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Research Article

Impacts of Just Culture on Perioperative Nurses' Attitudes and Behaviors With Regard to Patient Safety Incident Reporting: Cross-Sectional Nationwide Survey

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SUMMARY

Purpose: Just culture refers to a culture that encourages members of an organization to exchange important safety information and compensates them when they perform such information exchanges. The establishment of a just culture in hospital organizations might be an important means of enhancing patient safety incident reporting. This study aimed to investigate the impact of just culture on the attitudes and behaviors toward patient safety incident reporting in perioperative nurses.

Methods: A nationwide cross-sectional survey was performed using structured questionnaires. The participants were 208 perioperative nurses in tertiary general hospitals in South Korea. Data were collected by self-reported on-line questionnaires, from August to September 2020. Data were analyzed with descriptive statistics, independent t-test, chi-square test, Fisher's exact test, one-way ANOVA, Scheffé test, Pearson's correlation analysis, Spearman rank correlation analysis, hierarchical multiple regression, and hierarchical logistic regression using the SPSS WIN 23.0 program.

Results: Hierarchical multiple regression analysis revealed that just culture explained an additional 34.5%p of the attitudes on patient safety incident reporting. Hierarchical logistic regression analysis showed that just culture was a significant predictor of behaviors regarding patient safety incident reporting (odds ratio = 2.25, $p = .017$). The final regression model accounted for 16.0% of the behaviors regarding patient safety incident reporting.

Conclusion: This study empirically shows that just culture impacted the attitudes and behaviors regarding patient safety incident reporting in perioperative nurses. This study provides an evidence about the importance of the just culture in every day nursing practice setting. Personnel and organizational efforts for improving or implementing just culture are required to ensure greater patient safety by enhancing the patient safety incident reporting of perioperative nurses in hospitals.

Introduction

Recently, patient safety incidents have become an important issue worldwide. In 2020, the World Health Organization (WHO) reported 134 million cases of side effects in hospitals annually, of which 2.6 million deaths were due to unsafe treatment [1]. South Korea reported that approximately 2051 medical malpractice suits were filed in 2022 [2]. With regard to petitions for medical dispute mediation from 2018 to 2022, those related to surgery accounted for more than 40.1% of the total number, thereby accounting for the highest proportion. These statistics verify the seriousness of safety-related issues in operating rooms [2].

Generally, operating rooms have a comparatively high risk of medical accidents and/or errors, which can be fatal to patients [3].

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As errors in operating rooms are directly connected to patients' lives, patient safety in this area should be given more thorough consideration [4]. The role of perioperative nurses is exceptionally significant in ensuring patient safety [5,6]. Patient safety incident reporting [PSIR] is a crucial mechanism for improving patient safety [7]. The number of incidents reported in many countries such as South Korea is used for measuring risk management and quality improvement of hospitals. Through this report, hospitals could conduct system improvement and hospital service education by discovering major errors and systemic problems [8–10].

PSIR involves attitudes and behaviors on the part of those tasked with incident reporting. An earlier study reported that the PSIR behaviors of nurses were associated with their attitudes toward PSIR [11]. It is obvious that fewer patient safety incidents are reported than occur in practice [12]. The medical staff was reported to avoid patient safety incident reporting mainly due to criticism over and stigma regarding the occurrence of such incidents [13]. To overcome this problem, a “no blame culture” has been emphasized in many countries. This “no blame culture” has recently been settled upon as the concept of “just culture.” Just culture refers to a culture that encourages members of an organization to exchange important information on safety, compensates them when they perform such information exchange, and ultimately increases trust among members [14]. Just culture encourages the members of an organization to exchange important safety information by compensating them when they perform proper information exchanges, and ultimately increases trust among the members [15,16]. The establishment of just culture in hospital organizations enhances the patient safety incident reporting system by developing an atmosphere where people can be openly informed about patient safety incidents [17]. It also supports organizational control by increasing workers' capabilities and contributes to effective problem solving related to patient safety incidents [14]. Previous studies indicated that a just culture increased the number of patient safety incidents reported, helped medical staff to learn from the incidents reported, reduced the possibility of further patient safety incidents, and ultimately, improved patient safety [5,14,17]. However, just culture has not yet been actively examined in many countries, including South Korea. Therefore, this study undertook an analysis of the impact of just culture on the attitudes and behaviors of perioperative nurses in South Korea regarding PSIR. It is anticipated that the study findings can be used as necessary baseline data to more widely establish just culture and increase patient safety in medical institutions in all countries.

Methods

Design, setting, and participants

The design involved a cross-sectional survey using nationwide participation. The inclusion criteria for the participants were as follows: 1) worked in the operating room in a tertiary hospital for a year or longer [18] and 2) experienced at least one patient safety incident related to nursing tasks, including a near-miss event, an adverse event, or a sentinel event, within the last six months. To estimate the sample size, G* Power program 3.1.9.2 was used. Based on a significance level (α) of .05, power (1-β) of .90, medium effect size ($f^2 = .15$), and 16 predictors, the estimated sample size was 175. We selected a medium effect size because, in a previous study of nurses at a hospital in South Korea [19], the effect of just culture on patient safety management had an R^2 value of 0.21 ($f^2 = 0.26$), which is near the level of medium effect size. Considering a dropout rate of 20%, a total of 220 subjects were recruited.

Ethical considerations

This study was conducted with the approval of the Institutional Review Board (IRB NO: JBNU 2020-07-007-001). To ethically protect participants, the following actions were clearly stated. First, submitted questionnaires were encrypted. Second, response details and personal information were guaranteed to be confidential and used solely for research purposes. In addition, submitted questionnaires will be discarded after being stored in a separate, locked storage space for three years. It was also stated that participants would not experience any kind of disadvantage for withdrawing or refusing to participate in this study. To fully inform participants about this study, a research notice describing the purposes and details of this study and the name and contact information of these authors, was placed on the first page of the online questionnaire. Then, the question “do you voluntarily agree to participate in this study?” was presented, and participants were asked to select a response between “yes, I agree” and “no, I don't agree.” Only those who selected the response “yes, I agree” were permitted to move to pages with specific questionnaire items. In addition, when participants wished to receive a copy of the agreement, they were permitted to screenshot screens presenting the research notice and status of agreement and to use these screenshots as the copy of the agreement. Relevant details were clearly stated on the screen presenting details of the agreement.

Measurements/instruments

Just culture

This study used the just culture assessment tool (JCAT) developed by Petschonek et al. [20]. The original tool consisted of six factors and 27 items. The original tool was translated into Korean and revised according to the features of the Korean healthcare system. Translation and back translation were done by nursing professors and a professional English translation company. The contents of the revised tool (Korean translation), were validated by three nursing professors. In addition, three perioperative nurses were asked to review the terms used in this tool. Based on their review and their opinions reflecting their understanding of these terms, the term “manager” was adjusted to “nursing manager.” Through this process, the final version of the revised tool was created. This study conducted a factor analysis to verify 27 items of the original version, considering social and cultural background differences. The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were performed to identify whether or not the items were appropriate for a factor analysis ($p < .001$). The varimax rotation based on a principal component analysis was applied. After 2-times factor analysis considering Cronbach's α and eigen values, we confirmed 24 items. The factor loading values of all 24 items were .40 or higher [21], and the total variance was 61.7% [Appendix 1]. Finally, the 24 items and six factors selected as the final items and factors, were: “organizational trust” (eight items), “acceptance of opinions” (three items), “logical organizational system” (four items), “information exchange” (four items), “organizational balance” (two items), and “comfort in reporting” (three items). Each item was measured based on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much). The higher the score, the more strongly the target nurse perceived just culture to be firmly established in the organization. In this study, Cronbach's α of the revised just culture measurement tool was .86.

Attitudes toward patient safety incident reporting

The original tool for measuring nurses' attitudes and knowledge related to PSIR[12] was revised and used in this study. The original tool consisted of 17 items. One item (“I participated in education on

PSIR methods”) was excluded from the knowledge domain according to the comment of the expert, and the factor with three items was re-named “awareness of PSIR methods and procedures.” Consequently, the revised tool consisted of 16 items. Each item was measured based on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much). The higher the score, the more positive the attitude of the target nurse toward PSIR. In this study, Cronbach's α of the revised tool was .80.

Behaviors related to patient safety incident reporting

A research team developed a tool that included six items for use in this study. The six items were related to the number of near-miss events, adverse events, and sentinel events that the participants had experienced in their fields within the six months before the survey and the number of these events that they had reported in clinical practice. Specifically, the ratio of PSIR behaviors was calculated by converting the number of patient safety incidents that the participants had experienced in a clinical setting within six months of the survey and the number of those incidents that they had reported in practice as a percentage. A higher percentage indicated a higher degree of PSIR behavior.

General characteristics of the participants

The questionnaire on the general characteristics of participants consisted of 10 items selected by reviewing previous research. These were sociodemographic characteristics (age, gender, marital status, religion, and education level), and work and organization-related characteristics (total length of operating room career experience, position, working types, working hours per week, and nursing staffing grade: Nursing staffing grade is a standard used by the Korean government to provide additional reimbursement to hospitals, based on the ratio of nursing staff to inpatients.)

Data collection/procedure

This study involved an online survey using a self-reported questionnaire. Online data collection was performed from August 3 to September 21, 2020. In order to ensure anonymity and secure the reliability of the study, the data collection was conducted through an online survey method to ensure anonymity, as research subjects and institutions may be reluctant to expose their identity in relation to the behaviors of reporting incidents on patient safety, and the recruitment of research subjects was conducted nationwide by publicizing the recruitment guide to various organizations and individuals related to nursing and online. Those selected as participants gained access to the online survey based on a QR code and an online survey link. They were also provided with a coffee coupon as a compensation for participation. A total of 220 questionnaires were collected, and 208 were utilized for data analysis, excluding 12 insufficient responses. The distribution of the hospitals across the nation from which the 208 participants were recruited reflects a comprehensive regional representation. Specifically, participants were drawn from a variety of provinces, including Seoul (32.2%), Gyeonggi-do (17.8%), Gyeongsang-do (18.8%), Jeolla-do (21.6%), Chungcheong-do (7.7%), and Gangwon-do (1.9%).

Data analysis

Descriptive statistics and Pearson's correlation coefficients or Spearman's rank correlations were calculated to identify the degree and relationship between the research variables. Before the regression analysis, multicollinearity ($r < 0.80$), the Durbin-Watson index ($d_U < d < 4\text{-}d_U$), tolerance (>0.1), and the variance inflation factor (VIF < 10) were tested and accepted. Hierarchical multiple regression analysis and hierarchical logistic regression analysis were conducted to examine the effect of just culture on attitudes or behaviors related to PSIR. The Kolmogorov–Smirnov (K–S), Breusch-Pagan, and Hosmer–Lemeshow's tests, and a verification test based on the Nagelkerke R^2 value were conducted to evaluate the goodness of fit of the regression model. Factor analysis and Cronbach's α were performed. Factor analysis was performed for testing the construct validity of the just culture assessment tool. Statistical analyses were performed using SPSS WIN 23.0 (IBM SPSS Inc. Chicago, IL, USA) and set at a 5% level of significance.

Results

General characteristics of the participants

The average age was 29.8 ± 5.5 years old (range 22-53) and female participants accounted for 87.5%. Single participants accounted for 77.9% and those with no religion were 66.8%. Those who had graduated from nursing colleges or universities was 93.3%. About 52% of all participants had worked at ORs for more than two years and less than 10 years. The average work experience of participants in ORs was 3.86 ± 5.05 years and 90.9% of participants were staff nurses. Almost 71% of all participants performed shift work and 54.3% worked 40 hours per week. The average number of work hours per week was calculated to be 44.17 ± 6.17 hours (Table 1).

Difference in degree of just culture, as perceived by perioperative nurses, and their attitudes and behaviors with regard to patient safety incident reporting according to their general characteristics

Perioperative nurses' perceptions of just culture did not differ significantly according to their general characteristics ($p > .05$), while their attitudes toward patient safety incident reporting differed significantly according to work experience at operating rooms ($F = 7.51$, $p = .001$). To analyze differences in perioperative nurses' behaviors with regard to patient safety incident reporting according to general characteristics, participants were classified into two groups according to the average ratio of patient safety incident reporting behaviors. The two groups comprised, first, a group with active participation in patient safety incident reporting that demonstrated a higher rate of patient safety reporting behaviors than the normal rate, and second, a group with reluctant participation in patient safety incident reporting that demonstrated a rate of patient safety reporting behaviors below the normal rate. The analytic result indicated that the groups showed a statistically significant difference according to age ($\chi^2 = 6.10$, $p = .047$), academic background ($\chi^2 = 6.22$, $p = .013$), work experience at ORs ($\chi^2 = 7.63$, $p = .022$), and work hours per week ($\chi^2 = 6.37$, $p = .041$) (Table 1).

Degree of just culture, and attitudes and behaviors regarding patient safety incident reporting

The average score of just culture was 3.24 ± 0.47, and the attitudes regarding PSIR was 3.39 ± 0.46 out of 5 points. The average behaviors rate of PSIR was 65.1%, and the behavior rate of PSIR in near-miss events, adverse events, and sentinel events were 62.2%, 86.4%, and 79.5%, respectively (Table 2).

Correlation between just culture and attitudes and behaviors regarding patient safety incident reporting

A just culture was significantly positively associated with attitudes ($r = 0.62$, $p < .001$) and behaviors ($\rho = 0.24$, $p = .001$) regarding PSIR.

Table 1 *Differences in Study Variables According to Participants' General Characteristics (N = 208).*

Variable	Categories	*n* (%) M ± SD		Just culture			Attitudes			Behaviors			
				M ± SD	*t* or *F* (*p*) Scheffé		M±SD	*t* or *F* (*p*) Scheffé		High-rank group[a] (*n* = 128) *n* (%)	Low-rank group[a] (*n* = 80) *n* (%)	χ^2 (*p*)	
Age (years)	22~29	128	(61.5)	3.25 ± 0.48	0.32	.728	3.36 ± 0.47	1.30	.275	72(56.3)	56(43.7)	6.10	.047
	30~39	65	(31.3)	3.21 ± 0.45			3.41 ± 0.42			43(66.2)	22(33.8)		
	≥40	15	(7.2)	3.32 ± 0.47			3.55 ± 0.49			13(86.7)	2(13.3)		
		29.86 ± 5.51											
Gender	Men	26	(12.5)	3.27 ± 0.44	0.14	.709	3.47 ± 0.31	0.95	.330	16(61.5)	10(38.5)	0.00	>.999
	Women	182	(87.5)	3.24 ± 0.48			3.38 ± 0.47			112(61.5)	70(38.5)		
Marital status	Single	162	(77.9)	3.24 ± 0.49	0.04	.834	3.36 ± 0.45	2.60	.108	95(58.6)	67(41.4)	2.60	.074
	Married	46	(22.1)	3.25 ± 0.41			3.48 ± 0.45			33(71.7)	13(28.3)		
Religion	No	139	(66.8)	3.24 ± 0.46	0.01	.937	3.45 ± 0.37	1.82	.179	85(61.2)	54(38.8)	0.03	.107
	Yes	69	(33.2)	3.24 ± 0.50			3.45 ± 0.49			43(62.3)	26(37.7)		
Education level	3-year diploma, 4-year bachelor	194	(93.3)	3.24 ± 0.48	0.00	.997	3.37 ± 0.45	3.84	.051	115(59.3)	79(40.7)	6.22	.013
	≥Master degree	14	(6.7)	3.24 ± 0.43			3.61 ± 0.50			13(92.9)	1(7.1)		
Total length of operating room career experience (years)	1 ~<2^{a}	79	(38.0)	3.14 ± 0.46	2.74	.067	3.24 ± 0.47	7.51	.001	47(59.5)	32(40.5)	7.63	.022
	2 ~<10^{b}	109	(52.4)	3.30 ± 0.48			3.47 ± 0.42	c>a		63(57.8)	46(42.2)		
	≥10^{c}	20	(9.6)	3.30 ± 0.45			3.51 ± 0.47			18(90.0)	2(10.0)		
		3.86 ± 5.05											
Position	Staff nurse	189	(90.9)	3.23 ± 0.48	0.87	.353	3.38 ± 0.45	1.21	.272	114(60.3)	75(39.7)	1.30	.254
	Charge nurse	19	(9.1)	3.34 ± 0.39			3.50 ± 0.51			14(61.5)	5(38.5)		
Working type	Non-shift regular	60	(28.8)	3.25 ± 0.38	0.05	.818	3.36 ± 0.42	0.38	.537	37(61.7)	23(38.3)	0.00	.981
	Two or three shifts	148	(71.2)	3.24 ± 0.50			3.40 ± 0.50			91(61.5)	57(38.5)		
Working hours per week	40	113	(54.3)	3.29 ± 0.47	2.96	.054	3.43 ± 0.48	1.82	.164	78(69.0)	35(31.0)	6.37	.041
	40~<50	50	(24.0)	3.28 ± 0.42			3.39 ± 0.45			28(56.0)	22(44.0)		
	≥50	45	(21.7)	3.09 ± 0.51			3.28 ± 0.39			22(48.9)	23(51.1)		
Nursing	1 Grade	127	(61.1)	3.28 ± 0.47	2.33	.100	3.36 ± 0.45	2.84	.061	74(58.3)	53(41.7)	2.33	.312
Staffing	2 Grade	71	(34.1)	3.22 ± 0.48			3.47 ± 0.45			46(64.8)	25(35.2)		
Grade	3 Grade ~ 5 Grade	10	(4.8)	2.96 ± 0.40			3.14 ± 0.51			8(80.0)	2(20.0)		

[a] High-rank group = with an equal to or greater than average reporting rate; Low-rank group = with less than the average reporting rate.

Table 2 *Level of Perioperative Nurses' Just Culture Perceptions and Attitudes and Behaviors Regarding Patient Safety Incident Reporting (N = 208).*

Variables (numbers of items)	Possible range	Actual range	M±SD or *n* (%)
Just culture (24)	1~5	2.04~4.58	3.24 ± 0.47
Trust in organization (8)		1.25~5.00	3.37 ± 0.64
Openness of communication (3)		1.00~5.00	3.16 ± 0.83
Rational organizational system (4)		1.50~5.00	3.79 ± 0.63
Sharing information (4)		1.75~5.00	3.31 ± 0.74
Balance (2)		1.00~5.00	2.36 ± 0.87
Comfortable with incident reporting process (3)		1.00~4.67	2.75 ± 0.82
Attitudes regarding patient safety incident reporting (16)	1~5	2.08~5.00	3.39 ± 0.46
Concerns over evaluation and application (6)		1.00~5.00	2.67 ± 0.71
Belief in improvement effects (4)		2.33~5.00	3.77 ± 0.61
Intention of reporting (3)		1.00~5.00	3.88 ± 0.87
Awareness of patient safety incident reporting methods and procedures (3)		1.67~5.00	3.82 ± 0.73
Behaviors regarding patient safety incident reporting[a] (6)			65.1% (B/A = 1.36 ± 1.65/2.20 ± 2.49)
Near-miss (2) ($n = 199$)			62.2% (B/A = 1.04 ± 1.27/1.76 ± 1.77)
Preventable adverse event (2) ($n = 44$)			86.4% (B/A = 1.16 ± 0.53/1.64 ± 1.37)
Negligent adverse event (2) ($n = 26$)			79.5% (B/A = 1.00 ± 0.57/1.34 ± 0.63)

[a] Rate of behaviors regarding patient safety incident reporting $= \frac{\text{number of reported incidents (B)}}{\text{number of experienced incidents (A)}}$.

Effects of just culture on attitudes regarding patient safety incident reporting

A hierarchical multiple regression analysis controlling for exogenous variables was conducted to examine the effect of just culture on attitudes toward PSIR. Work experience in the operating room was set as a dummy variable in the analysis. In the first step, total length of operating room career experience (2 to <10 years) and (≥10 years) explained 6.0% of the attitudes regarding PSIR ($F = 7.51$, $p = .001$). The second step showed that just culture increased the explanatory power for attitudes regarding PSIR by 34.5%p ($F = 47.78$, $p < .001$), which was calculated to have a great effect size ($f^2 = 0.53$). The Kolmogorov–Smirnov (K–S) test ($Z = 0.05$, $p = .200 > .05$) indicated the assumption of normality, and the Breusch-Pagan test ($\chi^2 = 0.31$, $p = .861 > .05$) indicated that the regression model was appropriate (Table 3).

Effect of just culture on behaviors regarding patient safety incident reporting

A hierarchical logistic regression analysis controlling for exogenous variables was conducted to examine the effect of just culture on behaviors regarding PSIR. Age, education level, total length of operating room career experience, working hours per week, and just culture were determined as the variables to be input into the regression analysis. In the first step, the explanatory power was 12.0%. In the second step, the just culture was verified as a predictive variable with significant effects on behaviors regarding PSIR. Thus, as the score for just culture increased by 1, the odds for behaviors regarding PSIR increased by 2.25 times (OR = 2.25, $p = .017$). The explanatory power of the regression model based on dependent variables was 16.0% (Nagelkerke $R^2 = .16$). The Hosmer-Lemeshow's test was conducted to determine the goodness of fit of the logistic regression analysis model derived in this study. The result ($\chi^2 = 4.21$, $p = .838$) of the test verified the appropriateness of the estimated model [22] (Table 4).

Discussion

Statement of principal findings

The average score for just culture was 3.24 ± 0.47 out of 5 points, which indicated that nurses perceived just culture established in hospitals positively, and at a higher level than simply moderate. The average score for perioperative nurses' attitudes regarding PSIR was 3.39 ± 0.46 out of 5 points and perioperative nurses expressed positive attitudes regarding PSIR. In this study, average behaviors rate of PSIR in perioperative nurses was 65.1%, which exceeded the normal rate. As for safety incident reporting behaviors according to three types, the average rate of adverse events reporting was the highest at 86.4%. The average rate of sentinel and near-miss event reporting was 79.5% and 62.2%, respectively.

