (%) or M (SD)	Gender	Men	21 (70.0)
19 (55.9)	1.16 (.249)	Women	9 (30.0)	15 (44.1)
Age (years)		57.63 (14.58)	61.27 (17.02)	0.91 (.366)
Level of Education	≤ Middle School	12 (40.0)	15 (44.1)	−0.04 (.968)
High School	11 (36.7)	9 (26.5)	≥ College	7 (23.3)
10 (29.4)	Religion	No	15 (50.0)	18 (52.9)
−0.23 (.818)	Yes	15 (50.0)	16 (47.1)	Marital Status
Married	26 (86.7)	31 (91.2)	1.54 (.553)[a]	Single

4 (13.3)	3 (8.8)		Occupation	No
15 (50.0)	18 (52.9)	−0.23 (.818)	Yes	15 (50.0)

Variables	Category	Intervention Group (n = 30)	Control Group (n = 34)	χ^2 (p)
n (%)	n (%)	Diagnosis	Acute leukemia	12 (40.0)
13 (38.2)	11.23 (.245)[a]	Chronic leukemia	4 (13.3)	1 (2.9)
Lymphoma	5 (16.7)	3 (8.8)	Multiple myeloma	1 (3.3)
3 (8.8)	MDS	1 (3.3)	4 (11.8)	MPN
5 (16.7)	3 (8.8)	AA	0 (0.0)	2 (5.9)
ITP	0 (0.0)	1 (2.9)	PRCA	1 (3.3)
0 (0.0)	Unknown Origin Cytopenia	1 (3.3)	4 (11.8)	History of Bone Marrow Biopsy
No	21 (70.0)	29 (85.3)	−1.46 (.151)	Yes
9 (30.0)	5 (14.7)	History of Bleeding	No	25 (83.3)
30 (88.2)	0.32 (.723)[a]	Yes	5 (16.7)	4 (11.8)
		M (SD)	M (SD)	t (p)
PLT ($\times 10^3/\mu L$)		334.33 (397.64)	181.25 (243.57)	−1.83 (.074)
PT (INR)		1.12 (0.14)	1.43 (1.63)	1.05 (.296)
Count of Comorbidity		1.20 (.48)	1.26 (.51)	0.52 (.606)

Variables	Categories		Intervention Group (n = 30)	Control Group (n = 34)	t (p)
M (SD)	M (SD)	Bleeding	One hour later		0.86 (1.12)
1.14 (1.53)	0.84 (.403)	Two hours later		1.41 (1.65)	1.75 (2.22)
0.69 (.491)	Pain	One hour later		0.33 (0.76)	0.79 (1.49)
1.58 (.120)	Two hours later		0.33 (0.66)	1.32 (1.87)	2.89 (.006)
Discomfort	One hour later		1.32 (0.36)	1.51 (0.41)	2.00 (.049)
Two hours later		1.43 (0.41)	1.79 (0.49)	3.09 (.003)	
		n (%)	n (%)	χ^2 (p)	Hematoma
One hour later	Present	0 (0%)	0 (0%)	0.00(1.000)	Absent
30 (100%)	34 (100%)	Two hours later	Present	0 (0%)	0 (0%)
0.00 (1.000)	Absent	30 (100%)	34 (100%)	One week later	Present
0 (0%)	0 (0%)	0.00 (1.000)			Absent

DETAILS

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PurposeAnalyzing information based on individual needs can maximize the effectiveness of education, leading to changes in personal health behaviors. This cross-sectional descriptive survey study aimed to identify the characteristics of mothers who experienced gestational diabetes mellitus and correlate the factors associated with their information needs.MethodsThe participants were 298 women between the ages of 20 and 49 years who were pregnant and diagnosed with gestational diabetes at the time of the study, or who were diagnosed with gestational diabetes mellitus within five years after delivery. The average age of the participants was 34.28 years. After comparing participants' demographics, diabetes, and breastfeeding-related characteristics according to their need for information on breastfeeding, a multiple logistic regression analysis was performed.ResultsFactors associated with participants' need for information on breastfeeding were economic conditions, usual body mass index, current pregnancy, and experience of breastfeeding.ConclusionThe findings can be used to implement programs that meet the needs of these women and help improve maternal and pediatric health and quality of life.