This study indicated that just culture perceived by perioperative nurses increased the explanatory power of their attitudes regarding PSIR by 34.5%. With an $f^2 = 0.53$, the effect size was verified to be significant. Also, just culture was verified as a predictive variable that had significant effects on behaviors. As the score for perioperative nurses' perceptions toward just culture increased by 1, the odds of engaging in PSIR behaviors increased by 2.25 times.

Strengths and limitations

This study performed a nationwide survey and proposed a just culture measurement tool with ensured validity and reliability based on nurses working in South Korea. This study also used accurate and logical statistical analyses. Its significance lies in the verification of just culture as a significant predictive variable affecting attitudes and behaviors regarding PSIR and for providing momentum for further research on just culture. However, the study also had a limitation. The participation rate of nurses over 40 years old was low, whereas more nurses in their 20s who had easy online access participated in the study. Therefore, there is a limitation in generalizing the results of this study.

Interpretation within the context of the wider literature

In a previous study [23], the average score of just culture perceived by hospital workers was 4.51 out of 7 points. In another study conducted in South Korea [19] on nurses working in various departments in hospitals, but not including perioperative nurses, the average score of just culture was 2.95 ± 0.25 out of 5 points. Thus, the average score in the present study exceeded those in the aforementioned studies. In a study of nurses conducted by Logrono [24], the average score in all subdomains of just culture was 4.2–5.3. The degree of just culture as perceived by perioperative nurses exceeded that of just culture, as perceived by general nurses

Table 3 *Hierarchical Multiple Regression Analysis of the Effect of Just Culture on Attitudes Regarding Patient Safety Incident Reporting by Perioperative Nurses (N = 208).*

Variable		Step 1		Step 2	
		β	*p*	*β*	*p*
Total length of operating room career experience (2~< 10 years)		0.26	<.001	0.16	.006
Total length of operating room career experience (≥10 years)		0.18	.013	0.12	.036
Just culture				0.60	<.001
	R^2	0.07		0.41	
	Adj. R^2	0.06		0.40	
	$\triangle R^2$ (*p*)			0.344 (<.001)	
	Δadj. R^2 (*p*)			0.345 (<.001)	
F		7.51		47.78	
p		.001		<.001	

Durbin-Watson = 2.124; Kolmogorov-Smirnov (Z = 0.05, *p* = .200); Breusch-Pagan (χ^2 = 0.31, *p* = .861); tolerance (0.86~0.97); variance inflation factor (1.03~1.16); dummy variable: total length of operating room career (1~<2 years) = 0.

working in various hospital departments. However, this difference can only be generalized to a limited extent because few studies have examined just culture based solely on nurses. For this reason, additional research should be conducted to compare just culture as perceived by perioperative nurses to that perceived by nurses working in different departments to specifically analyze just culture perceived by different nursing domains.

A previous study [25] reported that the average score for the attitudes of nurses working in hospital wards regarding PSIR was 4.01 ± 0.48 out of 5. However, in our study, we found that the attitude regarding PSIR events scored lower. This result contrasts with our findings, where concerns over evaluation and application received the lowest scores. This discrepancy may be attributed to differences in the nursing practice settings. Perioperative nurses exhibit different attitudes regarding PSIR compared to nurses in general wards, as patient safety incidents experienced in the perioperative setting can be critical and potentially fatal, often leading to medical disputes. Although the items used in our study differ from those in Kim et al. [11], preventing a direct comparison, it is evident that perioperative nurses have distinct methods, procedures, and scopes for reporting patient safety incidents compared to nurses in other departments.

Bagenal, Sahnan, and Shantikumarm [26] found that nurses reported more patient safety incidents than doctors (96% of nurses vs. 52% of doctors) and that nurses' attitudes regarding PSIR were more positive than those of doctors. Moreover, 61% of nurses responded that they perceived PSIR positively but at the same time, they felt severely pressured by criticism concerning the incidents [26].

The lowest rate of near-miss events reported was an unexpected result, given that a number of hospitals have modified their systems to increase the number of near-miss events reported. Furthermore, it was initially assumed that the proportion of sentinel events reported would be the highest, but it was not. These results could be understood by a previous study reporting [27] that most nurses had an inadequate level of perception regarding the importance of PSIR, and they tended to believe that only errors that directly affected patients should be reported. Consequently, they were more likely to avoid reporting near-miss events. Kim et al. [11] stated that only 26.3% of nurses working in tertiary medical institutions always reported medical malpractice cases that had negative effects on the patients. Therefore, the PSIR rate of 65.1% in this study was comparatively high. In a previous study [11], the rate of all patient safety incidents related to medication errors, injuries from falling, and blood transfusions reported by nurses working in hospitals in South Korea was 51.3%. In a study conducted by Baker and Norton [28], the rate of all patient safety incidents voluntarily reported by medical teams including nurses in another country was 23.0%. Thus, the rate derived in this study exceeded the rates reported in the aforementioned studies. In addition, the rate of sentinel event reporting was 79.5% in this study, which was lower than that for

Table 4 *Hierarchical Logistic Regression Analysis of the Effect of Just Culture on Behaviors Regarding Patient Safety Incident Reporting by Perioperative Nurses (N = 208).*

Variable	High-rank behaviors group (vs low-rank group)							
	Step 1				Step 2			
	B	OR	95% CI	*p*	*B*	OR	95% CI	*p*
Age (30~39 years)	0.23	1.26	0.63 ~2.52	.514	0.29	1.33	0.66 ~2.70	.424
Age (≥40 years)	−0.43	0.65	0.05 ~9.30	.750	−0.48	0.62	0.04 ~9.41	.731
Education level (masters or higher)	1.67	5.32	0.64 ~44.29	.122	1.72	5.60	0.67 ~47.10	.113
Total length of operating room career experience (2~<10 years)	−0.11	0.89	0.48 ~1.66	.721	−0.27	0.77	0.40 ~1.46	.418
Total length of operating room career experience (≥10 years)	1.78	5.90	0.47 ~73.81	.168	1.73	5.65	0.42 ~76.11	.192
Working hours per week (40 hours)	0.80	2.21	1.06 ~4.62	.034	0.67	1.96	0.92 ~4.14	.080
Working hours per week (40~< 50 hours)	0.32	1.38	0.59 ~3.24	.461	0.18	1.19	0.50 ~2.86	.693
Just culture					0.81	2.25	1.15 ~4.39	.017
Nagelkerke R^2	.12				.16			
Hosmer-Lemeshow's $\chi^2(p)$	2.53(.925)				4.21(.838)			
$x^2(p)\lfloor\Delta x^2(p)\rfloor$	19.26(.007)				25.24 (.001)[5.98(.014)]			

Tolerance (0.31~0.86); variance inflation factor (1.17~3.19); dummy variables: age (22~29 years) = 0, education (≤4-year bachelor) = 0, total length of operating room career (1~< 2 years) = 0, working hours per week (≥50 hours) = 0.

adverse event reporting (86.4%). This result was obtained because medical staff felt pressured to report fatal and permanent damage to patients caused by sentinel events. It could also have been affected by the sense of guilt felt by staff for accusing their medical colleagues of such malpractice, and their concerns over the possibility of lawsuits filed due to medical malpractice.

This study presented just culture as a significant predictive factor for attitudes and behaviors regarding PSIR. It was clear that perioperative nurses expressed more positive attitudes regarding PSIR when they perceived that just culture was firmly established in their workplaces. DiCuccio [29] found that just culture increased people's awareness of PSIR; reduced the death rate, rehospitalization rate, and rehospitalization period; and increased the level of satisfaction of patients and their families. In addition, the OR of 2.25 in this study was highly significant for verifying the importance of just culture in affecting perioperative nurses' behaviors. Haw et al. [30] conducted interviews with nurses and found that they avoided reporting near-miss events, mainly out of fear. Katie & Gerry [5] stated that a higher level of just culture firmly established in an organization increased the number of patient safety incidents reported. Moreover, the incident reports helped medical teams to learn from these cases, reduced the possibility of future patient safety incidents, and ultimately, enhanced patient safety. The balance between individual responsibility and systemic responsibility is ensured based on a system that avoids the simple criticism of individuals. Therefore, it appears highly advisable to encourage the establishment of a just culture in medical institutions, increasing practical behaviors regarding PSIR, and developing specific patient safety systems.

Implications for policy, practice, and research

It is expected that these findings can be utilized as essential baseline data to develop specific action plan strategies for enhancing the attitudes and behaviors of perioperative nurses with regard to PSIR, by making the just culture of operating room and hospitals. In a just culture, shared responsibility is the norm, and various processes are conducted to reduce the possibility of mistakes. Recognizing that individual nurses should not be held responsible for patient safety incidents beyond their control will also help establish a just culture. Also, nursing unit managers should try to create an atmosphere within the organization where even experienced nurses are not blamed when mistakes occur. Due to these reasons, tailored-education program of just culture for each position is required in operating room and hospitals. Through this education, each member can learn how to communicate without blaming others. At the same time, the operating room and hospitals should create guidelines based on just culture and promote just culture to employees by conducting campaigns and education. In addition, the just culture should be prioritized for patient safety incidents, and nursing unit managers, including medical staff and employees, should take the lead in preventing medical accidents by transparently investigating the weaknesses of safety accidents to identify strengths and improvements. In other words, it is necessary to establish a code of conduct to create the just culture in the hospital and a policy for voluntary reporting of patient safety incidents. Future research should aim to identify the individual and organizational characteristics that influence the culture of fairness. This additional study is necessary to understand the factors at both the personal and systemic levels that contribute to the development and sustainment of a just culture. This study further suggests directions for future research. First, extensive studies should be conducted to examine the effects of the perception of nurses working in departments other than operating rooms toward just culture and its relationship to PSIR. Second, other major variables affecting nurses' behaviors regarding PSIR should also be identified. Finally, factors affecting the establishment of just culture in medical institutions require further investigation.

Conclusions

This study empirically verified the effects of just culture as perceived by perioperative nurses on their attitudes and behaviors regarding PSIR in nursing practice. It is significant for verifying that just culture is a significant predictive variable affecting perioperative nurses' attitudes and behaviors regarding PSIR. It also provides a momentum for further research on just culture. To increase the perioperative nurses' attitudes and behaviors regarding PSIR, just culture must be preceded. In addition, the significance of this study is that it has established a just culture measurement tool based on nurses working in South Korea with ensured validity and reliability in the current circumstances. It is expected that the findings of this study will be used as essential baseline data to improve the patient safety of operating room in hospital, worldwide.

Ethical statement

This study was conducted after obtaining approval from the Institutional Review Board (IRB) of JBNU (IRB NO: JBNU 2020-07-007-001). Main ethical considerations involved consent, privacy, and confidentiality of participants. The consent form also stated and explained that there would be no negative consequence associated with drop-out or refusal to participate in this study.

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None.

Conflict of interest

There are no known conflicts of interest.

Data sharing statement

The data underlying this article will be shared upon reasonable request to the corresponding author.

Source of research

None.

IRB Approval

This study was conducted with the approval of the Jeonbuk National University's Institutional Review Board Investigator (IRB NO: JBNU 2020-07-007-001).

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Appendix 1 *Factor Analysis of Just Culture Scale.*

Factor		Items	Factor loading						Eigen value	% of variance
			1	2	3	4	5	6		
1. Trust in organization	1	The hospital adheres to its own rules and policies.	0.77						6.33	18.14
	2	By entering reports, I'm making the hospital a safer place for the patients.	0.73							
	3	The hospital devotes (time/energy/resources) toward making patient safety improvements.	0.72							
	4	I trust that the hospital will handle events fairly.	0.71							
	5	Each employee is given a fair and objective follow up process regardless of his/her involvement in the event.	0.70							
	6	The hospital sees events as opportunities for improvement.	0.68							
	7	There are improvements because of event reporting.	0.61							
	8	I trust supervisors to do the right thing.	0.47							
2. Openness of communication	9	Staff can easily approach supervisors with ideas and concerns.		0.82					2.75	10.49
	10	If I had a good idea for making an improvement, I believe my suggestion would be carefully evaluated and taken seriously.		0.78						
	11	Supervisors respect suggestions from staff members.		0.74						
3. Rational organizational system	12	My supervisors encourage me to report.			0.66				1.83	9.15
	13	Staff members use event reporting to “tattle” on each other.			0.64					
	14	Reports are being evaluated and reviewed after they're entered.			0.61					
	15	Coworkers discourage each other from reporting events.			0.56					
4. Sharing information	16	I often hear about event conclusions and outcomes.				0.80			1.72	8.88
	17	We don't know about events that happen in our unit.				0.74				
	18	Staff feel uncomfortable discussing events with supervisors.				0.60				
	19	The management does a good job of sharing information about events.				0.50				
5. Balance	20	Staff members fear disciplinary action when involved in an event.					0.82		1.12	7.93
	21	Staff members are usually blamed when involved in an event.					0.79			
6. Comfortable with incident reporting process	22	I feel comfortable entering reports about events in which I was involved.						0.77	1.07	7.12
	23	I am uncomfortable with others entering reports about events in which I was involved.						0.74		
	24	I feel comfortable entering report where others were involved.						0.54		
Total										61.71

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Research Article

Post-Treatment Experiences of Reproductive Concerns Among Young Breast Cancer Survivors: A Descriptive Phenomenological Study

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SUMMARY

Purpose: The long-term fertility impact of cancer treatments is a significant concern for young breast cancer survivors. These reproductive concerns often become a persistent source of stress, negatively affecting their quality of life. This study aims to explore the reproductive concerns experienced by young breast cancer survivors post-treatment and the factors influencing their perceptions.
Methods: This phenomenological study utilized semi-structured interviews to collect data. Eighteen participants were recruited from a tertiary hospital in Mainland China. The interviews were transcribed verbatim and analyzed using Colaizzi's method.
Results: Data analysis revealed five themes and fourteen subthemes: (1) multiple emotional burdens interwoven with concerns about fertility; (2) concerns about risks associated with reproduction; (3) dilemma of childrearing; (4) the significance of reproduction; (5) support needs from family, peers, and professionals.
Conclusion: Young breast cancer survivors in China face significant challenges related to reproductive issues. Reproductive health is a crucial aspect of breast cancer survivorship care. Healthcare providers must be attentive to the reproductive concerns of survivors, recognize the importance of multidimensional support for positive adaptation, and offer tailored and ongoing interventions to manage reproductive health in young breast cancer survivors.

Introduction

Breast cancer is the most common cancer affecting women's health globally. Studies have demonstrated that the average onset and peak ages for breast cancer in Asian countries are earlier than those in Western countries such as the U.S. In China, the peak age is between 40 and 59 years [1], in Korea, it is between 45 and 49 years [2], and in the U.S., it is around 70 years [3], indicating a notably younger trend in Asia. In China, young patients (<40 years old) represent 18.7% of all breast cancer cases [4], compared to 4% in Western countries [5].

With advancements in early screening and comprehensive therapies, the 5- and 10-year survival rates for breast cancer patients have reached about 90% and 80%, respectively [6]. During their extended survival, young survivors encounter numerous challenges as they reintegrate into their normal lives, such as a higher risk of recurrence, poor prognosis [7], treatment side effects including hair loss, fatigue, sexual dysfunction, sleep disorders, and pain [8,9], as well as sequelae such as changes in body image, anxiety, depression, fear of cancer recurrence, and fertility issues [10]. Research indicates that young women with breast cancer face significant reproductive challenges, including ovarian damage due to comprehensive treatment, the impact of childbirth on prognosis [11], effects on pregnancy outcomes [12], and concerns regarding the safety of fertility preservation techniques [13] and assisted reproductive technologies [14]. These reproductive concerns, encompassing reproductive function, personal health, child health,

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and childrearing, can be more distressing than the cancer itself and severely impact the quality of life. Consequently, young breast cancer survivors often experience more profound negative effects on aspects of femininity, sexuality, marriage, maternal characteristics, and parenting compared to their healthy peers [15]. Understanding the experiences and perspectives of these reproductive concerns is crucial for providing individualized fertility counseling and managing reproductive health, yet such insights remain limited in China.

Studies have shown that this population has high fertility needs. Due to the trend of young onset, postponement of marriage and childbearing, and the Chinese “two-child and three-child” fertility incentive policies [16], more young breast cancer survivors are unmarried or still planning for children at the time of diagnosis. In the United Kingdom, 40% of young breast cancer survivors post-treatment reported a desire to have children, compared to 26% in China [17]. However, only 3% of breast cancer patients conceive after treatment [18], indicating that the desire for parenthood remains largely unfulfilled. Despite the availability of fertility preservation and assisted reproductive technologies to mitigate infertility associated with cancer treatments, only 1.9% of patients undergo fertility preservation [19], which may be due to inadequate knowledge about these options and limited fertility counseling services [20].

Evidence indicates that young breast cancer survivors face significant reproductive challenges and pressures. These survivors are at a critical stage in life, balancing responsibilities such as forming relationships, raising children, and advancing their careers. Young women face a heightened risk of psychosocial issues (anxiety, depression, stress symptoms) due to unique stressors, such as disruptions in their expected life roles and responsibilities [21]. The prevalence of clinically significant anxiety and depression in this group is 44% and 20%, respectively, higher than rates seen in mixed-age populations [22]. Some oncological treatments impair fertility both short- and long-term and may also affect fetal development [23]. Breast cancer in young patients is also more likely to recur and metastasize post-treatment compared to older patients. Approximately 5%—10% of breast cancer patients with gene mutations have a 50% chance of passing these mutations to their offspring, which heightens concerns about genetic risks for their children [24]. Additionally, parenting is particularly challenging for young breast cancer survivors due to factors such as symptom burden, insufficient social support, unmet information needs about fertility, and financial difficulties [25].

As a result of reproductive challenges and pressures from individuals, families and societies, patients may experience ongoing psychological stress related to ambivalence about their reproductive needs and risks, leading to various reproductive concerns. Reproductive concerns are one of the psychosocial impacts of fertility impairment for cancer survivors, especially among female breast cancer survivors. One study indicated that 58% of breast cancer survivors reported high levels of reproductive concerns [26]. Despite the availability of fertility preservation measures, survivors may experience regret related to decision-making. Moreover, higher levels of reproductive concerns are associated with anxiety, depression, emotional maladjustments, and compromised quality of life [27].

Gaining insight into the experiences of living with reproductive concerns is crucial for healthcare professionals to provide appropriate care. Existing qualitative research has largely focused on young breast cancer survivors in Western countries, exploring topics such as fertility risks [28], fertility decision-making, and unmet reproductive information needs [29]. However, research on this population in East Asian countries, which share similar cultural backgrounds, remains relatively limited [30]. East Asian family structures and dynamics, characterized by extended family co-residence, strong family ties, and the paramount importance of family lineage [31], suggest a distinct cultural valuation of family and reproduction. In Chinese culture, a particular emphasis is placed on lineage and ancestral worship, with filial piety serving as the core value of the family. Consequently, perspectives on reproduction among young Chinese women with breast cancer may differ significantly from those in other regions. One's reproductive and parental experience is heavily influenced by culture, society, economic status, healthcare systems, and individual beliefs [30]. Identifying needs specific to this cultural context will enhance the broader understanding of reproductive concerns and can assist survivors of Asian origin globally. Thus, this qualitative study aimed to explore the reproductive concerns of young breast cancer survivors in China.

Methods

Design

A descriptive phenomenological qualitative design involving face-to-face semi-structured interviews was employed. This approach provides a rich, intuitive description of participants' lived experiences, emotions, behaviors, and factors influencing their reproductive concerns. Data analysis was conducted using Colaizzi's method, which offers sequential, detailed steps that enhance the reliability and dependability of the results [32]. The COREQ (Criteria for Reporting Qualitative Research) checklist was utilized to ensure the quality of the design and reporting of this study [33].

Setting and participants

Participants were recruited from the inpatient and outpatient services of a mammary gland department at a tertiary oncology hospital in Changsha, Hunan Province, China, from October 20, 2022 to January 31, 2023. Purposive sampling ensured the selection of participants who could provide deeper insights into the phenomenon of interest. The hospital, equipped with 220 beds, serves approximately 6,250 patients annually from urban and surrounding rural areas. Eligible participants were (1) females; (2) under 40 years old [23]; (3) who had completed primary therapy (surgery, chemotherapy, and/or radiation); (4) who had discussions with healthcare providers about pregnancy or had actual plans or attempts to conceive; and (5) who had normal fertility prior to diagnosis, without any symptoms of infertility. Exclusions included: (1) cancer recurrence and metastasis; (2) a diagnosis of cancer stage IV; and (3) an inability to communicate.

The first author, an experienced oncology specialist nurse (female, unmarried, postgraduate), was responsible for clinical nursing education and discharge follow-up care in the mammary gland department. The female research team comprised two principal investigators (one breast care nurse specialist and one postgraduate in oncology nursing) and three researchers (one chief nurse, one chief physician, and one follow-up nurse). Maximum variation sampling was employed, using medical records to obtain diverse sociodemographic and medical characteristics of participants. Access is limited to patient medical record information related to this study. The team adhered to ethical principles, maintaining the confidentiality of all medical data and ensuring that it was not freely disseminated. After establishing trusted relationships with potential participants, the first author explained the study's purpose, procedures, benefits, and risks, and that the interviews would be audio-recorded. In total, 23 patients were invited for interviews, with five declining to participate.

Data collection

Semi-structured interviews were chosen to allow interviewees to share and construct their perceptions of reality based on their experiences and interpretations of facts [34]. The follow-up nurse pre-arranged the interview times and locations with potential participants who met the inclusion criteria. Participants were typically interviewed after their routine re-examinations in a quiet and private setting such as an interview room or small meeting room, with only the participant and interviewer present. The first author conducted all interviews to maintain consistency. Prior to the study, the first author completed a course on qualitative research methodology and received specialized training in conducting interviews. According to the researchers' clinical practical experience and literature review, interview guidelines were formulated and revised by consulting relevant experts, and pilot interviews with two participants were conducted to refine the guidelines (Table 1). Before embarking on a study, the first author conducted pilot interviews with two participants to test the interview questions and gain some practice in interviewing. Based on the results of the pilot interviews, we reworded and reordered the interview questions to ensure data quality and more in-depth responses from participants. An interviewer guide, developed from previous studies on fertility experiences, was used to interject follow-up questions and prompts as needed. All conversations began with the same question: “Please talk about your experience after the diagnosis of breast cancer.” The interviewer remained open and neutral throughout the process and encouraged participants to express themselves freely. All interviews were audio recorded, and field notes capturing the interviewees' facial expressions, body language, and the interviewer's reflections were taken immediately after each interview. Three participants were interviewed twice for clarification and supplementary data due to their vague responses, while the remaining participants were interviewed once; each interview lasted between 35 and 95 min. Two pilot interviews were included in the data analysis because they provided meaningful information.

Data analysis

The recordings were professionally transcribed and the accuracy verified by the research team prior to analysis. The first and second authors independently conducted the coding, adhering strictly to Colaizzi's method [35]. Initially, both coders immersed themselves in the data by rereading the transcriptions, field notes, and reflections. They independently coded the transcripts to identify significant statements concerning participants' reproductive concerns, which were then abstracted and clustered into similitude coding units during the interaction and induction processes. The coders discussed and compared the first six transcripts until consensus was reached on the codes and coding definitions, and developed the initial coding framework, which included themes and subthemes. Following this, the remaining transcripts were coded. Data saturation was reached by the 15th interview, as no new information or insights emerged [36]; however, three additional interviews were conducted to confirm saturation. The emergent themes closely related to the research phenomena were defined and integrated into a comprehensive and consistent description. Finally, the fundamental structure of the phenomenon was described. Coding was conducted in Chinese, and the themes and quotes were translated into English by the first author and back-translated by the second author to ensure accuracy of the translation.

Table 1 *Interview Guidelines.*

Interview questions	
1	Please talk about your experience after diagnosis of breast cancer?
2	Please tell me about your opinion on fertility?
3	Have any family plans had to change since you got the disease?
4	What do you think about the factors that affect your fertility?
5	What is your family members' attitude toward your fertility?
6	What do you think about fertility preservation and assisted reproductive technologies?
7	What would be your attitude if you found out you were pregnant?
8	What do you think are the possible obstacles if you had a fertility experience?
9	What your opinion about rearing children?
10	What type of support or resources could help you?

Methodological rigor

Trustworthiness was applied to ensure qualitative rigor [37]. (1) Credibility: Some authors had backgrounds as nurses in mammary gland department and had experience in cancer nursing care and qualitative research training. The interviewer developed trusting relationships with participants through involvement in daily clinical nursing activities to enhance immersion and continuous observation. Frequent meetings were held by the entire author team to form, discuss, and define themes, clusters, and categories. Additionally, bias from researchers who cared for the patients was identified and mitigated during data collection and analysis. We reflected on each step of the research process to examine how researchers' demographic characteristics, experiences, and presuppositions might influence interactions with participants and the interpretation of results. We also shared the results with five participants and obtained their agreement on the analysis outcomes. (2) Confirmability: A detailed audit trail, including the original recordings, verbatim scripts, and data analysis records, was maintained for future verification and traceability. (3) Dependability: A qualitative theory expert outside the research team was invited to conduct peer debriefing to reduce bias and assist in refining the coding framework throughout the data analysis process. (4) Transferability: The diversity of participants' characteristics and the depth of the interviews ensured transferability.

Ethical consideration

Before recruitment, approval was obtained from the Ethics Committee of Hunan Cancer Hospital (No. KY2022284) on October 15, 2022. Participants were informed that they could refuse to answer any questions or withdraw from the study at any time without consequence and provided written informed consent before the interviews. All data were kept confidential, stored securely, and were accessible only to the research team. Identifying information was removed from the verbatim drafts, and participants' names were replaced with numbers (P01–P18). Given the sensitivity of topics such as breast cancer diagnosis and treatment, as well as reproduction, care was taken to minimize emotional distress for participants. To preserve interviewees' psychological well-being, those displaying significant distress were referred to a psychological counselor for free counseling and a follow-up visit one week later. Each participant received a small gift as a token of appreciation after the interview.

Results

Characteristics of the participants

All 18 participants contacted completed the interviews; none withdrew during the study. Participants' personal characteristics are detailed in Table 2.

Themes

The analysis generated five themes and 14 subthemes, highlighting significant psychological fluctuations among young breast cancer survivors due to reproductive concerns. These included multiple emotional burdens intertwined by fertility, concerns about risks arising from reproduction and the dilemma of child-rearing. Moreover, they argued that fertility represented certain things, including rehabilitation motivation, desiring the identity of motherhood, and maintaining family relationships. Furthermore, young breast cancer survivors require multiparty support to address their reproductive concerns. Table 3 presents extract of the themes and related subthemes.

Theme one: multiple emotional burdens intertwined by fertility

Fertility is a primary concern for young breast cancer survivors. Most participants reported negative emotions related to family planning, including distress, anxiety, worry, devastation, depression, disappointment, shame, and uneasiness. They expressed fears that declining fertility and changes in their sexual lives after primary cancer treatment might hinder their ability to conceive successfully. Some patients realized that lengthy treatments could cause them to miss their prime reproductive years. Additionally, societal and familial pressures related to infertility often compounded their stress.

Subtheme one: awareness that disease impair their fertility

Some breast cancer survivors reported achieving a good quality of life after primary cancer treatment. As their fear of cancer receded, their desire for fertility became more urgent. Participants who were preparing for pregnancy expressed concerns about the potential impact of treatment on the female genital system. They were worried that a decline in fertility could hinder their chances of successfully conceiving.

> *It has been three years since I was diagnosed with breast cancer, and now I am planning to get married. We want to have a child of our own … I know the treatment hurt my ovaries, and I currently have irregular periods … I am very confused about whether I can still get pregnant (Eyes turn red).* (P06, 27 years old)

Subtheme two: fear of missing the prime age for childbearing due to ongoing treatment

Some participants expressed concerns that lengthy endocrine treatment would cause them to miss their prime childbearing years, thereby diminishing their fertility and reducing the likelihood of conception.

> *To be honest, I would have been 40 years old after completing endocrine treatment. By then, I would be too old, missing the best age to have children. There is also the possibility of needing to adjust the treatment plan due to a relapse. The longer the treatment, the less likely I am to have a successful pregnancy.* (P04, 30 years old, history of miscarriage after cancer)

Table 2 *Characteristics of the Participants.*

ID	Age (years)	Marital status	Number of children	Education	Occupation	Duration of illness (months)	Family history of cancer	Treatment details	Operation method	fertility preservation
P1	39	Remarried	1	Middle school	Clerk	38	No	①②④	Left breast modification radical resection + breast reconstruction	No
P2	33	Married	0	Middle school	Unemployed	18	No	①②③④	Right breast modified radical resection	Cryopreservation embryos
P3	31	Divorced	1	College or above	Teacher	16	Yes	①②③④	Right breast radical resection	No
P4	30	Married	1	Middle school	Unemployed	36	No	①②③④	Right breast modified radical resection	No
P5	29	Married	2	Middle school	Freelancer	8	Yes	①②③④	Left breast modification radical resection + breast reconstruction	No
P6	27	Single	0	High school	worker	30	No	①②③⑤	Right breast modified radical resection	No
P7	39	Married	2	Middle school	Unemployed	24	No	①②④	Right breast modified radical resection	No
P8	39	Married	1	College or above	clerk	50	No	①②④	Right breast modified radical resection	No
P9	37	Married	1	College or above	Accountant	72	No	①②④⑤	Right standard breast conserving surgery	No
P10	33	Single	0	College or above	Designer	14	No	①②③④	Right breast modification radical resection + breast reconstruction	Ovarian cryopreservation
P11	36	Married	1	College or above	Teacher	36	No	①②④	Left breast modification radical resection + breast reconstruction	No
P12	32	Married	2	High school	Unemployed	108	No	①②	Left breast modified radical resection	No
P13	32	Married	1	College or above	Pharmacist	16	Yes	①②③④	Right breast modification radical resection + breast reconstruction	No
P14	35	Married	2	College or above	Nurse	78	No	①	Left breast modification radical resection + breast reconstruction	No
P15	28	Single	0	High school	Student	12	No	①②④⑤	Left breast modification radical resection + breast reconstruction	No
P16	35	Married	0	High school	Unemployed	19	No	①②	left standard breast conserving surgery	No
P17	30	Single	0	College or above	Civil servant	15	No	①	Right standard breast conserving surgery	Ovarian cryopreservation
P18	33	Married	1	College or above	Military	8	No	①②③	Left breast modification radical resection + breast reconstruction	Yes

①Surgery; ②Chemotherapy; ③Radiation therapy; ④Endocrine therapy; ⑤Targeted therapy; ⑥Traditional Chinese medicine therapy.

Table 3 *Themes and Related Subthemes.*

Themes	Subthemes
Multiple emotional burdens intertwined by fertility	1. Awareness that disease impair their fertility 2. Fear of missing the prime age for childbearing due to ongoing treatment 3. Psychological pressure from family and society due to infertility
Concerns about risks arising from reproduction	1. Concerns about pregnancy as a threat to one's health 2. Fear of own illness affecting the health of their offspring
Dilemma in childrearing	1. Insufficient ability of nurture 2. Inability to accompany growth 3. Financial stress of parenting
Meaning of reproduction	1. Get rehabilitation motivation 2. Desire for the identity of motherhood 3. Maintain family integrity
Support needs from family, peers, and professional	1. Craving for family and peer support 2. Need for multidimensional support from medical personnel 3. Provision of continuous pregnancy management from the multidisciplinary team

Subtheme three: psychological pressure from family and society due to infertility

A range of sexual issues, including reduced libido, vaginal dryness, and painful intercourse, persist in young breast cancer survivors after treatment, creating barriers in their marital lives and the formation of romantic relationships. Some married participants were concerned that an unsatisfactory sexual life with their spouse might lead to conception difficulties and felt a strong sense of inferiority. For single survivors, the uncertainty of fertility and cancer poses unique challenges. They fear rejection and avoidance by potential partners.

> *After the mastectomy, I couldn't even look at my breasts and the painful scars, let alone face my husband … Since I started taking tamoxifen, my husband and I haven't been able to enjoy sex. Gradually, I became very afraid of sexuality … How could we possibly have a baby?* (P7, 40 years old)
>
> *When we started dating, I was afraid to tell my boyfriend about my illness (breast cancer). I feared he would leave me. As our relationship progressed, sex and fertility became unavoidable issues, and we eventually broke up.* (P17, 30 years old)

Furthermore, the participants felt ashamed due to their long-term infertility, which was compounded by criticism from elders and societal judgments. They experienced significant negative psychological stress and stigmatization related to infertility.

> *My family wants me to have a baby, but it hasn't been successful … The atmosphere at home is tense, and I occasionally hear disparaging comments about my infertility from my elders and relatives. It's all because of my illness.* (P10, 33 years old)

Theme two: concerns about risks arising from reproduction

Participants consistently reported feelings of anxiety, fear, sadness, and regret due to the uncertainty surrounding potential reproductive risks. Concerns centered around recurrence, pregnancy discomfort, and the risks associated with fertility preservation methods, compounded by the residual toxicities of treatment, genetic heritability, and limitations of assisted reproduction technologies.

Subtheme one: concerns about pregnancy as a threat to one's health

Many young breast cancer survivors require adjuvant therapy after primary treatment. Those contemplating reproduction might pause their treatment to mitigate risks to the fetus, yet this interruption increases the risk of cancer recurrence. Additionally, hormonal fluctuations during pregnancy and breastfeeding are feared to increase susceptibility to recurrence, thereby impacting recovery and survival chances.

> *I need to prepare for pregnancy for the health of my child, which means I will postpone my endocrine treatment … Does this cause cancer to recur?* (P11, 36 years old)
>
> *I wavered on whether to have a baby before. I had heard that hormonal changes after pregnancy could stimulate my breasts … If I choose to breastfeed, I will not be able to check my breasts regularly for the next six months.* (P2, 33 years old)

Long after treatment, breast cancer patients often endure significant distress from cancer-related symptoms. Participants expressed concern that pregnancy could worsen these symptoms, negatively impacting their health.

> *You know that pregnancy can drain your body. Chemotherapy-induced vomiting scares me, and I really do not want to suffer from pregnancy-related vomiting again. My belly will get larger. Currently, I am tired when my activity level increases, and joint pain still plagues me. With only one healthy breast, I feel overwhelmed when I breastfeed, which makes me feel like my body cannot handle it.* (P5, 29 years old)

The initial diagnosis of breast cancer is profoundly distressing, with immediate concerns about the disease's threat to health. Even when considering fertility preservation techniques, participants were wary that these methods could delay treatment, potentially accelerate cancer progression, and inflict further harm.

> *The injection of ovulation promotion may influence my endocrine-type tumor. In my opinion, ovulation injections to freeze embryos or ovarian tissue freezing are traumatic to the body and require surgery.* (P18, 33 years old, received assisted reproductive technology)

Subtheme two: fear of own illness affecting the health of their offspring

Concerns about the health of offspring were evident in the interviews. There have been consistent reports that the toxicity of cancer treatments could have adverse teratogenic and fetal effects, potentially preventing the conception of a healthy child.

> *I used to use chemotherapy drugs, but now I am unsure. There were residual toxins in my body that could harm the unborn baby. If the child were born prematurely or with deformities, I would feel guilty for the rest of my life (tears in eyes).* (P12, 32 years old)

Breast cancer is partly due to inherited mutations in susceptibility genes, suggesting a risk of transmission to offspring. Some participants expressed concerns that their children might inherit the disease.

> *My mom and I have both undergone treatments for breast cancer, including mastectomies and experiencing hair loss and mental*

> *breakdowns … I know the horror of this illness, and it runs in our family. I cannot bear the thought of my daughter suffering this fate.* (P13, 32 years old)

While assisted reproductive technology might address infertility, participants were concerned that children conceived through such methods could face disadvantages in birth, growth, and development compared to those conceived naturally.

> *I am aware of in vitro fertilization, but these techniques do not guarantee a healthy baby. A friend told me that her baby was stillborn following in vitro fertilization. I am worried about having a child who may suffer from premature birth, have a weak immune system, or not develop optimally. I wouldn't want my child to be at a disadvantage from the start.* (P18, 33 years old, received assisted reproductive technology)

Theme three: dilemma of childrearing

Breast cancer survivors encounter more challenges in childrearing than healthy women. They often struggle with adequate nurturing abilities and face ongoing financial pressures from parenting. Concerns about their uncertain lifespan compound fears that they may not be around to see their children grow.

Subtheme one: insufficient ability of nurture

Some participants reported that limited stamina and ongoing treatment-related symptoms caused significant difficulties, including providing sufficient breast milk and tender care for toddlers. Their perceived inability to nurture adequately left them feeling emotionally overwhelmed. One pregnant participant detailed her nurturing challenges:

> *The joy of welcoming our newborn quickly turned to distress when I saw that my colostrum was scant and discoloured. I became irritable and frustrated when my child cried continuously. Why can't I breastfeed my baby properly? I still suffer from pain and stiffness in my shoulders and arms from the surgery … I worry that I might not be able to hold my baby. My physical strength and memory have deteriorated, making it difficult to care for my baby.* (P01, 39 years old, had one child after cancer)

Some participants experienced intense pressure at work, which compounded the challenges of balancing childcare and professional responsibilities. They felt depleted and concerned about their ability to manage both roles.

> *I need to work to support myself, and the demands of my job are exhausting. Having a baby requires significant adjustments, and I'm concerned that I won't be able to manage everything.* (P8, 39 years old)

Subtheme two: financial stress of parenting

Participants consistently described the financial stress associated with parenting. The inability to work following their illness and the costs associated with cancer treatment contributed to their strained financial situation. They found themselves unable to provide a materially abundant environment for their children during crucial developmental years.

> *I am currently unemployed, and the treatment has depleted our family savings, so the only financial resources for the entire family come from my husband … Honestly, assisted reproductive technology and raising children cost a lot of money … You need to consider the cost of food, clothing, education, and other necessities.* (P16, 35 years old)

Subtheme three: inability to accompany growth

Parental companionship is crucial in a child's development. Due to uncertainty about illness progression and prognosis, some participants worried that they might not live long enough to support their children through all stages of growth. They were concerned about the potential impacts on their children's personality development, academic performance, and future.

> *I am afraid that I might relapse in three or five years. Is it selfish to have a child and potentially leave them in the world alone? I believe that children cannot thrive without their mothers. Children would be more outgoing and optimistic and would likely complete their education more successfully if I am around. The future is uncertain. I do not know who would continue caring for my children if I were to pass away. (sigh)* (P3, 31 years old)

Theme four: meaning of reproduction

Despite numerous obstacles, participants affirmed that reproduction holds special significance for them. It enabled them to confront and accept life's challenges and hardships. Motherhood not only motivates participants to recover, but also enhances their sense of self-worth and identity. Additionally, some mentioned that children are crucial for maintaining family cohesion and continuity.

Subtheme one: get rehabilitation motivation

The maternal role is vital for women throughout their lives. Mothers perceived a strong sense of responsibility to regain their health and adopted a proactive stance in the face of their irreversible illnesses.

> *Sometimes, I am so irritable that I want to discontinue treatment. Why do you have this disease? (…) But when my daughter was born, I felt hope and joy for a long time. My daughter cannot live without her mother, and she gives me strength. I will manage my body well, get treatment, and cherish my life!* (P13, 32 years old)

Despite fertility challenges, participants remain optimistic about childbearing and parenthood, actively learning about pregnancy preparation and parenting and mobilizing external resources, which help alleviate reproductive concerns.

> *I had confidence in myself … I will take the initiative to communicate with my husband about our fertility plans, firstly. The existing technology can help us … I will have regular maternity visits and monitor my health … If it remains unsuccessful, we can choose to adopt a child.* (P10, 33 years old)

Subtheme two: desire for the identity of motherhood

Continuing the family line underscores the unique value of women, and motherhood elevates their social roles. Some participants felt a loss of femininity and self-worth when they were unable to conceive, yearning for validation through the role of motherhood. Additionally, the childrearing process brings happiness and hope, fulfilling their need for love.

> *The illness made me lose everything as a woman—my long hair, breasts, and even deprived me of my right to be a mother … Not being a mother made me feel like my life as a woman was incomplete and filled with regret … Five years later, I became pregnant. The child is a gift from God. If I am with my child, I feel happy. All worries disappear, and all the suffering I have endured is worth it. (smiling)* (P14, 35 years old, had a child after cancer)

Subtheme three: maintain family integrity

Some participants emphasized that children are the bond that maintains the integrity and permanence of family relationships, as well as the hope and future for continuing the family line. Thus, they consider fertility indispensable.

> *When you hear your child's laughter, you feel that the whole family is filled with happiness and hope. The child's grandparents are grateful for the birth of their grandchild, which brings joy to the entire family.* (P12, 32, had one child after caner)

Theme five: support needs from family, peers, and professional

This theme highlights the multidimensional support required by young breast cancer survivors to address their reproductive concerns.

Subtheme one: craving for family and peer support

Amidst various stressors, young patients deeply value emotional support, particularly the understanding and assistance from family members, with spousal support providing the greatest comfort. They hoped that their spouses or future partners would empathize with their challenges, listen to their concerns, respect their reproductive choices, and share in the childrearing responsibilities to provide emotional relief. The support from other family members, including parents, is also crucial when making decisions about reproduction and childcare.

> *Rearing a child requires cooperation from both spouses. I hope that my husband supports my decision and understands the sacrifices I have made for childbirth. I want my husband to help share childcare tasks when I am tired.* (P16, 35 years old)
>
> *When I was pregnant with my second baby, my parents disagreed and said I was gambling with my life. The family atmosphere was tense Fortunately, I gained support from all around. Elders and friends helped us take care of our children, and fellow patients shared their experiences of illness and parenting. It makes me feel confident about overcoming difficulties.* (P09, 37 years old, had one child after cancer)

Support from peers plays a crucial role for young female patients, encompassing emotional communication, value recognition, and the exchange of knowledge and experience. The sharing of information and resources among patients provides valuable references for young women who have undergone similar experiences. Young patients reported that interactions and mutual assistance among peers enhance their confidence and hope for fertility and life extension.

> *Peer patients gave me great support when I felt like having a baby. On one hand, she informed me about the potential challenges I might face during pregnancy and breastfeeding. On the other hand, she continuously encouraged me and shared that her baby, now four years old and healthy, should reassure me not to be afraid.* (P15, 28 years old)

Subtheme two: need for multidimensional support from medical personnel

Some patients find the topic of fertility sensitive and hesitate to consult medical staff, fearing misunderstanding. Additionally, many noted a lack of specific knowledge about cancer-related fertility issues and found that the information available on online platforms can be overwhelming and inaccurate, often leaving them without access to reliable fertility information. Moreover, some patients are aware of misleading information online, which can cause considerable distress. They emphasized that attention from doctors to the reproductive needs of young patients and the provision of specialized information are critical for motivating individuals to seek treatment and consider parenthood.

> *I don't know much about it, so I searched online, but it's hard to verify the accuracy … In my opinion, guidance and encouragement from doctors are particularly crucial. I need to know when to stop medication, the best time to conceive, and the risks of recurrence. When making significant decisions about fertility, I feel more assured receiving advice from a doctor.* (P15, 28 years old)

Some participants also expressed a desire for more comprehensive information from physicians specializing in reproductive medicine on fertility preservation and assisted reproductive technologies to make informed choices.

> *I was particularly concerned about fertility, and my doctor understood my urgent needs. He referred me to a fertility preservation center where we decided to freeze embryos. I'm grateful to my doctor for providing the option to have children.* (P02, 33 years old, had one child after caner)
>
> *At that time, when I consulted at the reproduction center, I wasn't married, and they told me I couldn't freeze eggs without a marriage certificate. Is that so?* (P6, 27 years old)

Subtheme three: provision of continuous pregnancy management from the multidisciplinary team

Participants noted that healthcare providers from a multidisciplinary team offered follow-up pregnancy, prenatal, and lactation guidance to support them in preparing for a successful delivery and becoming competent mothers.