Lim, J. M., & Cho, O. (2021). Effects of home-and-workplace combined exercise for patients with ankylosing spondylitis. Asian Nursing Research, 15(3), 181-188. doi:https://doi.org/10.1016/j.anr.2021.03.001

PurposeThe purpose of this study was to investigate the effects of home-and-workplace combined exercise on physical function, depression, and work-related disability in patients with ankylosing spondylitis.MethodsThis study adopted a non-randomized quasi-experimental design. Fifty-two patients were recruited: home-and-workplace combined exercise (n = 17), home exercise (n = 18), and control group (n = 17).ResultsThe home-and-workplace combined exercise group showed improvement in spinal mobility and pulmonary function and significantly lower absenteeism and overwork impact than the home-exercise group and control group. The home-and-workplace combined exercise and home exercise groups showed a higher level of activity improvement than the control group.Conclusionhome-and-workplace combined exercise can be recommended to patients with ankylosing spondylitis to enhance their physical function, including spinal mobility and pulmonary function, and reduce work-related disability.

Zhou, H., Wang, X., Du, R., Cheng, X., Zheng, K., Dong, S., . . . Wang, T. (2021). The work experience of newly recruited male nurses during COVID-19: A qualitative study. Asian Nursing Research, 15(3), 203-209. doi:https://doi.org/10.1016/j.anr.2021.05.001

PurposeThis study was to investigate the work experience of newly recruited male nurses during the COVID-19 pandemic.MethodsWith a phenomenological approach, this qualitative study was adopted semistructured interviews by phone or video calls. A total of 9 male nurses newly recruited for the COVID-19 wards in Chinese hospitals were interviewed for this study. And Colaizzi's method was applied for evaluation in the data analysis.ResultsBased on our findings, three themes were extracted. First, the newly recruited male nurses showed negative emotions at the beginning of COVID-19 epidemic, which was caused by changes in working conditions and content, but also prompted the nurses to change the way of coping with the crisis. Second, they gradually mastered the working skills and psychological training to cope with COVID-19 and developed a positive attitude toward life and a high sense of professional responsibility. Finally, we learned about their needs to respond to public health emergencies such as the COVID-19 pandemic.ConclusionCOVID-19 is a disaster for all of humanity. The newly recruited male nurses are an important force in emergency rescue. Although they suffered from short-term negative emotions, they quickly adapted to the crisis. In order to better prepare for future emergencies, the disaster response capacity of newly recruited male nurses needs to be further improved. In addition, newly recruited male nurses have a strong demand for timely and personalized career development guidance.

Wen-sheng, H., Lu, S., Meng-yan, X., Min-cong, Z., Zhen-ming, Y., & Yue-yue Deng. (2021). Behavioral responses of pregnant women to the early stage of COVID-19 pandemic in the network era in china: Online questionnaire study. Asian Nursing Research, 15(3), 215-221. doi:https://doi.org/10.1016/j.anr.2021.06.003

PurposeThe aim of this study was to examine the behavioral responses of pregnant women during the early stage of Coronavirus Disease 2019 (COVID-19) outbreak.MethodsWe recruited 1,099 women to complete an online questionnaire survey from February 10 to February 25, 2020. The subjects were divided into two groups (the pregnant women group and the control group).ResultsConcerns about infection: most of the participants watched the COVID-19 news at least once a day. Protective behaviors: the utilization rate of pregnant women (often using various measures) was higher than that of nonpregnant women. Exercise: 30.6% of the pregnant women continued to exercise at home, whereas in the control group, this percentage was 8.4%. Spouse relationship: 38.8% of the subjects' relationship improved, whereas only 2.3% thought the relationship was getting worse.ConclusionPregnant women had some unique behavioral responses different from that of nonpregnant women. It is important to understand the behavioral responses of pregnant women in this network era.