> *Ah, you know, our physical condition as breast cancer survivors differs from that of normal mothers. We need healthcare providers who are experts in both oncology and obstetrics to provide prenatal and pregnancy guidance, ensuring a smooth birth and the safety of both the mother and child.* (P18, 33 years old, received assisted reproductive technology)

Discussion

This qualitative study explored the reproductive concerns of young breast cancer survivors, filling gaps in knowledge about their post-treatment experiences and insights. The findings reveal that participants' concerns about reproduction are dynamic. Before cancer treatment, some patients prioritized discussions on fertility despite the urgency of cancer treatment. During recovery, the desire to have children often strengthens after achieving better survival rates or entering into marriage. These results align with previous research indicating that fertility decision-making processes before, during, and after cancer treatment evolve over time, influenced by pre-treatment desires for children and experiences during treatment. Previous studies have shown that many survivors reconsider their initial disinterest in having children and seek assisted reproductive technologies 3–7 years post-treatment [38]. Therefore, all patients of reproductive age should receive comprehensive information about the impact of cancer treatment on future fertility and options for fertility preservation. It is crucial to understand the ongoing needs of women with breast cancer to balance their desire for children with their perceptions of cancer prognosis and its impact on fertility, assisting them in planning if desired.

In this study, participants described feelings of hopelessness and anxiety when contemplating parenthood amidst an uncertain future. This uncertainty is often linked to declining fertility and potential risks to their own and their offspring's health. Previous research has highlighted similar uncertainties [39]. This may stem from inadequate or misconceived knowledge about reproduction and fertility among this group. Breast cancer patients' subjective perceptions of their own risk and the genetic risks are often exaggerated, leading to undue reproductive concerns. Similar findings were obtained in this study. On one hand, most participants believed that sexual activity, assisted reproductive technologies, pregnancy, and breastfeeding could elevate hormone levels and potentially trigger breast cancer recurrence or metastasis. However, existing evidence confirms that pregnancy and assisted reproductive technologies do not negatively impact survival in breast cancer patients [40]. Concerns about the genetic risk of cancer and the teratogenic effects of medications heighten anxieties about potential health issues in offspring, prompting some to forego having children, consistent with previous findings [41]. This underscores the need for personalized guidance that considers patients' multifaceted experiences and needs, such as balancing antitumor therapy and fertility, breastfeeding, contraception, and genetic counseling. These guidelines highlight the critical role of nurses in fertility consultations. Nurses, who often have closer contact and communication with patients and their families, and a deeper understanding of their psychological, social, and rehabilitative needs, are well-positioned to tailor fertility advice, integrating patients' preferences into fertility consultations and ensuring they are well-informed and supported in their reproductive decisions.

Previous studies have indicated that young breast cancer survivors who are parenting minor children are more susceptible to developing mental disorders during the disease trajectory than patients with other types of cancer [42], a finding that was corroborated by our study. These survivors experience added pressure to raise their children during prolonged rehabilitation periods, which contributes to increased anxiety and reproductive concerns. The results of this study align with existing literature, highlighting challenges such as residual symptoms, breastfeeding difficulties, work-family conflicts, and financial strains during the childrearing process. Reproduction involves not only the biological aspect but also raising children, necessitating long-term emotional and financial commitment. The dilemmas faced made participants feel inadequate as mothers, fueling their anxiety and reproductive concerns. This phenomenon is global but particularly pronounced in China for two main reasons. First, societal expectations in China generally dictate that women should be introverted, delicate, and emotionally rich [43]; thus, their typical mode of expression tends to be more subdued. When facing reproductive difficulties, these women often opt to conceal their distress and suppress their emotions. This tendency toward inhibitive emotional regulation leads to invasive thinking and internalization of reproductive concerns, preventing them from properly processing stressful events cognitively and emotionally, thereby exacerbating their reproductive concerns. Second, the traditional “male-breadwinner and female-housewife” model prevalent in Confucian Chinese culture [44] places a disproportionate childrearing burden on mothers, requiring them to invest significant energy in their children. Consequently, women with breast cancer experience substantial psychological stress from their perceived inability to fulfill their parenting responsibilities. Healthcare professionals must therefore provide robust support to these women, encourage active participation from spouses and family members in childcare, and assist them in fulfilling their roles as mothers during their survivorship.

Furthermore, under the influence of traditional Chinese family-oriented culture, becoming a mother is often seen as an obligation, and children are viewed as the hope and future of families. Thus, fertility is also considered a crucial aspect of marriage quality and family relationships. When women are unable to conceive or fulfill their maternal responsibilities, they may experience significant psychological pressure from the elderly and society, sometimes leading to the stigma of infertility. However, it is noteworthy that this study found the maternal role both motivates rehabilitation and is seen as a means of regaining feminine identity or getting one's life back on track. This finding aligns with previous studies [45], which highlighted that having a child is integral to a woman's self-worth, and being a mother involves more responsibilities and attempts to reassess their suffering by imparting positive meaning to life. From a feminist perspective, this study observed that young female patients' perceptions of reproduction are shifting. They stated that reproduction is pursued not only for the sake of marital relationships and socio-familial responsibilities but also as independent individuals seeking the positive life experience of motherhood and affirming the unique self-worth of women. Therefore, this shift in the meaning of reproduction is crucial for young breast cancer patients, and personalized guidance focusing on their reproductive needs during their survivorship is essential. Therefore, this shift in the meaning of fertility is crucial for young breast cancer patients, and we should tailor our guidance to address their fertility needs during survivorship.

This study also demonstrated that young breast cancer survivors are eager to receive substantial help and support from family members, especially their spouses, to offset their limited parenting capacity. This finding aligns with previous research indicating that support from family members can alleviate reproductive concerns [46]. Fertility and parenting are seen as family-centric events. Families facing breast cancer were observed to have lower marital satisfaction and increased hyperarousal [47]. However, families that adapted successfully exhibited a cohesive pattern of engagement and found a new balance to effectively respond to the cancer crisis. The Chinese family, characterized by an extended kinship system with intergenerational co-residence and close family ties, fosters strong family intimacy, which enhances patients' willingness to share personal concerns with family members. Patients actively and flexibly mobilize available resources to gain substantial emotional and material support from their spouses, family members, and friends. Therefore, a dynamic assessment of young breast cancer survivors' reproductive concerns and family support could effectively help them manage stress.

Previous studies have shown that reproductive concerns among young cancer patients often stem from unmet information needs, with reproductive issues ranking as the top unmet need [48]. This aligns with findings from the current study, where interviewees expressed uncertainty about reproductive matters and sought more comprehensive information on topics such as referral resources, assisted reproductive technologies, and the impact of pregnancy on cancer relapse, subsequent pregnancies, and prenatal guidance. In China, there is a reluctance to openly discuss sensitive issues like sex and reproduction with medical personnel [49]. Research indicates a preference among young cancer patients for digital health interventions [50]. We recommend the creation of dedicated websites to assist in reproductive decision-making and to provide personalized fertility information support based on patient preferences. However, this digital support should complement rather than replace direct consultations with medical professionals. Consequently, hospitals should establish specialized fertility consultation rooms within oncology wards to offer expert reproductive guidance. Additionally, during the recovery process, there should be a shift in focus from treatment to reproduction, providing support for genetic testing, artificial insemination, pregnancy reviews, and other related aspects to enhance the efficiency and quality of reproductive care and services. Furthermore, enhancing collaboration among reproductive specialists, geneticists, and oncologists is critical to meet the sexual and reproductive health needs of young breast cancer survivors.

As breast cancer survival rates improve, the emphasis on fertility preservation among survivors has increased, and the demand for fertility preservation is growing. However, as revealed in this study, participants were hesitant about both fertility preservation and assisted reproductive technology. This hesitation often stems from the high costs of fertility preservation services in China, low reimbursement rates by health insurance, the irrational allocation of resources, and unclear patient rights to fertility preservation [51]. Therefore, it is recommended that health administrative bodies refine fertility preservation legislation, strengthen regulations, improve medical resource allocation, provide ethical and legal support, and enhance the dissemination of fertility preservation technology to further improve the quality of life for breast cancer survivors.

Limitations

There are several limitations to this study. First, patients diagnosed with recurrent or advanced metastatic disease were excluded. Including their perspectives is essential to fully explore these themes. Second, although saturation was achieved, the concept of saturation is inherently relative. Further interviews are necessary to enhance the depth and breadth of these categories.

Conclusions

This study elucidates the perceptions of reproductive concerns among young breast cancer survivors. The findings support the delineation of five themes: multiple emotional burdens intertwined by fertility; concerns about risks arising from reproduction; dilemma of childrearing; meaning of reproduction; and support needs from family, peers, and professionals. These themes also offer valuable insights into the reproductive concerns of this population in other Asian countries. Future research will involve collecting perspectives from stakeholders such as spouses and healthcare providers, adding further depth to our understanding of reproductive issues. Given that reproductive health is a crucial aspect of breast cancer survivorship care, healthcare providers must be attuned to patients' experiences of reproductive concerns, recognize the importance of multidimensional support for positive adaptation, and deliver comprehensive, tailored interventions to manage their reproductive health.

This study holds significant implications for nursing practice. Healthcare providers should recognize and address the challenges and stressors faced by young breast cancer survivors due to reproductive and fertility changes post-treatment. Our findings indicate that healthcare providers should undergo training and continuing education in oncofertility to better serve the reproductive health needs of this group. Providers should offer personalized fertility consultations and decision-making support to address reproductive concerns stemming from unmet information needs. Additionally, providers can assist young breast cancer survivors in accessing broader support from their families and society to mitigate culturally specific fertility pressures. Future research should aim to integrate cultural considerations into interventions and guidelines to enhance fertility management and, consequently, improve the quality of life for young breast cancer survivors.

Author contributions

Wenjing Xu: Writing – original draft, Writing – review and editing, Formal analysis, Data curation. **Xiangyu Liu:** Provision of Resources and Project administration. **Cuicui Zhang:** Conceptualization, Methodology, Supervision. **Lili Zhu:** Conceptualization. **Yuxiu Zhao:** Formal analysis. **Changju Liao:**Formal analysis, Supervision, Conceptualization, Supervision, Formal analysis, Data curation, Validation. All authors read and approved the final manuscript.

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Conflict of interest

The authors have no conflict of interest to declare.

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Research Article

Optimizing the Regulation of Nursing in the Asian Context: Development and Application of a Legal Framework

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SUMMARY

Purpose: It is essential to regulate nursing to protect the population's health. As regulation constantly changes in response to societal trends, periodic reviews of nursing regulations become imperative. Therefore, we developed a legal framework by extracting essential elements for nursing regulation and explored its potential application.

Methods: This study consisted of two parts. First, the legal framework for nursing regulation was developed through reviewing literature that mentions the content that can be included in nursing regulations, and through a content validity assessment by five experts. Second, this legal framework was applied to the nursing laws of China, Hong Kong, Japan, and Taiwan to confirm the suitability of the framework.

Results: In the first part of the study, the legal framework for nursing regulation consists of seven categories (purpose, definitions, standards for practice, license acquisition and registration to practice, regulatory body, protection of the legal authority of nurses, offenses/penalties, and disciplinary procedures) and 17 items was developed. As a result of applying this framework to nursing laws in four countries, the average utilization rate for all 17 items was 68.4%. The matching scores between the framework and the law were over 60% for all four laws.

Conclusion: Regulations, especially in the form of legislation, must be carefully considered because laws involve enforcement and potential penalties. This study is significant for identifying essential nursing regulation elements and offering a practical reference tool, expected to be widely utilized in future nursing policy and regulatory research.

Introduction

Efforts have recently intensified worldwide to achieve universal health coverage (UHC), with the World Health Organization (WHO) emphasizing the pivotal role of nurses in this pursuit [1]. Since the healthcare industry is labor-intensive, the level of healthcare is determined by the quality of the medical workforce [2]. Nurses are core workers, accounting for the largest portion of the healthcare workforce. Therefore, it is essential to regulate the supply and demand, qualifications, responsibilities, and duties of nurses to protect the health of the population and maintain public health [3]. The International Council of Nurses (ICN) also emphasizes that profession-led nursing regulations establish standards of nursing practice, further enhance the competence of nurses, and contribute to improving quality patient outcomes [4].

In this context, regulations governing nursing are typically expressed through laws. In an administrative state, laws made through the legislative process are the main means of social regulation [5]. The ICN has urged each country to enact nursing laws and introduced the Model Nursing Act in 2007 which suggests the inclusion of specific components in the law [6]. The WHO (2002) also suggested the inclusion of specific components in the Nursing Act, emphasizing the necessity of regulating nursing [7]. In the United States, the Model Nursing Act was developed by the National Council of State Boards of Nursing (NCSBN) to ensure uniformity of nursing laws across all the states, some of which have been implemented since 1988, and updated periodically (latest version 2021) [8]. These recommendations align with various theoretical frameworks on legal regulations, which argue that such regulations protect public interests. Professions accept certain regulations and responsibilities in exchange for their status, and the law reflects

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and changes social norms, underscoring the crucial importance of legal regulations [9,10].

The nursing laws or regulations proposed so far tend to be centered on Western countries, so there are limitations in properly reflecting the characteristics of other countries and regions. In addition, according to a WHO report that analyzed the global nursing status by region, some Asian countries had relatively fewer regulations on nursing, including educational standards for nurturing nurses, training, continuous professional development, roles of nurses, and working conditions [11]. This difference can be attributed to the historical context in which nursing first developed in the West and later spread to Asian countries [12]. Additionally, the sociocultural background of each country can be an influential factor. Sociocultural factors in each country have a significant influence on the content of the regulation, and the regulation including law constantly changes according to the trends of the times and social demands. Therefore, nursing regulations, including education, qualification recognition, scope of practice, and discipline, need to be modernized [11,13].

Therefore, the purpose of this study is to develop a legal framework by extracting the essential elements that must be included when creating a nursing regulation or enacting a nursing law and to apply this framework to some countries to examine its feasibility.

Methods

Study design

This study consists of two parts: legal framework development and application. The first part was to establish a legal framework and evaluate content validity through a comprehensive literature review and expert consultation. The primary objective of this part is to identify the essential elements that must be included when creating a nursing regulation or enacting a nursing law. The second part was to apply the developed legal framework to the laws of each country. Through the application, we confirmed the usefulness of the framework within the legislative context of each country.

Part 1: Development of the legal framework

Data collection

We conducted a literature review to identify sources discussing content that could be included in nursing regulations or laws to establish a legal framework. The inclusion criteria comprised English-language literature published from 2000 to 2020 mentioning items relevant to nursing regulations or laws. We conducted the review using keywords (“nurse”, "nursing regulation", "law", "acts", "legislation", and "framework") on Google Scholar, encompassing both peer-reviewed articles and grey literature such as reports and white papers from organizations like WHO and ICN. This approach was chosen to ensure the inclusivity of diverse perspectives and relevant sources on nursing regulation and law [14]. As a result of the keyword search, 1,880 records were identified. After reviewing titles and abstracts, 1,867 records were excluded as they did not meet the study purpose. The remaining 13 literature were independently reviewed by two researchers, followed by a consensus meeting. During the discussion, eight literature were excluded, and three new literature were added. Finally, eight literature, including studies and reports, were selected [6,7,15–20] (Figure 1).

Data analysis

The first author constructed an outline of the coding matrix by extracting the essential elements of nursing regulation through a careful reading of one of the eight literature. Thereafter, the two researchers independently analyzed the eight literature, extracted the essential elements required for nursing regulation presented in each framework, and listed them according to the coding matrix. If new elements or elements that were difficult to classify were found during the analysis, we occasionally discussed and reached a consensus via e-mail or meetings. In particular, there were many cases where the definitions of the extracted elements were not explained in the literature, and we clarified the definitions for each element by discussing this as well. As there were many intermediate agreements, no disagreements were found after cross-checking the independent analysis results of the two researchers. Based on a data-filled coding matrix, we grouped similar elements into categories and drafted a legal framework.

Content validity ratio (CVR) was then used to determine content validity. Since the appropriate number of experts is conventionally prescribed as preferably three or more and 10 or fewer [21], five experts participated in the CVR of this study. To ensure validity, we carefully composed a panel of experts with relevant knowledge and practical experience in various fields such as academia, government, and professional associations. In accordance with considerations of representativeness, we selected one expert with more than 5 years of experience from each field of administration, legislation, academia, and advocacy groups. We individually contacted these experts to explain the research purpose, obtain their consent, and conduct written consultations. They were compensated for their participation in the study. The characteristics of the experts, including their educational backgrounds and disciplines, are presented in Table 1. Five experts were asked to measure the validity of each item of the draft framework on a 4-point scale and write their opinions on each item. We modified the framework by reflecting on the CVR results and experts' opinions.

Part 2: Application of the legal framework

Data collection

We selected laws to which the developed legal framework would be applied based on the following criteria: 1) enacted for the purpose of regulating nursing; 2) from Asian countries; 3) written in a language the research team can read; and 4) allowing access to the entire text of the law. As a result, laws from China, Hong Kong, Japan, and Taiwan were selected. In June 2022, we searched and collected laws aimed at regulating nursing in each country from the official online legal website operated by the Ministry of Justice of each country.

Data analysis

Two researchers independently analyzed the laws of the four countries according to the framework. If the laws contain the contents corresponding to each item in the framework, we were marked as “Yes,” if only partial contents matched, “Partial,” and if no contents corresponded, we were marked as “No.” The two researchers' analysis results were compared, and any disagreements were resolved through discussion. In addition, to check the matching score and the utilization rate, “Yes” was given 1 point, “Partial” was given 0.5 points, and “No” was given 0 points. Matching score refers to how similar the country's law is to the framework, and utilization rate refers to how many times one item is included in the four laws.

Results

Part 1: Development of the legal framework

The results of experts' content validity evaluation of the draft framework are shown in Table 2. As there were five experts in the group, the acceptance criterion for the content validity was .99 [22].

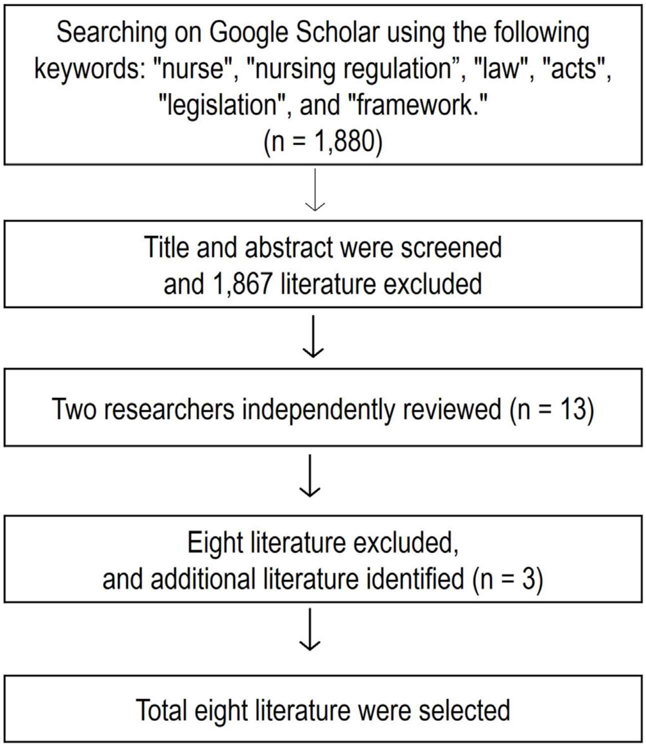

Figure 1. Flow chart of the literature search.

Table 1 *General Characteristics of Experts.*

No.	Sex	Age	Affiliation	Position	Years of experience	License	Field of expertise
1	Female	30s	Ministry of Health and Welfare, ROK	Expert advisor	over 5 years	Registered Nurse, Lawyer	Law and policy (especially, healthcare field)
2	Female	50s	College of Nursing in ROK	Professor	over 20 years	Registered Nurse	Nursing law and ethics, Nursing management (PhD in law)
3	Male	40s	Korean Nurses Association	Director	over 10 years	Not applicable	Nursing law and policy (PhD in law)
4	Female	50s	National Assembly Research Service, ROK	Legislative research officer	over 15 years	Registered Nurse	Legislative Process (PhD in public health)
5	Female	40s	National Assembly, ROK	Chief Policy Advisor	over 20 years	Not applicable	Legislative Process and Policy participation (especially, healthcare field)

Note: ROK = Republic of Korea, PhD = Doctor of Philosophy.

Therefore, the two items (‘practice standards’ and ‘method of appointment/election to the regulatory body’) that fell below .99 were deleted from the framework. Experts left opinions that these items are inappropriate to be regulated by law because they must be revised frequently according to changes in the times and the development of nursing knowledge. In addition, experts presented opinions to improve the framework, and we modified the framework based on these. There were three changes. First, since both initial issuance/registration and renewal of license were included in item 4.3, we separated 'initial' and 'renewal' into separate items. Therefore, the name of item 4.3 has been modified to ‘Initial license issuance and registration.’ Second, since item 4.4 ‘Reports’ is one of the methods for license renewal, this item was changed to ‘Criteria for maintenance and renewal of licensure to practice,’ and the contents of the definition were also modified accordingly. Lastly, experts suggested that not only the qualifications of advanced practice nurses (APNs) but also their scope of practice should be included in the framework. Accordingly, we created ‘category 5,’ moved item 4.5, and also added a new item regarding the scope of APN's practice (5.2 scope of practice defined). Ultimately, the essential elements identified through literature review and expert consultation were a total of eight categories (17 items). In particular, experts emphasized that item 3.1 (scope of practice defined) is absolutely necessary because controversy over the scope of practice can always arise in clinical settings where various occupations work together.

Part 2: Application of the legal framework

Table 3 summarizes the results of the analysis of the laws in the four countries according to the legal framework developed. The average utilization rate for all 17 items was 68.4%. There were five items stipulated in all four laws (utilization rate 100%). One of the items with a 100% utilization rate is “2.2 Categories/level of nurse,” which means ‘Types of workers related to nursing.’ According to the laws of each country, China has 'nurses', Hong Kong has 'enrolled nurse and registered nurse’, Japan has 'public health nurse, midwife, nurse, and assistant nurse’, and Taiwan has 'professional registered nurses and registered nurses.’ On the other hand, because only Taiwan's law included information on APNs, the

Table 2 *The Draft of Legal Framework and Calculation of CVR.*

Category	Item	Definition	CVR	Interpretation
1. Purpose	1.1 Purpose of legislation	A description of the purpose for which the law was enacted	1	Remained
2. Definitions	2.1 Definition of nursing	The concept and definition of 'What is Nursing'	1	Remained
	2.2 Categories/level of nurse	Types of workers related to nursing	1	Remained
3. Standards for practice	3.1 Scope of practice defined	Scope of practice that a person holding a nurse's license can perform	1	Remained
	3.2 Code of conduct/ethics as a baseline for practice	Ethical values, responsibilities and professional accountabilities of nurses that defines and guides ethical nursing practice within the different roles nurses assume.	1	Remained
	3.3 Practice standards	Guidelines for practices carried out by nurses within the scope of their duties (e.g. Indwelling catheterization techniques and precautions)	.6	Eliminated
4. License acquisition and registration to practice	4.1 Eligibility criteria for obtaining license	Requirements to obtain a nurse license: (a) education, (b) examination	1	Remained
	4.2 Grounds for disqualification	Status of being unable to obtain a nurse license or register as a nurse (e.g., mental competence, physical competence, criminal background check)	1	Remained
	4.3 License issuance and registration	Procedures and requirements for issuing, registering, and renewing nurse licenses	1	Modified
	4.4 Reports	The obligation of nurse license holders to periodically report their status to the government or nursing regulatory body	1	Modified
	4.5 Specialist/advanced qualifications/certification	Requirements to obtain a specialist/advanced nursing license: (a) education, (b) examination	1	Modified
5. Regulatory body	5.1 Organization and establishment of the regulatory body	The form, identity, and name of the regulatory body (e.g., function independently, part of a single multidisciplinary body, unique structures, self-regulatory professional body only, handling by the Ministry of Health)	1	Remained
	5.2 Description of the purpose and scope of the regulatory body	Roles and functions of regulatory body (e.g., responsible for qualification management tasks such as examination operation, license issuance, and registration)	1	Remained
	5.3 Structure and composition of the regulatory body	Number of members, qualification requirements of members, etc.	1	Remained
	5.4 Method of appointment/election to the regulatory body	How to select members of the regulatory body (e.g. appointments by government, election, government approval after designation by nursing professional members)	.6	Eliminated
6. Protection of the legal authority of nurses	6.1 Protection of titles, etc.	Regulations to protect the expertise of nurses and the safety of nursing recipients (a) prohibition of abuse of the title nurse (b) prohibition of unlicensed nursing practice	1	Remained
7. Offences/penalties and Disciplinary procedures	7.1 Offences/penalties listed	Penalties (e.g., imprisonment or fine) or administrative measures (e.g., suspension or revocation of a nurse's license) imposed on nurses depending on the reasons for disciplinary action.	1	Remained
	7.2 Disciplinary procedures	Disciplinary procedures, appeals, remedies, etc.	1	Remained

Note: CVR = content validity ratio, e.g = exempli gratia.

utilization rate of items in category 5 was relatively low. Additionally, in countries other than Hong Kong, all regulatory bodies were government such as the Ministry of Health, so item 6.3 only applied to Hong Kong, resulting in a utilization rate of 25%.

The matching scores between the framework and the law were over 60% for all four laws. The law with the highest matching score was Taiwan (73.5%), and China had the lowest (61.8%). Taiwan's Nursing Personnel Act, enacted in 1991, is most similar to the legal framework we developed and includes provisions corresponding to 12 out of 17 items. The contents of the examination as an eligibility criteria for becoming a nurse were stipulated in this law, but the contents of education could not be found, so item 4.1 was classified as 'Partial.' Japan's Act on Public Health Nurses, Midwives, and Nurses was enacted first among the four countries in 1948 and had the second-highest matching score (70.6%). Hong Kong's Nurse Registration Ordinance, enacted in 1961, contained provisions corresponding to 11 out of 17 items (matching score 67.6%). Although there was no provision on the purpose of legislation in this law, the preamble included related content, so item 1.1 was 'Partial.' China's Nursing Regulations, enacted in 2008, had provisions corresponding to 10 out of 17 items. In addition, although there is a provision in this law regarding the prohibition of unlicensed nursing practice, no provision was found regarding the prohibition of abuse of the title ‘nurse’, so item 7.1 was classified as 'Partial.'

Discussion

In this study, we conducted a comprehensive literature review and consulted with experts to identify essential components for enacting nursing regulations or laws. Subsequently, we developed a legal framework comprising seven categories (purpose, definitions, standards for practice, license acquisition and registration to practice, regulatory body, protection of the legal authority of nurses, offences/penalties, and disciplinary procedures) and 17 key items. Applying this framework to nursing laws in four countries revealed a matching score exceeding 60%, with an average utilization rate of items reaching 68.4%. This analysis affirms the practical applicability of the developed legal framework.

The scope of nursing practice extends beyond specific tasks or functions; it involves a combination of knowledge, judgment, and skills. Legislative considerations aim to make it adaptable to dynamic changes in society, health demands, and technological advancements [4]. In clinical settings, various occupations share one goal, ‘patient recovery and health,’ and cooperate to achieve that

Table 3 *Summary of Results of Applying the Framework to the Laws of each Country.*

Items	China	Hong Kong	Japan	Taiwan	Utilization rate (%)
Title	Nurses Regulation	Nurses Registration Ordinance	Act on Public Health Nurses, Midwives, and Nurses	Nursing Personnel Act	–
Year of enactment	2008	1961	1948	1991	–
1.1 Purpose of legislation	Yes	Partial[a]	Yes	No	62.5
2.1 Definition of nursing	No	No	No	No	0.0
2.2 Categories/level of nurse	Yes	Yes	Yes	Yes	100.0
3.1 Scope of practice defined	Yes	No	Yes	Yes	75.0
3.2 Code of conduct/ethics as a baseline for practice	Yes	No	Yes	Yes	75.0
4.1 Eligibility criteria for obtaining license	Yes	Yes	Yes	Partial[a]	87.5
4.2 Grounds for disqualification	No	Yes	Yes	Yes	75.0
4.3 Initial license issuance and registration	Yes	Yes	Yes	Yes	100.0
4.4 Criteria for maintenance and renewal of licensure to practice	Yes	Yes	No	Yes	75.0
5.1 Eligibility criteria for obtaining an initial license (APN)	No	No	No	Yes	25.0
5.2 Scope of practice defined (APN)	No	No	No	Yes	25.0
6.1 Organization and establishment of the regulatory body	Yes (The competent health department of the State Council)	Yes (Nursing Council of Hong Kong)	Yes (The Minister of Health, Labour and Welfare)	Yes (The Ministry of Health and Welfare)	100.0
6.2 Purpose and scope of the regulatory body	Yes	Yes	Yes	Yes	100.0
6.3 Structure and composition of the regulatory body	No	Yes	No	No	25.0
7.1 Protection of titles, etc.	Partial[a]	Yes	Yes	Yes	87.5
8.1 Offences/penalties listed	Yes	Yes	Yes	Yes	100.0
8.2 Disciplinary procedures	No	Yes	Yes	No	50.0
Matching score (%)	61.8	67.6	70.6	73.5	

Note: APN = advanced practice nurses.

[a] The meaning of ‘partial’ is as follows. Hong Kong's law does not have individual provisions for legislative purposes, but it is mentioned in the preamble. In Taiwan's law, there is no provision for "education" in the requirements to obtain a nurse license, but there is content for "exam.” In China's law, there is no provision for “prohibition of abuse of the title nurse,” but there is provision for “prohibition of unlicensed nursing practice.“; The sources of law in each country are as follows. China https://flk.npc.gov.cn/index.html. Hong Kong https://www.elegislation.gov.hk/hk/cap164. Japan https://www.japaneselawtranslation.go.jp/en/laws/view/3993. Taiwan https://law.moj.gov.tw/ENG/LawClass/LawAll.aspx?pcode=L0020166 (last access on 06 January 2024).

goal. However, unintentional disputes may occur due to conflicting roles between occupations or gray zones where responsibility is unclear [23]. Therefore, it is essential to define the scope of practice that nurse license holders can perform. This also applies to APNs. There is strong evidence that APNs contribute to increasing patient access to care and improving patient outcomes [24,25]. In a healthcare environment where the number of people with chronic diseases increases worldwide and the aging of the population accelerates, APN will become a key force in achieving UHC that solves the problems of medical manpower shortages and unmet medical service areas. As APNs have been started and developed mainly in Western countries [26], Asian countries remain at a relatively early stage [27]. For reference, in South Korea, the qualification requirements for APNs were stipulated by law, but there were no regulations on their role for a long time.; therefore, APNs have not been activated [28]. However, after considerable effort, public discussions on the legalization of the APN role began in 2018; finally, in April 2022, the scope of practice for APNs was stipulated by law. South Korea's experience like this has great implications. Occupational licensing provides the authority to perform specific tasks only to those who meet a certain level of qualification criteria, thereby maintaining the expertise of workers and providing quality services [29,30]. Therefore, medical personnel who deal with human life are representative occupations for licensing, and the framework developed in this study also includes licensing-related items. However, if there are only qualifications and no scope of practice, it will be almost impossible for the profession to secure its own area within the complex healthcare environment and will eventually decline [31,32]. Therefore, for any occupation, it is necessary to clearly specify not only the qualification requirements but also the scope of practice permitted by the license.

From a governance perspective, the Nursing Regulatory Body (NRB) is an institution that maintains and promotes professionalism in nursing by managing nurse qualifications, developing practice standards, and disciplining when necessary [33]. Within the framework developed in this study, item 5.1 specifically addresses the ‘organization and establishment of the regulatory body.’ With the exception of Hong Kong, in all countries analyzed in this study, governmental entities were responsible for regulatory functions related to the management and supervision of nurse qualifications**.** Unfortunately, these tasks are often handled by people who have nothing to do with nursing. According to a survey of 320 jurisdictions around the world by the NCSBN, NRB members were most often appointed by government authority, followed by the election of officials [34]. In order for NRB to operate properly, it needs members with specialized knowledge in nursing. However, because the structure and form of NRBs vary greatly from country to country, it may be inappropriate to unify the criteria for selecting members or to stipulate them in the laws. In countries such as the United States and Canada, separate organizations or committees are in charge of tasks as part of self-regulation, and in some cases, both national and self-regulation are operated [35]. In addition, depending on the scope of practice, independent bodies may perform only nursing regulatory work or a single body in charge of various tasks may be in charge of nursing regulatory work [34]. In most of the countries analyzed in this study, the national administration served as NRB. Nevertheless, it seems necessary to seek systematic improvement measures so that appropriate people with expertise can take charge of NRB's tasks. If this role is taken on by the national administration, such as the Ministry of Health, one solution may be to create a dedicated nursing department within the administration that is solely responsible for nursing-related tasks. Additionally, nurses can monitor NRB's activities from the outside while paying attention to policies related to nursing regulation.

The purpose of nursing regulation is to establish nursing standards and secure the expertise of nurses to provide high-quality services to the public [4]. To achieve this goal, nursing regulation is mainly approached from the perspective of controlling nurses. The laws of Japan, China, and Hong Kong in this study included provisions corresponding to the ‘purpose of legislation,’ and these also had similar contents. However, even nurses with a high level of professionalism cannot demonstrate all their expertise in a work environment with a heavy workload. In many countries around the world, the demand for nursing services is soaring due to changes in the healthcare paradigm; however, they are suffering from a chronic and serious nurse shortage [36]. If providing quality services to the public is the ultimate goal of nursing regulation, regulation at the individual nurse level alone has limitations. There is a need to approach regulation from the perspective of managing and improving the nursing environment. This is related to previous studies that nursing regulation is influenced by sociocultural factors [13,37]. It is true that the social image of nursing has improved compared to the past, and the needs for nursing is also increasing as we move toward a super-aging society [38]. Many countries are feeling a sense of crisis due to the shortage of nurses and are considering ways to retain them. A representative example of reflecting these sociocultural changes in law or policy is the ‘California's nurse staffing legislation.’ [39]. Unlike other laws, China's Nurses Regulation in this study included provisions such as protection of nurses' rights and duties of medical institutions for nurses, so it appears that it can be a reference in changing the perspective of nursing regulation.

The present study had several limitations. First, we focused on whether the literature review mentioned items that could be included in nursing regulations or nursing laws. As a result, some of the eight selected literature are from 20 years ago and may have limitations in reflecting the latest changes in the medical environment. Additionally, we conducted a literature review using Google Scholar, encompassing both peer-reviewed articles and grey literature. However, relying solely on Google Scholar may have limited the comprehensiveness of our review. While Google Scholar is useful for locating a significant amount of grey literature and specific studies, previous research suggests that it alone is insufficient for systematic reviews [14]. Accordingly, we attempted to supplement the limitations of the eight selected literature by allowing additional opinions to be freely expressed in addition to the items in the framework presented at the expert consultation stage. Second, when regulating nursing care in a country, it may not be regulated only in the form of a single law. Sometimes, there are countries where nursing is not regulated at the legal level but in sub-statutes or guidelines [40]. However, we reviewed nursing regulations at the legal level. This limits the integrated approach to nursing-related regulations in one country. In other words, even if a particular item of the framework was marked “No” in our study, it is dangerous to interpret this as a country that has no regulations for that item at all. Finally, the items of the legal framework were confirmed only as “Yes/No.” Therefore, we propose additional research that examines the specific details of the law, such as what kind of curriculum, if any, and what the contents of the test are, if there is one, and the level of regulation. In particular, the form and content of laws may vary depending on the country's legal system, legislative background, and the intentions of legislators, necessitating additional research that considers these factors.

Nevertheless, this study is significant in several aspects. This study is significant in that it identifies the necessary elements for nursing regulation and provides a useful tool that policymakers in each country can refer to when regulating nursing care. In particular, this study can help reflect on the concept of nursing regulation and current tasks in Asian countries where the nursing regulation environment is relatively immature. It is expected to be used extensively in policy and regulatory research on nursing in the future. Additionally, nursing continues to evolve according to medical technology development, the development of new knowledge, and social needs [41]. However, legislation takes considerable time because it must go through a series of procedures and also requires political agreements. In addition, there are cases in which political matters, rather than the necessity of legal enactment, have a greater impact on the legislative process [42,43]. Therefore, putting all regulations in the form of law may not be the right answer. However, in practical areas of legislation or policy-making, this framework serves as a valuable tool to ensure essential elements are not overlooked. Lastly, integrating the legal framework developed in this study into the nursing curriculum can significantly enhance nursing students' and nurses' understanding of the regulatory environment. Educating them on reviewing nursing-related regulations and laws, as well as actively involving them in law-related procedures and policy-making processes, will deepen their engagement in legislative and nursing policy matters. This educational initiative empowers nursing students and nurses to effectively participate in political and policy development processes, thereby ensuring their active involvement in legislative aspects of nursing. Moreover, these initiatives enable them to perform their roles more effectively as professionals and contribute to the advancement of nursing practice. This approach not only prepares them for effective professional practice but also holds profound implications for nursing education, particularly in cultivating professionalism and leadership among nurses [44].

Conclusion

Regulating nursing is difficult and complicated because it must consider various aspects such as the trend of the times and the development of healthcare technology. Purpose of legislation, definitions, scope of practice, license acquisition and registration, regulatory body, protection of titles, and discipline standards are the essential elements of nursing regulation. It is necessary to check and update nursing regulations using the framework developed in this study to enhance the professionalism of nurses and advance the field of nursing. Integrating this framework into the nursing curriculum can deepen future nurses' understanding of the regulatory environment, fostering professionalism and leadership. This integration enables them to perform their roles more effectively and contribute to the advancement of nursing practice. Additionally, this framework serves as a practical tool in legislation and policy-making, ensuring essential elements are not overlooked. This study provides a valuable reference for policymakers and highlights the need for continuously evolving nursing regulations to meet current and future healthcare needs.

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Conflict of interest

The Authors declare that there is no conflict of interest.

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Research Article

Effect of Tele-exercise Interventions on Quality of Life in Cancer Patients: A Meta-analysis

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SUMMARY

Purpose: To evaluate the impacts of tele-exercise intervention with cancer patients' quality of life, taking into account the influence of the duration of tele-exercise intervention, type of intervention, and gender of cancer patients on quality of life.
Methods: The PubMed (MEDLINE), Embase, CINAHL, Cochrane Central Register of Controlled Trials (CENTRAL), Web of Science, and PsycINFO databases were searched from inception to August 21, 2023. The Cochrane Collaboration's risk of bias tool 2 was utilized to estimate the risk of bias, and the Grading of Recommendations, Assessment. For statistical analyses, R Studio was employed.
Results: This meta-analysis contained eight trials. When compared to controls, tele-exercise interventions (SMD = 0.41, 95% CI: 0.12 to 0.70, $p < .010$; $I^2 = 54\%$, $p = .030$) have a positive influence on boosting the quality of life within cancer patients. Subgroup analyses demonstrated the greater effectiveness of tele-exercise in enhancing the quality of life of cancer patients when the duration was greater than or equal to 10 weeks. Furthermore, tele-exercise was found to have a stronger advantageous effect on quality of life among female cancer. In addition, among the types of interventions for tele-exercise, neither web-based nor telephone-based formats significantly enhanced quality of life among cancer patients.
Conclusion: Tele-exercise interventions are a cost-effective and feasible non-pharmacologic complementary way to promote cancer patients' quality of life. Additional large-sample, carefully designed randomized controlled trials are warranted to further validate the impact of tele-exercise concerning cancer patients' quality of life.
Registration number: CRD42023477147.

Introduction

In 2022, there were approximately 20 million new cases of cancer and 10 million cancer-related deaths, according to the most recent estimates from the International Agency for Research on Cancer (IARC). By 2050, the number of cancer cases globally is projected to grow by 77% to 35 million [1]. Due to the impacts of cancer, treatments, and complications, cancer patients often suffer from severe symptom burdens, such as fatigue, pain, and psychological distress, which can lead to impaired quality of life [2–4]. Moreover, poor quality of life and physical dysfunction, leading to increased symptom burden and reduced survival rates [5,6]. This

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vicious cycle leads to poor recovery, high financial burden, increased readmission rates, and even death in cancer patients [7–9]. Therefore, there is an urgent need for an intervention that can reduce healthcare costs and be easily and widely implemented to enhance cancer patients' quality of life.

Exercise is a cost-effective and safe intervention that has been recommended as an important measure by the American Cancer Society to boost cancer patients' physical functioning and quality of life [10,11]. Although exercise has many advantages, previous studies have revealed just 35% of cancer patients exercise for at least two hours per week, and the majority of cancer patients fail to meet the recommended amount of 150 minutes of moderate-intensity exercise or 75 minutes of vigorous-intensity exercise per week, as recommended by the American Cancer Society [12,13]. Traditional forms of exercise (e.g., hospital-based on-site programs) have low participation rates, which may be due to issues such as commuting, accessibility of services, and physical vulnerability that counteract motivation and adherence to exercise among cancer patients, particularly for remote rural areas and older patients [14,15]. Hence, there is an urgent need to implement interventions with high service accessibility and without time and space constraints to address the above issues. There is substantial evidence that these difficulties can be overcome with the help of remote technology and that tele-interventions may be more popular with cancer patients [12,16,17].

Tele-exercise is the utilization of remote technology and internet platforms, including the use of mobile applications, web pages, telephone calls, or other online tools to provide exercise instruction and supervision to participants [18–20]. And it has many benefits, including cost-effectiveness, convenient access, and broad coverage [12]. As previous studies have pointed out, tele-exercise can assist cancer patients gain a greater quality of life, with benefits similar to in-person exercise [14,21]. Moreover, tele-exercise can overcome the drawbacks of traditional exercise forms, better meet the preferences of cancer patients, and improve the motivation for exercise, with a high satisfaction level of patients [22–24].

As a result of COVID-19, there has been a surge in research on tele-exercise, with published studies that have proven that tele-exercise improves patients' physical pain and mental distress (e.g., anxiety and depression) [10,25]. However, it's unknown how tele-exercise affects cancer patients' quality of life. The findings of earlier randomized controlled trials have reported that tele-exercise does in no way enhance quality of life [26,27], while some studies have demonstrated that tele-exercise is an efficient way to increase quality of life [21,28,29]. Therefore, further research is warranted. On the other hand, there are limitations and knowledge gaps in the currently available reviews. Only two meta-analyses have examined the influence of tele-exercise on quality of life; one meta-analysis only examined breast cancer patients [30], and the other only examined patients with chronic diseases [14]. Hence, the findings for specific populations may not be generalizable to cancer patients, and further research is necessary. In addition, the existing studies suggest that intervention type, intervention duration and sex of the cancer patient may have different effects on the effectiveness of the intervention [31,32]. However, as far as we know, no quantitative aggregated outcomes of studies have been reported on the effect of the tele-exercise intervention type, the duration of the intervention, or sex of the cancer patient on the quality of life. Therefore, further quantitative and comprehensive analyses are necessary. The objectives of the research were: (1) to ascertain the overall impact of tele-exercise on cancer patients' quality of life; (2) to identify the impact of tele-exercise intervention type, duration, and cancer patient's sex on quality of life; and (3) to provide the theoretical basis for the scalability of telemedicine within cancer patients.

Methods

Meta-analysis was conducted in this study, and the study protocol was registered in the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42023477147). The methods for Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) were adhered to while reporting this research [28]. Informed consent or ethical approval was not needed, as all data utilized within the study were derived from earlier studies that had been published.

Search strategy

The PubMed (MEDLINE), Embase, CINAHL, Cochrane Central Register of Controlled Trials (CENTRAL), Web of Science, and PsycINFO databases were searched from inception to August 21, 2023. The search strategies and eligibility criteria were developed in accordance with the "Population, Intervention, Comparison, and Outcome" principle. MeSH terms and free-text terms were employed in combination. The key search terms included "neoplasms," "cancer," "tumour," "exercise," "physical activity," "training," "telerehabilitation," "telemedicine," and "internet-based." Refer to Supplementary Table 1 in the supplementary materials for a comprehensive explanation of our search methodology.