Seo, S. M., Jeong, I. S., Song, J. Y., & Lee, S. (2021). Development of a nomogram for carbapenem-resistant enterobacteriaceae acquisition risk prediction among patients in the intensive care unit of a secondary referral hospital. Asian Nursing Research, 15(3), 174-180. doi:https://doi.org/10.1016/j.anr.2021.02.005

PurposeThis study aimed to identify the risk factors of carbapenem-resistant Enterobacteriaceae (CRE) acquisition to build a nomogram for CRE acquisition risk prediction and evaluate its performance.MethodsThis unmatched case-control study included 352 adult patients (55 patients and 297 controls) admitted to the intensive care unit (ICU) of a 453-bed secondary referral hospital between January 1, 2018, and September 31, 2019, in Busan, South Korea. The nomogram was built with the identified risk factors using multiple logistic regression analysis. Its performance was analyzed using calibration-in-the-large, the slope of the calibration plot, concordance statistic (c-statistic), and the sensitivity and specificity of the training set, subsets, and a new test set.ResultsThe risk factors of CRE acquisition among ICU patients at a secondary referral hospital were Acute Physiology and Chronic Health Evaluation II score at the time of admission, use of a central venous catheter and a nasogastric tube, as well as use of cephalosporin antibiotics. At 20.0% of the predicted CRE acquisition risk in the training set, the calibration-in-the-large was 0, slope of the calibration plot was 1, c-statistic was .93, sensitivity was 85.5%, and specificity was 84.8%. The performance was relatively good in the subsets and new test set.ConclusionThe nomogram can be used to monitor the CRE acquisition risk for ICU patients who have a similar case mix to patients in the study hospitals. Future studies need to involve more rigorous methodology and larger samples.

Du, J., Zhang, L., Xu, C., & Qiao, J. (2021). Relationship between the exposure to occupation-related psychosocial and physical exertion and upper body musculoskeletal diseases in hospital nurses: A systematic review and meta-analysis. Asian Nursing Research, 15(3), 163-173. doi:https://doi.org/10.1016/j.anr.2021.03.003

PurposeNurses' musculoskeletal diseases (MSDs) are worldwide prevalent and are considered to be a costly occupational injury. This study aims to investigate the relationship between exposure to occupation-related psychosocial factors, physical workload, and upper body musculoskeletal diseases among hospital nurses.MethodsAn electronic search was implemented using nine databases with June 2019 as the latest search date. English and Chinese studies were chosen, and data were independently and separately extracted by two investigators. Pooled odds ratio (OR) and its 95% confidence interval (CI) were estimated for each subset, using the fixed or random-effects model, following heterogeneity between studies for research synthesis. The source of heterogeneity was explored through subgroup, sensitivity, and meta-analyses.ResultsEighteen studies were included in the meta-analysis. Most participants were women (51.4%–100.0%), aged between 20 and 60. A correlation was found between high job demand and the prevalence of low back pain (OR = 1.41; 95% CI = 1.23-1.62). Total job strain was related to the risk of low back pain (OR = 1.71; 95% CI = 1.15-2.55), neck pain (OR = 1.67; 95% CI = 1.26-2.20), shoulder pain (OR = 1.62; 95% CI = 1.06-2.48) and back pain (OR = 1.45; 95% CI = 1.10-1.91). Furthermore, the physical workload was significantly associated with the prevalence of low back pain (OR = 1.76; 95% CI = 1.32-2.35), neck pain (OR = 1.17; 95% CI = 1.08-1.27), shoulder pain (OR = 1.59; 95% CI =

1.37-1.85) and back pain (OR = 1.66; 95% CI = 1.45-1.90).ConclusionThere were significant associations between occupational strain, more physical workload and upper body MSDs, but the evidence advocating a growth risk in MSDs due to low levels of social support is quite weak.