Study eligibility criteria

Two researchers (Chen and Zhu) individually screened the studies using the subsequent inclusion criteria: (1) adult patients (over 18 years old) having a cancer diagnosis at any stage during the disease; (2) the intervention group received only tele-exercise intervention, including tele-exercise instruction and education; (3) the comparators received usual care, traditional treatment, wait list control, or self-directed exercise without any tele-exercise intervention; (4) the outcome was quality of life; (5) the studies were published in English or Chinese; and (6) the studies were randomized controlled trials (RCTs) or pilot RCTs. Studies fulfilling the subsequent criteria were not included: (1) qualitative studies, letters, conference articles, abstracts, commentaries, reviews, meta-analyses, duplicate reports, or protocols; and (2) studies that did not include the full text.

Study selection and data collection

EndNote X9, which is a citation management programme for introducing and managing search results. After eliminating duplicates, the same authors individually filtered the studies with respect to the eligibility criteria. The following data were extracted: (1) study information (study authors, country, date of publication, and design); (2) patient details (type of cancer, sex, sample size, and mean age); (3) intervention and control group details (type of intervention, duration of the intervention, and control groups); and (4) results (assessment tools).

If there was any disagreement, the two researchers (Chen and Zhu) discussed the disagreement together based on the literature's eligibility criteria. These criteria strictly follow the PICOS principles: Population, Intervention, Comparator, Outcomes, and Study design. In addition, if any disagreement was still present, it was resolved by consulting or discussing with the third researcher (Hu), a professor with extensive experience and deep knowledge in the field of oncology nursing and evidence-based care.

Quality assessment

In this study, the Cochrane Collaboration's risk of bias tool 2 (ROB2) [33] was utilized to estimate the risk of bias of the included studies from the five domains: randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reporting results. Under each area, studies were judged to be at low risk of bias, some concerns, or high risk of bias. The Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) [34] was adopted to evaluate the certainty of evidence for the quality of life outcomes.

Statistical analyses

For statistical analyses, R Studio was used. A meta-analysis was carried out to determine the pooled effectiveness of tele-exercise on quality of life among patients in the intervention and control groups, and the postintervention means and standard deviations were calculated. Because these entered studies used distinct measures, standardized mean differences (SMDs) and 95% confidence intervals (CIs) were taken to gauge the effect of the interventions in terms of quality of life and fatigue. Heterogeneity was estimated with the I^2 statistic and p value. To provide more conservative findings, the data were synthesized and analysed employing a random effects model; in cases where the number of included studies did not exceed five, a fixed effects model was implemented [35,36]. The leave-one-out method was utilized to carry out the sensitivity analysis [7]. In addition, subgroup analyses were carried out in a predesigned manner according to the duration of intervention, type of intervention, and sex of cancer patients, where subgroup analyses should meet the requirement of including at least two studies per subgroup. Funnel plots were utilized to visually examine potential publication bias related to the outcome.

Results

Study selection

The database and reference list were searched, yielding a total of 5395 records (without duplicates). After initial screening, 125 studies met the inclusion criteria; however, 117 of those studies were disqualified for the subsequent reasons: study participants not meeting the inclusion criteria ($n = 32$), unavailable full text ($n = 29$), lack of study data ($n = 7$), no relevant outcomes ($n = 21$), non-English/Chinese literature ($n = 8$), or not RCTs/pilot RCTs ($n = 20$). Ultimately, eight studies that met the inclusion/exclusion criteria were used in this study (Figure 1).

Study characteristics

The eight studies incorporated, which were carried out in Spain ($n = 1$) [29], China ($n = 1$) [21], Australia ($n = 1$) [37], Canada ($n = 2$) [27,28], the United Kingdom ($n = 1$) [38], and Denmark ($n = 2$) [26,39] (Supplementary Table 2) were published between 2011 and 2021. In all, 445 cancer patients participated in the study, of which 222 and 223 were in the intervention and control groups, respectively, with sample sizes between 33 and 95. The mean age (SD) of the intervention group ranged from 47.40 (9.60) to 69.50 (6.60), the mean age of the control group ranged from 49.20 (7.90) to 70.80 (10.20), and there were 279 (62.70%) females. The interventions were performed via website ($n = 2$) [27,29], telephone ($n = 2$) [28,38], website combined with telephone ($n = 1$) [34], smartphone application ($n = 1$) [39], exergaming system combined with telephone ($n = 1$) [26] or internet combined with social media ($n = 1$) [21]. The duration of the intervention varied between 8 and 12 weeks. Additional detailed research characteristics are covered within Table 1.

In these included studies, the tele-exercise interventions varied. Regarding intervention dimensions, tele-exercise intervention types were most commonly website-based and telephone-based. Tele-exercise intervention durations ranged from 8 weeks to 12 weeks. Within the exercise dimension, exercise types included aerobic, resistance, and flexibility training. Two studies provided exercise interventions through websites; specifically, Galiano-Castillo et al. (2016) [29] provided participants with website-based resistance and aerobic exercise. Forbes et al. (2015) [27] tracked participant step counts through a website and gave instructions and exercise reminders. Two studies provided exercise interventions over the telephone; specifically, Donnelly et al. (2011) [38] had physical therapists provide exercise counseling and instruction over the telephone. Vallerand et al. (2018) [28] used a telephone to offer participants a program of exercise behavior change interventions. Three studies delivered exercise interventions via hybrid remote technology or internet platforms; specifically, Dong et al. (2019) [21] used internet and social media software to provide participants with exercise training and regular pushes of knowledge about exercise rehabilitation. Evans et al. (2021) [37] used a website and telephone to provide participants with personalized exercise program development, exercise preference, and question-answer guidance, respectively. Villumsen et al. (2019) [26] used an exercise program system and telephone for exercise and adherence as well as adverse event documentation. Christensen et al. (2019) [39] used an application on a smartphone for exercise training that included individual adaptive testing and training features.

In terms of the control groups, four studies applied usual care, one study adopted wait list controls, one study used traditional treatment, and one study used self-directed exercise.

Risk of bias

The distribution of studies at low risk of bias, some concerns, and high risk of bias in the five evaluation fields was as follows: randomization process (62.5%, 25%, and 12.5%, respectively); deviations from intended interventions (62.5%, 37.5%, and 0%, respectively); missing outcome data (85.7%, 12%, and 0%, respectively); measurement of the outcome (75%, 25%, and 0%, respectively); and selection of the reported results (87.5%, 12.5%, and 0%, respectively). Ultimately, the overall risk of bias was 25%, 62.5%, and 12.5% for low risk of bias, some concern, and high risk of bias, respectively. Additional specific information on the assessment can be obtained from in supplementary Figure 1. Furthermore, the distribution of the funnel plot was mostly symmetrical and not markedly distinct (supplementary Figure 2).

Quality of evidence

According to the GRADE methodology guide, the certainty of evidence on quality of life is high. Details of the outcome's certainty of evidence results and assessments are provided in supplementary Table 2.

Meta-analysis results

Quality of life

There were eight studies that reported on the impact of tele-exercise on quality of life, involving a total of 445 cancer patients.

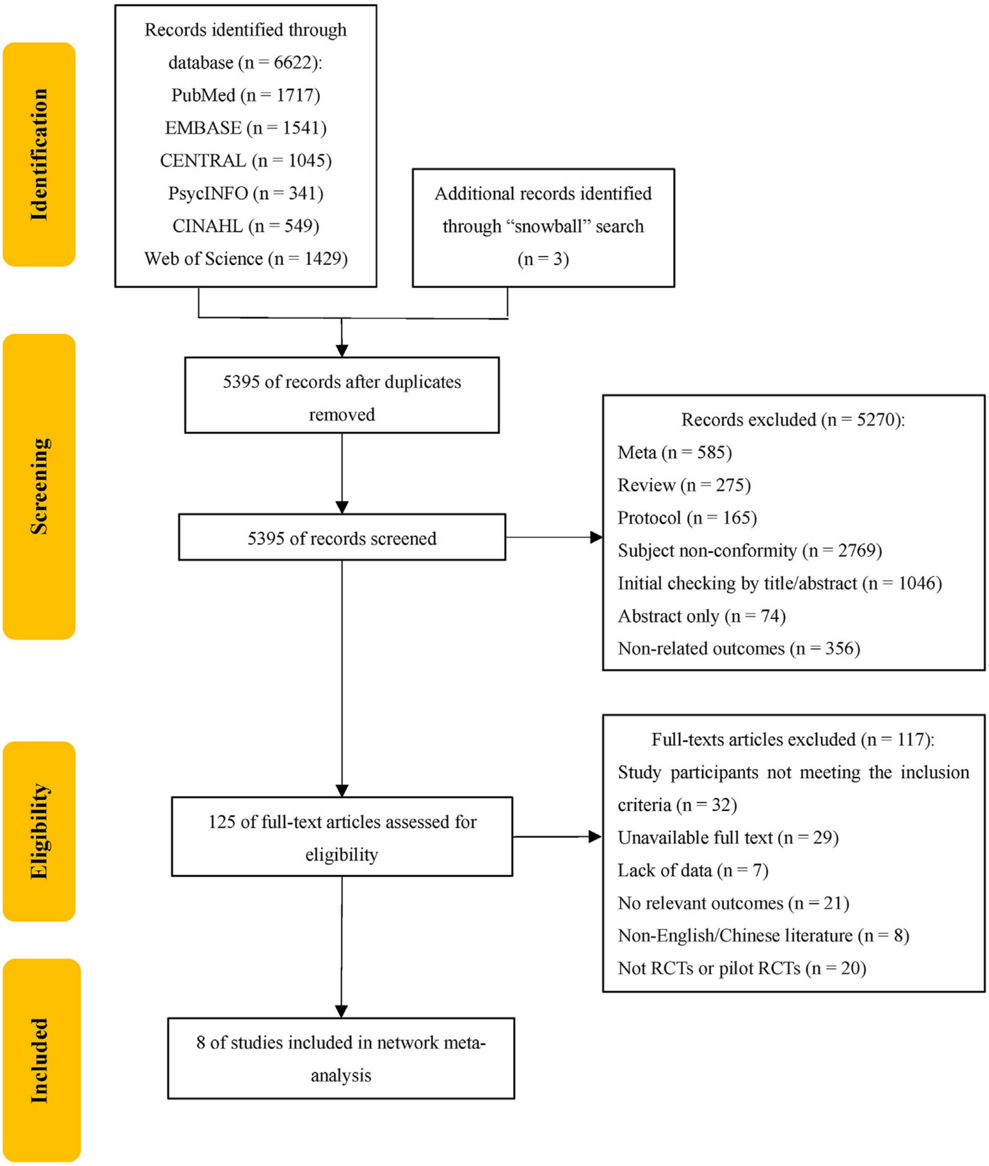

Figure 1. Flowchart of study selection and literature screening process.

Conclusions from the meta-analysis found that postintervention quality of life was significantly higher in the intervention group compared to the control group (SMD = .41, 95% CI: 0.12 ~ 0.70, $p < .010$; $I^2 = 54\%$, $p = .030$) (Figure 2A). Furthermore, after excluding studies one at a time, the summary findings of the meta-analysis remained steady (supplementary Figure 3).

According to the results of the cumulative meta-analysis, there was evidence as early as 2019 that tele-exercise enhanced the quality of life with cancer patients, and the effect's orientation has stayed constant to this day (supplementary Figure 4).

Subgroup analysis

When the studies were grouped according to intervention duration, the summarized outcomes showed that the subgroup with greater than or equal to 10 weeks of tele-exercise demonstrated positive outcomes and low heterogeneity (SMD = .38, 95% CI: 0.11 ~ 0.65, $I^2 = 0\%$); Regarding the subgroups with less than 10 weeks, no noteworthy variations were observed (SMD = .44, 95% CI: −.25 ~ 1.12, $I^2 = 83\%$) (Figure 2B).

Sex-based subgroup analysis of cancer patients was carried out, which demonstrated that tele-exercise intervention had a significant influence and low heterogeneity in female cancer patients (SMD = .62, 95% CI: 0.04 ~ 1.19, $I^2 = 68\%$) but no effect in males (SMD = .33, 95% CI: −0.10 ~ 0.76, $I^2 = 0\%$) (Figure 2C).

Additionally, subgroup analyses according to type of tele-intervention utilized were carried out, and their pooled results revealed that the type of tele-exercise had no apparent influence on either web-based (SMD = .55, 95% CI: −0.51 ~ 1.62, $I^2 = 91\%$) or telephone-based (SMD = .10, 95% CI: −0.33 ~ 0.53, $I^2 = 0\%$) interventions, as well as that heterogeneity in the former form was high (Figure 2D).

Discussion

Summary of main results

A total of 445 patients with cancer were enrolled in the research. We discovered that the tele-exercise intervention had a favorable

Table 1 *Characteristics of Included Studies.*

Study author, year, country	Study design	Participants					Intervention			Duration (from postintervention)	Outcome measures
		Type of cancer	Sample size				Intervention type	Type of exercise program, frequency	Control		
			Baseline/post-intervention	Allocation (I/C)	Male/female	Mean age					
Christensen, 2019 Denmark [39]	RCT	Colorectal cancer	39/39	19/20	18/21	57.80(10.40)/60.30 (8.90)	Smartphone application	Interval walking, at least 150 minutes per week (at least every third week)	Usual care	Post-inter 12 weeks	FACT-C
Dong,2019 China [21]	RCT	Breast cancer	60/50	30/30	0/60	48.00(5.54)/ 51.63(7.49)	Internet + social media software	Muscle training, 3 times per week; cardiorespiratory capacity training, 4 times per week	Traditional treatment	Post-inter 12 weeks	SF-36
Donnelly, 2011 UK [38]	RCT	Gynaecological cancer	33/33	16/17	0/33	53.50(8.70)/ 52.10(11.80)	Telephone	Walking and strengthening exercise, 30 minutes at least 5 days per week	Usual care	Post-inter 12 weeks	FACT-G
Evans, 2021 Australia [37]	Pilot RCT	Prostate cancer	40/38	20/20	40/0	69.50 (6.60)/70.80 (10.20)	Website + telephone	Aerobic training, 2–3 sessions per week for 16–40 min; Resistance training, 2–3 days per week; Flexibility exercises	Wait-list control	Post-inter 8 weeks	EORTC QLQ-C30
Forbes, 2015 Canada [27]	RCT	Breast, prostate, and colorectal cancer	95/84	48/47	42/53	64.50 (8.40)/65.70 (8.60)	Website	Walk, N/A	Usual care	Post-inter 9 weeks	FACT-G
Galiano-Castillo, 2016 Spain [29]	RCT	Breast cancer	81/81	40/41	0/81	47.40 (9.60)/49.20 (7.90)	Website	Resistance and aerobic exercise, 3 sessions per week (on nonconsecutive days), 90 min each day	Usual care	Post-inter 8 weeks	EORTC QLQ-C30
Vallerand, 2018 Canada [28]	RCT	Hematologic cancer	51/51	26/25	20/31	N/A	Telephone	Aerobic exercise, at least 60 min/week	Self-directed exercise	Post-inter 12 weeks	SF-36
Villumsen, 2019 Denmark [26]	RCT	Prostate cancer	46/46	23/23	46/0	67.60(4.60)/ 69.80(4.40)	Exergaming system + telephone	Aerobic and strength exercise, 3 times a week	Usual care	Post-inter 12 weeks	EORTC QLQ-C30

Note. BC = breast cancer; EORTC-QLQ-C30 = the european organization for research and treatment of cancer quality of life questionnaire core 30; FACT-C = the functional assessment of cancer therapy-colorectal; FACT-G = functional assessment of cancer therapy-general; N/A = not available; RCT = randomized controlled trials; SF-36 = the 36-item short form health survey; UK = the United Kingdom.

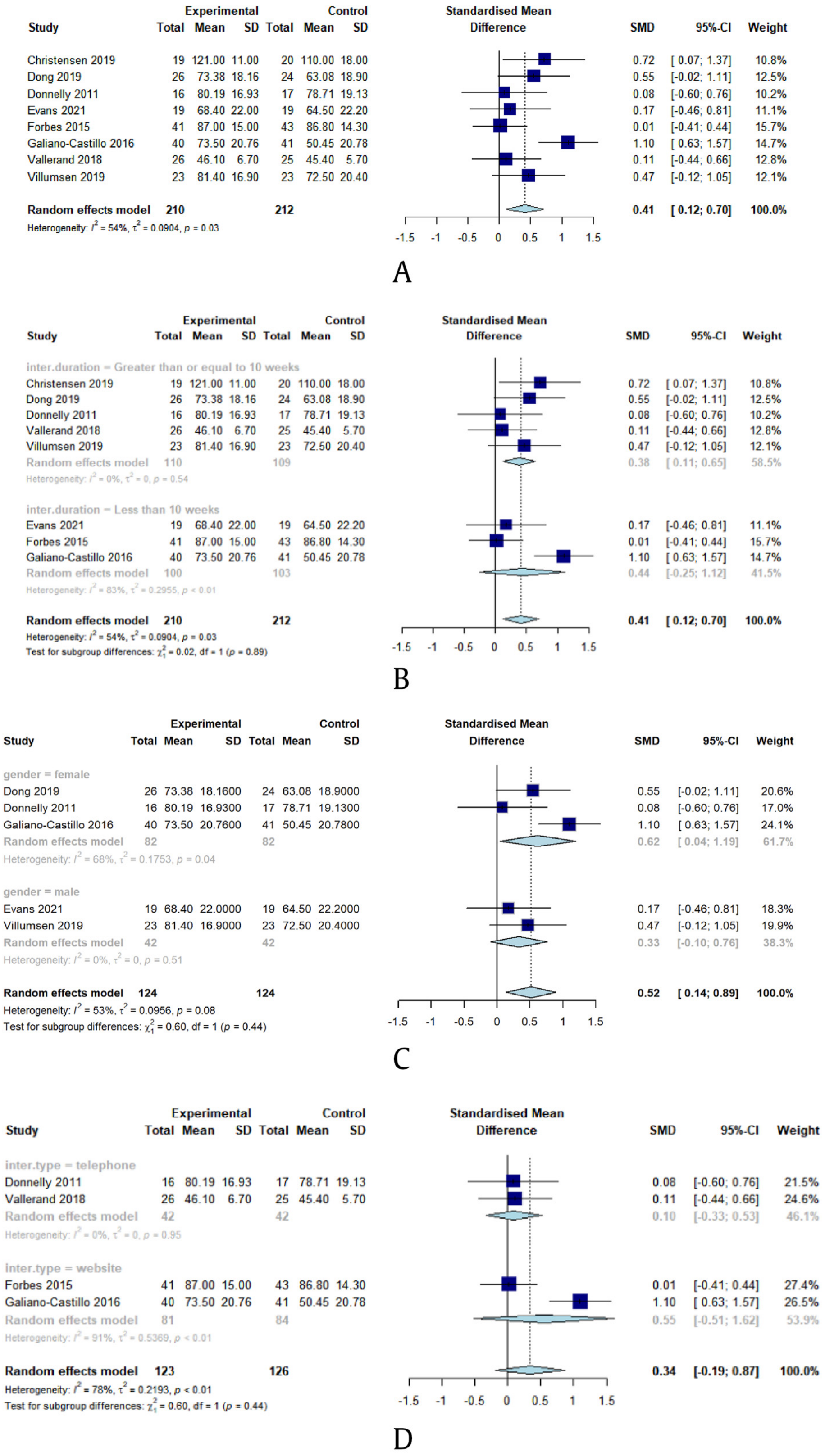

Figure 2. Results of meta-analysis: forest plots for the comparison of tele-exercise intervention against usual care. Quality of life: (A) - total effects, (B) - grouped by duration of interventions; (C) - grouped by gender of cancer patients; (D) - grouped by type of interventions.

effect as compared to a control group on the quality of life of cancer patients. In addition, we observed from the subgroup results that tele-exercise intervention for a duration greater than or equal to 10 weeks considerably enhanced cancer patients' quality of life. The tele-exercise intervention had a more beneficial impact on the quality of life among female cancer patients than among their male counterparts.

Furthermore, in this review, only some of the studies (5/8) in the exercise dimension reported the type of exercise (e.g., aerobic, resistance, and flexibility training), frequency (2-5 times per week or at least 60 minutes per week), and time (16-90 minutes per session). However, detailed descriptions of exercise intensity were lacking in all included studies. It is known that exercise intensity is one of the most important factors affecting the effectiveness of exercise interventions [31]; therefore, future studies should develop more detailed tele-exercise intervention programs based on the principles of Frequency, Intensity, Time, and Type of exercise (FITT) to improve the reproducibility and scientific validity of the studies.

Quality of evidence and methodology

Evidence of results is of high quality; however, given the small sample size of the incorporated research and the limited comparative data, the findings ought to be interpreted with care, and additional large, well-designed sample studies should be conducted in the future to validate our findings.

Effectiveness of tele-exercise interventions on quality of life

Consistent with earlier published meta-analyses [24,30], this study's findings showed that cancer patients' quality of life substantially rose as opposed to the control group, who obtained the tele-exercise intervention [10,30,40]. Tele-exercise could improve physical functioning, such as enhancing aerobic capacity and muscle strength, as well as reducing psychological burden in cancer patients. On the other hand, tele-exercise decreased the incidence of complications associated with cancer treatment [41]. Accordingly, a range of physical and mental conditions were alleviated, thus contributing to their quality of life. Moreover, the implementation of tele-exercise interventions facilitated healthcare professionals to keep track of the exercise completion status of cancer patients and to provide timely and appropriate exercise guidance [24]. Based on this, patients with cancer may gain a more informed understanding of their physical status and the ability to handle their troubles, helping them to feel a higher sense of empowerment and confidence, which has a positive influence on their quality of life [42,43]. Furthermore, tele-exercise interventions breakdown space-time constraints, particularly for patients in remote or rural areas and are characterized by convenience, efficiency, and cost savings in health care, with high levels of satisfaction among cancer patients [23,44,45]. Therefore, their need for cost-effective extended care is guaranteed, which further improves quality of life [45].

Subgroup analysis

Greater than or equal to 10 weeks of tele-exercise intervention was shown to be the most beneficial for enhancing cancer patients' quality of life, according to the results of the subgroup analysis of the intervention's duration. One possible explanation was that tele-exercise could dramatically increase physical activity levels, diminish the risk of recurrence and mortality, and control symptoms in cancer patients, and long-term regular exercise was more likely to lead to sustained consolidation and greater magnification of these benefits [46,47]. Therefore, an intervention duration greater than or equal to 10 weeks is more conducive to enabling cancer patients to develop healthy behavioural patterns and habitual exercise, thereby enhancing their quality of life [48]. In addition, interventions of greater than or equal to 10 weeks may result in greater proficiency in tele-exercise manoeuvres, as well as frequent contact with medical staff and acquisition of additional self-management skills, both of which may promote active participation in the tele-exercise program by cancer patients, leading to a positive influence on their quality of life [49–52]. However, caution should be taken when interpreting our outcomes as evidence from current studies in the field of tele-exercise in cancer patients is limited. More relevant trials are warranted in the future to prove the impact of quality of life in cancer patients in relation to the duration of tele-exercise interventions to determine the optimal intervention duration program.

With respect to sex, our subgroup findings indicated that tele-exercise improved quality of life for female cancer patients more than it did for male cancer patients. Three-fifths [21,29,38] of the studies in our subgroup analyses based on sex primarily included female cancer patients (breast and gynaecologic cancers), who are prone to body image disorders, sexual dysfunction, and low self-esteem [53,54]. Tele-exercise interventions allow these cancer patients to manage their health and boost their quality of life by accessing professional exercise instruction in a familiar home environment [22,55]. In the context of cancer stigma, the telemedicine format also gives them a relatively anonymous way to seek psychosocial support, minimizing the fear of cancer stigma [56,57]. Therefore, tele-exercise interventions may enable better support services for patients across specific cancer types [22]. For these reasons, tele-exercise interventions may be very effective for female cancer patients and be a stimulating factor to promote their active participation as well as enhance their quality of life [24]. Moreover, cancer patients of different sexes exhibited varying coping strategies, such as the adoption of healthy lifestyles with different attitudes [58]. Male cancer patients tend to take negative and avoidant attitudes, while females show higher acceptance and positive willingness to use [59–61]. Therefore, female patients with cancer may be more likely to adhere to tele-exercise interventions, which could lead to a better quality of life. Nevertheless, only five [21,26,29,37,39] of the eight studies included in this study were carried out on sex-specific cancer patients alone. As such, one should proceed with caution when interpreting the results due to the small sample sizes of the subgroups and the restricted number of studies. Future studies should expand the sample size to further validate differences in the effects of tele-exercise interventions across sexes.

Subgroup analyses of the types of tele-exercise interventions revealed that there was no statistically marked improvement in quality of life for cancer patients with either web-based or telephone-based forms of tele-exercise, but the present study found more enhancement in quality of life with web-based tele-exercise, which may be related to the accessibility and ease of use of the web, increasing the reach of effective interventions [22,55,62]; therefore, web-based forms of telemedicine are highly feasible and have a positive influence on quality of life [12,62]. Nevertheless, the subgroups of web-based interventions had a high degree of heterogeneity, which could potentially be explained by differences in the design of the web-based interventions across studies; for instance, one study's intervention included both resistance and aerobic exercise [29], whereas another focused on aerobic exercise (walking) [27]. Due to the limited number of studies included in the web-based subgroup analysis (only two studies), which may have reduced the efficacy of the statistical tests and thus led to higher heterogeneity, the results need to be treated with caution. As well, future evaluations should include more high-quality, large-scale studies. It is also notable that in our study, apart from a single telemedicine vehicle, multimodal and exercise-paired forms of telemedicine interventions emerged, for example, the web combined with social software, the web combined with the telephone, and the smartphone applications. As a consequence, future studies also need to consider combining more emerging technologies with exercise interventions [30] and optimizing the form of tele-exercise interventions to improve cancer patient satisfaction and reduce dropout rates.

Limitations

The study has several limitations. First, the cancer type and age of participants may have different impacts concerning the quality of life of cancer patients, and due to insufficient data from initial studies and the few eligible studies that were included in this meta-analysis, we were unable to perform subgroup analyses. Second, although we developed a comprehensive search strategy, some of the studies lacked relevant data or had no access to full text, which may have affected the aggregated results, and the results should be treated with caution. Finally, because this review is the first meta-analysis to investigate the influences of the duration of tele-exercise interventions and the sex of cancer patients on their quality of life, it is difficult to make direct comparisons with previous studies.

Implications

This study was conducted by quantitatively integrating existing studies and discovered that tele-exercise interventions were beneficial to cancer patients in freeing them from poor quality of life. Utilizing telemedicine technology to piggyback on exercise interventions with a combination of both advantages makes tele-exercise interventions economical, convenient, and scalable [62,63]. Therefore, healthcare professionals ought to be inspired to incorporate tele-exercise interventions into comprehensive treatments and to combine multidisciplinary teams, such as adding nutritional and psychosocial care panels, to meet the diversified care demands of patients who arise during the course of their cancer journey and to create a patient-centered model of cancer care [7,50].

We also noted that the intervention influence of tele-exercise was strongly related to the duration of intervention and that it is critical to understand whether there is a sustained effect on quality of life improvement after the intervention; therefore, future longitudinal studies need to be designed to identify trends in the developmental trajectory and maintenance of the effects of tele-exercise intervention duration on quality of life [48]. Furthermore, in our study, the current tele-exercise interventions were mainly performed in developed countries, with only one from a developing country [21]. This could be attributed to differences in economic levels and cross-cultural backgrounds in different geographic areas [64,65]. Considering this, more randomized controlled trials of head-to-head tele-exercise interventions should be conducted in the future to identify the best form of tele-exercise interventions for cancer patients of different economic levels and cultural backgrounds to maximize their benefits.

Conclusion

In conclusion, tele-exercise played an important positive role in raising quality of life among cancer patients. Of note, our study is the first meta-analysis to quantitatively integrate the effects of tele-exercise intervention duration as well as cancer patients' sex on their quality of life. The results suggested that a duration of tele-exercise intervention greater than or equal to 10 weeks was most effective in enhancing quality of life. Compared to male cancer patients, tele-exercise was more prominent in boosting quality of life in female patients. Additional longitudinal studies should be undertaken to define the time-effect relationship between tele-exercise interventions and quality of life in cancer patients and the maintenance of this influence after the end of the intervention. Furthermore, designing head-to-head randomized controlled trials may be more conducive to optimizing the selection of the most appropriate form of tele-exercise intervention to maximize benefits for cancer patients from countries of different economic levels and cultural backgrounds.

Author contributions

Study Design and writing: XLC, XLH, CMZ and JJL.
Data Collection: XLC, CMZ, JJL, LZ, SZ, and YZ.
Data Analysis and Interpretation: XLC, CMZ, LZ, SZ, and YZ.
Manuscript Writing: XLC, CMZ and XLH.

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Ethical statement

Informed consent and ethical approval were unnecessary, as the data used in this study came from already published studies.

Data availability statement

Data sharing are not applicable to this article because no new data were created in this study.

Conflict of interest

No conflict of interest exists in the submission of this manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anr.2024.09.005.

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Research Article

An Evaluation Index System to Assess Nurse Competency in Enhanced Recovery After Surgery Programs: A Delphi Study

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SUMMARY

Purpose: To construct an index system to evaluate the competencies of nurses in enhanced recovery after surgery (ERAS) programs and provide a scientific foundation for their training and assessment.
Methods: Utilizing a literature review and semi-structured interviews, a preliminary indicator system was constructed. Based on the preliminary indicator system, a Delphi questionnaire was developed and utilized to achieve consensus among experts in two rounds of Delphi studies. The indicators were selected based on a mean importance score greater than 4 and a coefficient of variation less than .25. The weights of the indicators were calculated using the Analytic Hierarchy Process.
Results: The study developed a system that evaluates the competencies of nurses involved in ERAS programs, offering a reference for their training and evaluation. The final index system includes 7 primary indicators, 20 secondary indicators, and 66 tertiary indicators. The primary indicators consist of competencies in the following components: 1) Direct clinical practice (20 items); 2) Expert coaching and guidance (9 items); 3) Consultation (6 items); 4) Research (7 items); 5) Leadership (11 items); 6) Collaboration (8 items); and 7) Ethical decision-making (5 items).
Conclusion: The developed competency evaluation index system is reliable and can serve as a foundation for the selection, training, and assessment of ERAS nurses.

Introduction

Enhanced recovery after surgery (ERAS) refers to the application of a variety of conventional perioperative management measures proven to be effective by evidence-based medicine, as well as their modification, optimization, and combination, to reduce perioperative stress comorbidities and accelerate patients' postoperative recovery [1]. The concept was first proposed by Professor Kehlet in 1997. Its multidisciplinary and multimodal concept of perioperative rehabilitation interventions has been recognized and applied in several surgical subspecialties such as gastrointestinal surgery, liver surgery, cardiac surgery, breast surgery, urology, gynecology, etc. Nowadays, it is widely practiced in more than 20 countries [2]. In 2007, Professor Li took the lead in introducing the ERAS concept to China [3], which promoted the reform and innovation of the perioperative care model in Chinese healthcare institutions. The implementation of ERAS shortened the length of hospital stay, reduced the incidence of complications, improved patient satisfaction, and played an important role in improving the efficiency of healthcare resource utilization and reducing healthcare costs. This helped improve healthcare quality and rational utilization of healthcare resources [4].

The ERAS program encompasses the entire continuum of patient care spanning from pre-hospitalization through to post-discharge stages and comprises a comprehensive array of core components and interventions [5]. Implementing these changes necessitates significant alterations to clinical practice across various specialties, posing a substantial challenge for surgical healthcare professionals. While many hospitals have already developed relevant ERAS protocols, simply establishing a protocol is far from sufficient. The key to success lies in ensuring the implementation of ERAS-related measures [6,7]. At least 70% compliance has been proven to be a necessary condition for achieving improved clinical outcomes [8,9]. However, healthcare professionals face several barriers in implementing ERAS, including outdated concepts, poor doctor-patient collaboration, insufficient multidisciplinary cooperation and communication, and imperfect indicators for assessing the effectiveness of interventions [10,11].

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To ensure the implementation and sustainability of ERAS, consideration should be given to appointing a dedicated nurse or healthcare professional who is responsible for the implementation, evaluation, and sustainability of ERAS and who can assess the progress, completion, and dimensions of barriers to ERAS promptly and develop practical solutions [12–14]. The importance of ERAS coordinators has been emphasized in international studies. In foreign countries, the position of ERAS coordinator has become permanent, being one of the key members of the ERAS core team [15], which is usually filled by a dedicated ERAS nurse [16]. ERAS nurses are responsible for preoperative patient consultation and education, postoperative support, and follow-up after discharge. They also play a crucial role in managing ERAS projects, conducting staff education and training, collecting and auditing clinical data, and developing and implementing ERAS pathways [17]. From preoperative preparation to postoperative recovery, their scope of work covers the entire patient treatment process to ensure that patients receive comprehensive support and care.

Chinese hospital administrators can learn from foreign experience to ensure the quality of ERAS implementation by selecting nurses with good professional knowledge, communication skills, health education ability, and adaptability, and training them to become full-time ERAS nurses [13]. At present, some regions in China, such as Zhejiang and Chongqing, have set up training bases for nurse specialists in ERAS. However, in China, there is no unified standard for the training, evaluation, and management of nurse specialists, leading to inconsistent quality among nurse specialists [18]. The role of ERAS nurse specialists in China is a relatively emerging field, hence, the relevant competency assessment tools may not have been fully developed and utilized yet. Compared to other nurse specialists, ERAS nurse specialists require specific knowledge and skills such as postoperative rehabilitation management, multidisciplinary teamwork, etc., which may render conventional nursing assessment tools inadequate.

Therefore, the purpose of this study is to construct an index system to evaluate the competencies of nurses in ERAS programs and provide a scientific foundation for their training and assessment.

Theoretical background

A comprehensive conceptual model suitable for all advanced nursing practice roles was developed in 1996 by Hamric, an American nurse practitioner, who defined and characterized advanced nursing practice [19]. She considers advanced nursing practice as the extended application of practice, theory, and research-based competencies to the resolution of patient problems within a particular clinical context within an expanded nursing disciplinary area. The key elements of her model include essential requirements for APNs, competencies, and factors affecting APN practice. Hamric proposes that APNs should have competencies in direct clinical practice, expert-level mentoring, and training, provision of counseling, scientific research, and leadership. Hamric suggests that APNs should have competencies in direct clinical practice, expert coaching and guidance, consultation, research, leadership, collaboration, and ethical decision-making. Therefore, based on Hamric's model, this study constructs the ERAS nurse specialists' competency evaluation index system.

Methods

Design

This study comprised two phases: 1) Utilizing a literature review and semi-structured interviews, a preliminary indicator system was constructed; and 2) Based on this preliminary indicator system, a Delphi questionnaire was developed. Following two rounds of Delphi studies, consensus among the experts was achieved.

Establishing a research team

The research team consisted of eight individuals, including seven nursing managers and one postgraduate student, each with a minimum of three years of experience in ERAS. The team's responsibilities entailed developing the expert consultation questionnaire, deciding on the necessary number of experts for consultation, distributing and collecting the questionnaires, and synthesizing the experts' feedback.

Literature search

Upon comprehensively searching the literature, eight Chinese and English databases including PubMed, Web of Science, Embase, CINAHL, Cochrane Library, China National Knowledge Infrastructure (CNKI), Wanfang Database, and VIP Journal were used to collect data on the role, ability, competency, and evaluation indicators of ERAS nurse specialists. The following keywords were used: (ERAS OR enhanced recovery after surgery OR FTS OR fast track surgery) AND (facilitator OR coordinator OR project manager OR nurse specialist OR ERAS nurse) AND (competency OR competence). The development status, trends, and related research progress of ERAS nurse specialists were clarified, and the characteristics of ERAS nurse specialists' competency were extracted and analyzed.

Semi-structured interviews

Following a team meeting to clarify the interview objectives, the research team designed a structure for the expert interviews. Employing purposive and snowball sampling methods, the team selected ERAS nurse specialists, nursing managers, and physicians for the semi-structured interviews based on defined inclusion criteria. ERAS nurse specialists had to i) have completed ERAS nurse specialists training and certification, ii) possess at least one year of experience in ERAS implementation, and iii) agree to participate voluntarily. Nursing managers needed i) at least five years of experience as surgical nursing managers, ii) to have implemented ERAS in their units for a minimum of three years, iii) to hold an intermediate title or higher, and iv) to participate voluntarily. The physicians' inclusion criteria included i) participation in an ERAS multidisciplinary team for at least three years, ii) holding an intermediate title or higher, and iii) voluntary participation in the study. To ensure the quality of the semi-structured interviews conducted in this study, we employed a rigorous and systematic approach. The interview questions were developed based on an extensive review of relevant literature and in consultation with experts in the field of ERAS and nursing competencies. This process ensured that the questions were comprehensive and relevant to the research objectives. The semi-structured interviews were conducted with a purposive sample of experienced ERAS nurses 、 nursing managers and physicians. Each interview lasted approximately 30–60 minutes and was conducted in a private and quiet setting to ensure the participants felt comfortable sharing their experiences and insights. All interviews were audio-recorded with the participants' consent and transcribed verbatim for accuracy. Prior to the interviews, informed consent was obtained from all experts, and the interviews concluded upon reaching data saturation. Content analysis of the interview data was used to identify the competency characteristics of ERAS nurse specialists.

Development of questionnaires

Drawing on the relevant literature and semi-structured interviews, the research team crafted a draft indicator system to shape the first round of expert consultation questionnaires. The questionnaire was divided into three sections. The first section was a letter to experts, offering a concise overview of the study's background and its significance. The second was a consultation form, which included instructions for completing and evaluating job competency indicators. This form featured 7 level-one indicators, 21 level-two indicators, and 71 level-three indicators. Experts assessed each indicator using a 5-point Likert scale and provided “revision comments” and “additional items” for open-ended feedback. The third section provided expert information, which included general information, degree of familiarity, and experts' basis for judgment.

Delphi expert consultation method

Conducting Delphi expert consultations, which generally require the inclusion of 15-50 experts. Eighteen experts from tertiary hospitals in Zhejiang, Guangzhou, Sichuan, Wuhan, and Chongqing were chosen based on the following inclusion criteria: 1) possession of a bachelor's degree or higher; 2) holding an intermediate-level position or above; 3) a minimum of five years of surgical nursing experience in tertiary hospitals; 4) at least three years of involvement in ERAS programs; and 5) voluntary participation in the study with signed informed consent forms.

Delphi study is an anonymous feedback approach in which the experts do not know each other and can not exchange opinions during the procedure. Questionnaires with the questions to be asked to obtain expert viewpoints are used in multiple rounds of consultation until an agreement is established. This method of individual consultation can prevent them from discussing or exchanging ideas. All questionnaires were distributed and collected via email, with a two-week response window provided to the experts. After the first questionnaire round, indicators with a mean importance score greater than 4 and a coefficient of variation less than .25 were retained. Experts' feedback led to the integration, revision, combination, or deletion of original indicators, with new ones added. This refined set of opinions was sent back to the experts for a subsequent review within two weeks. The second consultation round yielded mostly consistent expert opinions, marking the consultation's conclusion. The questionnaires underwent further refinement and enhancement based on expert feedback. If divergent opinions persisted, additional rounds of consultation were conducted until a consensus was reached.

Statistical analysis

Excel 2010 facilitated data entry, while SPSS Version 25.0 software supported data collation and analysis. The questionnaire return rate was computed to assess the experts' response level. Statistical summaries were articulated using mean and standard deviation. The expert authority coefficient represented the results' reliability. To depict the consensus among experts, the coefficient of variation and Kendall's W were utilized. The weights of the indicators were calculated using the Analytic Hierarchy Process.

Ethical considerations

This study was approved by the Ethics Committee of Sir Run Run Shaw Hospital, Zhejiang University School of Medicine (Approval no. 20220225101314730) in February 2022. Participation was voluntary, with assurances of anonymity and confidentiality regarding participants' data. The study was conducted in accordance with accepted national and international standards. Informed consent was obtained from the participants prior to their participation in the study. The privacy of study participants was maintained. The authors declare no conflict of interest.

Results

General information about the experts

Thirteen experts were interviewed through semi-structured interviews, including five ERAS nurse specialists, four physicians who were part of ERAS multidisciplinary teams, and four nursing managers experienced in ERAS implementation in surgical units, across six tertiary care hospitals. See Table 1 for details.

Eighteen experts were initially selected for the Delphi study. Two individuals were excluded due to prolonged non-response, resulting in a final inclusion of sixteen experts from Zhejiang, Guangzhou, Sichuan, Wuhan, and Chongqing. The selected experts have extensive experience in clinical practice and management, enabling them to provide constructive feedback and suggestions for this study. General information about the experts is provided in Table 2.

Motivation and authority coefficient of experts

During the first consultation round, 18 questionnaires were distributed, and 16 valid responses were received, yielding a return rate of 88.9%. Eight experts (50.0%) offered suggestions in this round. In the subsequent round, 16 questionnaires were distributed, and all were returned valid, achieving a 100% return rate. Three experts (18.7%) provided suggestions, indicating a high level of expert motivation. The judgment basis for the first round of experts was .98, the familiarity level was .89, and the authority coefficient for expert consultation was .93. In the second round, these figures were .94 for the judgment basis, .89 for familiarity,

Table 1 *General Information About the Experts of Semi-structured Interviews.*

Participants	Code	Sex	Years of experience
Nurse specialist	N1	F	16
Nurse specialist	N2	F	17
Nursing manager	N3	F	8
Nursing manager	N4	F	17
Nurse specialist	N5	F	11
Nurse specialist	N6	F	12
Nursing manager	N7	F	19
Nursing manager	N8	F	15
Nurse specialist	N9	F	19
Physicians	D1	M	4
Physicians	D2	F	9
Physicians	D3	M	22
Physicians	D4	F	21

Table 2 *General Information About the Experts of Delphi Studies.*

General information		Frequency	Percentages
Age	30-39	6	37.5
	40-49	7	43.8
	50-59	3	18.8
Educational level	BSc	13	81.3
	MSc	3	18.8
Years of experience	10-19 years	6	37.5
	20-29 years	7	43.8
	≥30 years	3	18.8
Area of expertise	Clinical nursing	11	68.8
	Nursing education	1	6.3
	Nursing management	4	25.0

Table 3 *Results of the Primary and Secondary Expert Consultation for the Enhanced Recovery After Surgery (ERAS) Specialist Nurses Competency Evaluation Index System.*

Primary and Secondary Indicators	Importance Assignment ($\bar{x} \pm s$)	Variation Coefficient	Combination Weights
1 Direct Clinical Practice	5.00 ± 0.00	.00	0.35
1.1 Holistic care application ability	4.94 ± 0.25	.05	0.17
1.2 Strong patient rapport-building skills	5.00 ± 0.00	.00	0.27
1.3 Advanced clinical reasoning skills	4.88 ± 0.34	.07	0.10
1.4 High-level technical proficiency	4.69 ± 0.48	.10	0.04
1.5 Proficiency in self-reflective practice	4.81 ± 0.40	.08	0.06
1.6 Evidence-based practice application ability	4.88 ± 0.34	.07	0.09
1.7 Nursing practice evaluation ability	5.00 ± 0.00	.00	0.27
2 Expert Coaching and Guidance	4.81 ± 0.40	.08	0.12
2.1 Patient and family education ability	4.94 ± 0.25	.05	0.67
2.2 Clinical teaching and training proficiency	4.81 ± 0.40	.08	0.33
3 Consultation	4.81 ± 0.54	.11	0.12
3.1 Interpersonal communication skills	4.81 ± 0.40	.08	0.75
3.2 Proficiency in consultation procedures	4.56 ± 0.63	.14	0.25
4 Research	4.63 ± 0.50	.11	0.08
4.1 Research integrity and academic ethics	4.81 ± 0.54	.11	0.50
4.2 Clinical research proficiency	4.81 ± 0.40	.08	0.50
5 Leadership	4.56 ± 0.51	.11	0.07
5.1 Enhancement of the clinical practice environment	4.50 ± 0.73	.16	0.11
5.2 Promotion of professional development capacity	4.75 ± 0.45	.09	0.70
5.3 Organizational and coordination skills	4.63 ± 0.50	.11	0.19
6 Collaboration	4.88 ± 0.34	.07	0.21
6.1 Ability to work collaboratively with patients and families	4.88 ± 0.34	.07	0.33
6.2 Ability to collaborate effectively within medical teams	4.94 ± 0.25	.05	0.67
7 Ethical Decision-making	4.38 ± 0.62	.14	0.06
7.1 Professional values	4.69 ± 0.70	.15	0.80
7.2 Ability to resolve ethical conflicts	4.50 ± 0.82	.18	0.20

and .92 for the authority coefficient. With both rounds' authority coefficients exceeding .80, the expert authority was substantial.