Yao, Y., Long, T., Pan, Y., Li, Y., Wu, L., Fu, B., & Ma, H. (2021). A five-step systematic therapy for treating plugged ducts and mastitis in breastfeeding women: A Case–Control study. Asian Nursing Research, 15(3), 197-202. doi:https://doi.org/10.1016/j.anr.2021.04.001

PurposeThis study aimed to describe the clinical response to five-step systematic therapy (FSST) in the management of plugged ducts and mastitis. FSST was a comprehensive milk stasis dredging treatment, which contained five steps to make the milk out of the plugged duct.MethodsThis retrospective study included 922 breastfeeding women, 714 with plugged ducts, and 208 with mastitis who received FSST from June to September 2017. The breast pain score, swelling degree, and range of breast induration were recorded pre-FSST and post-FSST.ResultsAfter a single FSST, pain score and swelling degree were significantly improved (both $p < .001$) in all cases. After FSST, the mean breast pain relief score was 1.69 ± 0.70, whereas the mean swelling fade away degree was 1.61 ± 0.62. In the subgroup analysis, pain score and swelling degree were significantly improved (both $p < .001$) in the plugged ducts group and the mastitis group. The score of pain relief in the plugged ducts group was less than that in the mastitis group (1.63 ± 0.68 vs. 1.91 ± 0.70, $t = 5.30$; $p < .001$), whereas improvement of swelling fade away was greater in the plugged ducts group than the mastitis group (1.65 ± 0.64 vs. 1.48 ± 0.56, $t = 3.49$; $p = .001$). The composition ratio of changes in induration range between the two groups was statistically different (Pearson $\chi2 = 137.87$, $p < .001$), of which more obvious improvement in the plugged ducts group than the mastitis group ($\chi2 = 25.65$, $p < .001$).ConclusionFSST can relieve pain, reduce breast swelling and range of induration, and for plugged ducts or mastitis varied degree differently.

Kang, H., & Jung-Won, A. (2021). Model setting and interpretation of results in research using structural equation modeling: A checklist with guiding questions for reporting. Asian Nursing Research, 15(3), 157-162. doi:https://doi.org/10.1016/j.anr.2021.06.001

PurposeThis study develops a checklist with guidelines for the methods and important factors to consider in research using structural equation modeling (SEM).MethodThe paper discusses the factors to consider in the process across the three stages of 1) model setting, 2) model evaluation and modification, and 3) interpretation and reporting of SEM-based studies.ResultsThe authors present a checklist for researchers during the stages of model setting, model evaluation and modification, result analysis, and reporting, along with examples of figures and tables with explanations.ConclusionA checklist will help to improve the reporting quality of SEM-based studies.

Yu, M., Yang, M., Ku, B., & Mann, J. S. (2021). Effects of virtual reality simulation program regarding high-risk neonatal infection control on nursing students. Asian Nursing Research, 15(3), 189-196. doi:https://doi.org/10.1016/j.anr.2021.03.002

PurposeVirtual reality simulation can give nursing students a safe clinical experience involving high-risk infants where access to neonatal intensive care units is limited. This study aimed to examine the effects of a virtual reality simulation program on Korean nursing students' knowledge, performance self-efficacy and learner satisfaction.MethodsA nonequivalent control group design was applied. Senior nursing students were divided into an experimental group (n = 25) experiencing virtual reality simulation and routine neonatal intensive care unit practice and a control group (n = 25) having routine neonatal intensive care unit practice. The program consisted of three scenarios: basic care, feeding management and skin care and environmental management for prevention of neonatal infection. The total execution time for the three scenarios was 40 minutes. The simulation created immersive virtual reality experiences using a head-mounted display with hand-tracking technology. Data were collected from December 9, 2019, to January 17, 2020, and were analyzed using descriptive statistics and the t-test, paired t-tests, Mann-Whitney test and Wilcoxon signed-ranks test.ResultsCompared to the control group, the experimental group showed significantly greater improvements in high-risk neonatal infection control performance self-efficacy ($t = -2.16$, $p = .018$) and learner satisfaction ($t = -5.59$, $p < .001$).ConclusionThe virtual reality

simulation program can expand the nursing students' practice experience in safe virtual spaces and enhance their performance self-efficacy and learning satisfaction.

Ra, J. S. (2021). Evaluation of a mobile-based maternal feeding education program for overweight prevention in infants. Asian Nursing Research, 15(2), 136-143. doi:https://doi.org/10.1016/j.anr.2021.02.001