Coordination of expert opinions

Expert opinion coordination was assessed using the coefficient of variation and Kendall's W. In the first round, variation coefficients ranged from 0 to .35, with Kendall's W values for primary, secondary, and tertiary indicators being .38, .20, and .18, respectively ($p < .010$). In the second round, variation coefficients spanned from 0 to .18, and Kendall's W values for primary, secondary, and tertiary indicators were .26, .15, and .11, respectively ($p < .010$). These results indicated a high level of expert agreement in both rounds.

The Delphi consulting results

In the first round of expert consultation, the primary indicators received a mean importance assignment ranging from 4.06 to 5.00, with a coefficient of variation between 0 and .27. The secondary indicators were assigned a mean importance ranging from 3.94 to 5.00, with a coefficient of variation from 0 to .34. Tertiary indicators had a mean importance assignment from 3.75 to 5.00, with a coefficient of variation spanning from 0 to .35. Based on the screening criteria, expert feedback, and group discussions, the indicators were revised. One secondary indicator, “ability to promote health-related policies,” was removed. Additionally, six tertiary indicators were eliminated: “conflict management,” “emotional support and empathy,” “keeping up-to-date with the latest developments in ERAS, such as expert consensus and guidelines,” “the ability to critically analyze healthcare policies, recommendations, and issues from the perspectives of patients, nurses, other healthcare professionals, and stakeholders,” “serving on authoritative healthcare system policy designation committees or panels,” and “directing, initiating, and leading policy-related activities to influence practice, health services, and public policy.” A new tertiary indicator, “identifying risks in the nursing process early and providing effective interventions promptly,” was introduced. Modifications were made to the expressions of some indicators based on expert comments to prepare the consultation form for the second round.

In the second round of expert consultation, primary indicators' mean importance scores ranged from 4.38 to 5.00, with a coefficient of variation between 0 and .14. Secondary indicators had mean importance scores from 4.50 to 5.00, with a coefficient of variation between 0 and .18. Tertiary indicators received mean importance scores from 4.31 to 5.00, with a coefficient of variation from 0 to .18. No indicators were added or removed during the second round of consultation. However, the expressions of some indicators were adjusted based on experts' feedback. Ultimately, the finalized index system for evaluating the competency of ERAS nurse specialists comprised 7 primary, 20 secondary, and 66 tertiary indicators, as detailed in Table 3 and Table 4.

In addition, Figure 1 illustrates the overall degree of consensus and change in opinion between rounds, with the fountain graphs displaying the mean values and standard deviations of all indicators. It is evident that through the two rounds of Delphi expert consultation, expert opinions have converged. The figure demonstrates a stabilization of opinions across the rounds, with the majority of indicators achieving a mean score of 4.0 or above, indicating strong agreement among panelists. By round 2, consensus was reached for all indicators, with a notable decrease in standard deviation (SD) scores, reflecting increased agreement.

Figure 2 displays the trajectory of the seven primary indicators, which include Direct Clinical Practice, Expert Coaching and Guidance, Consultation, Research, Leadership, Collaboration, and Ethical Decision-making. By analyzing the trajectories in the graph, we can observe the degree of consensus and changes in expert opinions across different rounds. The consistency in Direct Clinical Practice and Collaboration suggests that these areas were already well-agreed upon from the outset. In contrast, the increased mean values and decreased standard deviations for the other indicators demonstrate a convergence toward a common understanding, reflecting a refinement and alignment of expert perspectives through the Delphi process. This indicates a stabilization of expert opinions, with a stronger consensus forming around the importance of these indicators.

Figure 3 displays the trajectory of the secondary indicators. Most indicators remained stable or showed a trend toward consensus in the second round of consultation.

Discussion

Drawing on a literature review on nurse specialists' competency, semi-structured expert interviews, and an analysis of the current state of ERAS nursing practices in China, this study utilized the Delphi expert consultation method to create a competency evaluation index system for ERAS nurses, tailored to China's national conditions. Sixteen experts from tertiary hospitals in five provinces—Zhejiang, Guangzhou, Sichuan, Wuhan, and Chongqing—were selected. More than 93.0% of these experts had over a

Table 4 *Results of the Tertiary Expert Consultation for the Enhanced Recovery After Surgery (ERAS) Specialist Nurses Competency Evaluation Index System.*

Tertiary Indicators	Importance Assignment ($\bar{x}$ s)	Variation Coefficient	Combination Weights
1.1.1 Focus on humanistic care, create a humanistic atmosphere, and demonstrate respect for patients while prioritizing attention to the patient's physical, mental, social, and spiritual needs.	4.81 ±0.40	.08	0.01
1.1.2 Perform timely and accurate assessments and analyses of patients' conditions.	4.94 ±0.25	.05	0.02
1.1.3 Develop a comprehensive care plan and execute it with precision by collaborating with a multidisciplinary team to manage complex and unstable conditions	4.94 ±0.25	.05	0.02
1.1.4 Continuously assess changes in the patient's condition, provide timely feedback, and make necessary adjustments to the care plan.	4.88 ±0.34	.07	0.01
1.1.5 Evaluate nursing care plans and measures and continuously improve them to assess nursing care outcomes and enhance patient satisfaction.	4.81 ±0.40	.08	0.01
1.1.6 Develop follow-up plans, utilize telemedicine, and provide continuous service to ensure consistent care.	4.81 ±0.40	.08	0.01
1.2.1 Utilize flexible communication-related theories and skills to effectively communicate with patients and obtain necessary information.	4.88 ±0.34	.07	0.09
1.3.1 Apply knowledge and experience in accelerated rehabilitation surgery to conduct a comprehensive analysis and make sound judgments regarding a patient's existing or potential nursing problems.	4.88 ±0.34	.07	0.01
1.3.2 Collect comprehensive patient data, develop individualized plans for treatment and care for special patients and situations, and implement and continuously improve them.	4.88 ±0.34	.07	0.01
1.3.3 Identify risks in the nursing process early and make effective interventions on time.	4.88 ±0.34	.07	0.01
1.4.1 Master relevant clinical operation skills, such as pulmonary rehabilitation, pain management, and others, as appropriate.	4.94 ±0.25	.05	0.01
1.4.2 Master the operation of common clinical instruments and equipment, such as respiratory function exercisers, analgesic pumps, and others as appropriate.	4.81 ±0.54	.11	< 0.01
1.5.1 Accurately assess oneself, identify areas that need improvement, and take prompt action to address them.	4.63 ±0.50	.11	0.02
1.5.2 Show proficiency in recognizing personal stress and utilizing various stress reduction methods for self-regulation on time.	4.31 ±0.70	.16	< 0.01
1.6.1 Conduct critical analysis and evaluation of relevant literature and other forms of evidence.	4.69 ±0.48	.10	0.01
1.6.2 Identify discrepancies between evidence and practice and analyze them.	4.63 ±0.62	.13	< 0.01
1.6.3 Apply relevant evidence to improve practice.	4.81 ±0.40	.08	0.02
1.7.1 Provide prompt and efficient guidance and supervision for clinical care to guarantee the proper implementation of ERAS measures.	4.88 ±0.34	.07	0.06
1.7.2 Utilize information technology and artificial intelligence techniques to evaluate the effectiveness of care.	4.38 ±0.81	.18	0.01
1.7.3 Gain an understanding of patient healing and progress by implementing follow-up programs.	4.56 ±0.63	.14	0.02
2.1.1 Be proactive in accessing health education resources and directing patients to social organizations' support and resources.	4.69 ±0.48	.10	0.01
2.1.2 Analyze the educational requirements of patients and their families and create personalized education strategies.	4.94 ±0.25	.05	0.03
2.1.3 Employ a range of health education techniques to provide health education for patients.	4.94 ±0.25	.05	0.03
2.1.4 Evaluate and reflect on the results of health education and adjust the educational strategies accordingly.	4.88 ±0.34	.07	0.02
2.1.5 Produce health education materials related to ERAS.	4.75 ±0.45	.09	0.01
2.2.1 Evaluate the educational requirements and devise customized education plans.	4.75 ±0.45	.09	0.01
2.2.2 Employ various teaching techniques and appropriate methods to utilize the available teaching resources fully.	4.63 ±0.62	.13	0.01
2.2.3 Evaluate the results of teaching and training, including receiving and incorporating feedback and promptly addressing any deficiencies. Focus on improving the quality of teaching and training through continuous evaluation and improvement.	4.75 ±0.58	.12	0.01
2.2.4 Organize and facilitate regular lectures on topics related to ERAS knowledge dissemination and deepen understanding among healthcare professionals.	4.75 ±0.58	.12	0.01
3.1.1 Flexibly apply communication-related theories and skills to communicate with the consultant and obtain the required information.	4.81 ±0.40	.08	0.05
3.1.2 Understand the thoughts, feelings, and behaviors of others while respecting different cultural differences to establish a harmonious, mutually respectful, and accepting relationship with the consultant.	4.75 ±0.45	.09	0.03
3.1.3 Engage in self-reflection and identify areas of growth in interpersonal communication.	4.56 ±0.51	.11	0.01
3.2.1 Have the ability to provide nursing consultations.	4.69 ±0.60	.13	0.01
3.2.2 Provide guidance and support related to ERAS initiatives and their implementation in healthcare settings.	4.81 ±0.40	.08	0.02
3.2.3 Organize case discussions.	4.69 ±0.48	.10	0.01
4.1.1 Pursue truth and truthfulness in research activities.	4.94 ±0.25	.05	0.03
4.1.2 Comply with guidelines and norms during academic research.	4.88 ±0.34	.07	0.01
4.2.1 Engage in literature search and critical reading.	4.69 ±0.48	.10	0.01
4.2.2 Engage in research selection and design.	4.75 ±0.45	.09	0.01
4.2.3 Implement research and conduct statistical analysis of data.	4.69 ±0.48	.10	0.01
4.2.4 Conduct transformation of scientific research results	4.69 ±0.60	.13	0.01
4.2.5 Participate in collaborative research	4.69 ±0.60	.13	0.01
5.1.1 Demonstrate strict self-discipline and continuous self-improvement to serve as a positive role model.	4.81 ±0.40	.08	< 0.01
5.1.2 Assist in the establishment of hospital practice standards and guide their implementation. Oversee the implementation of standards, practice guidelines, and clinical pathways to ensure that they are being followed correctly.	4.81 ±0.40	.08	< 0.01
5.1.3 Identify barriers that exist in organizational systems and apply continuous quality improvement methods and tools to improve the clinical practice environment.	4.69 ±0.48	.10	< 0.01
5.1.4 Participate in developing, implementing, and monitoring organizational performance standards.	4.50 ±0.52	.12	< 0.01
5.1.5 Maintain contact with other medical institutions and professionals to participate in evaluating medical services.	4.50 ±0.52	.12	< 0.01
5.2.1 Set goals, continue learning about the latest advances in ERAS, such as expert consensus and guidelines, plan rationally, and continuously improve operational capabilities.	4.88 ±0.34	.07	0.03
5.2.2 Promote and articulate the role of specialist nurses in ERAS to the public and other healthcare professionals.	4.63 ±0.50	.11	0.01

Table 4 (*continued*)

Tertiary Indicators	Importance Assignment ($\bar{x}$ s)	Variation Coefficient	Combination Weights
5.2.3 Actively participate in meetings, training, and other activities related to ERAS.	4.69 ±0.70	.15	0.01
5.3.1 Provide nursing support throughout the patient's recovery process, from active treatment to the transition to stabilization.	5.00 ±0.00	.00	0.01
5.3.2 Promote communication among multidisciplinary teams to jointly develop patient treatment plans and reduce fragmented or delayed care.	4.94 ±0.25	.05	< 0.01
5.3.3 Facilitate coordination among patients, families, physicians, and other departments to reduce barriers in the treatment process.	4.88 ±0.34	.07	< 0.01
6.1.1 Guide patients and their families to participate in the management of their disease treatment.	4.88 ±0.34	.07	0.03
6.1.2 Understand the thoughts, feelings, and behaviors of others and build trust with patients and their families.	4.75 ±0.58	.12	0.01
6.1.3 Maintain patients' dignity and rights, respect their decision-making rights, and encourage their active participation in decision-making.	4.75 ±0.58	.12	0.01
6.1.4 Respect different cultural differences and promote mutual respect and acceptance.	4.69 ±0.60	.13	0.01
6.1.5 Assist patients in developing plans to promote health and manage their diseases.	4.81 ±0.40	.08	0.02
6.2.1 Facilitate and promote multidisciplinary teamwork.	4.88 ±0.34	.07	0.08
6.2.2 Encourage mutual recognition of the value of different areas of knowledge and skills within the team.	4.81 ±0.40	.08	0.04
6.2.3 Encourage recognition, acceptance, and support of change and innovation within the healthcare system.	4.75 ±0.58	.12	0.02
7.1.1 Demonstrate a passion for the profession, genuine care for patients, and adherence to the hospital and nursing service philosophy, vision, and values.	4.88 ±0.34	.07	0.02
7.1.2 Create a positive and ethical professional atmosphere.	4.88 ±0.34	.07	0.02
7.2.1 Possess knowledge of ethical principles and practices.	4.63 ±0.62	.13	0.01
7.2.2 Recognize and identify ethical conflicts as they arise.	4.50 ±0.73	.16	< 0.01
7.2.3 Apply ethical decision-making models to address ethical issues.	4.50 ±0.73	.16	< 0.01

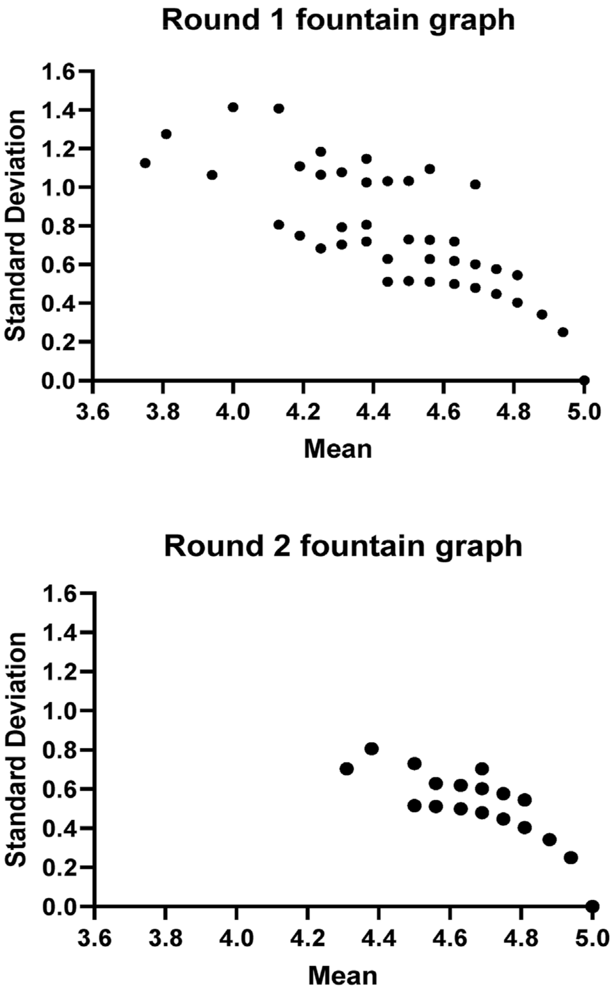

Figure 1. Fountain graphs displaying the mean values and standard deviations of all items.

decade of nursing experience, with 68.8% holding associate senior titles or higher, showcasing the hospitals' comprehensive experience in implementing accelerated rehabilitation surgery and ERAS nursing practices and management. During the two rounds of expert consultation, the positive response rates were 88.9% and 100%, respectively, indicating significant interest in the study. Additionally, 50.0% and 18.7% of the experts offered suggestions during the two consultation rounds, respectively, affirming their engagement with the study. The authority coefficients were notably high, with values of .93 and .92 for the first and second rounds, respectively. Following these rounds, the coefficient of variation for all indicators remained below .25. Kendall's W was statistically significant, reflecting a strong consensus among experts. Therefore, the ERAS specialist nurse competency evaluation system developed through this study is deemed reliable.

This study established an evaluation index system for the competency of ERAS nurse specialists, considering various aspects of skills required for ERAS specialized nursing. Through this evaluation index system, we explored how to cultivate a high-quality team of ERAS nursing experts, providing a scientific and quantified basis for their recruitment, training, and assessment. For ERAS

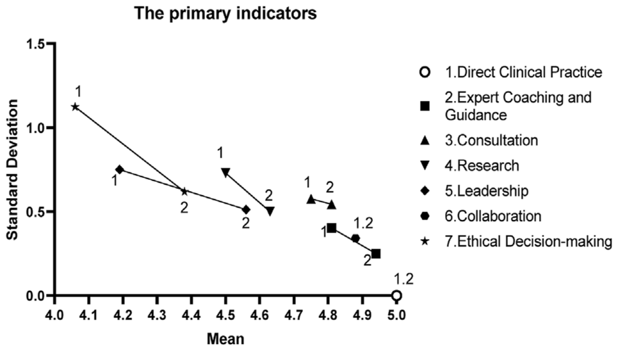

Figure 2. Trajectory graphs showing the mean and standard deviation of the primary indicators. The rounds are identified by the numbers in the graph.

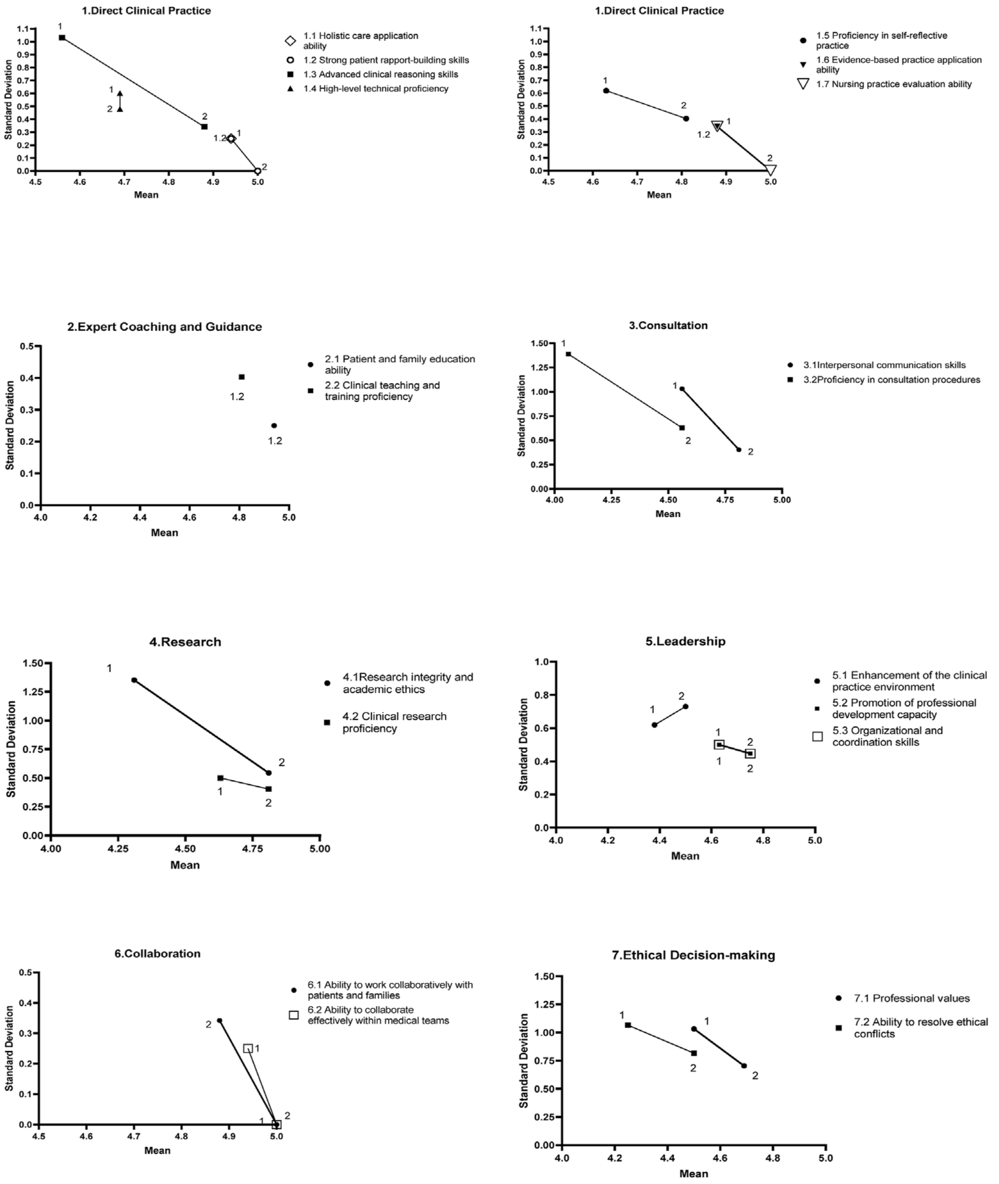

Figure 3. Trajectory graphs showing the mean and standard deviation of the secondary indicators. The rounds are identified by the numbers in the graph.

nurse specialists, assessing their competency can provide a clearer understanding of their own professional abilities, prompting continuous self-reflection and improvement in their work. This evaluation index system can help them identify the direction of their career development, further refine their individual career plans, and provide robust support for achieving professional growth and advancement. For nursing managers, these indicators can serve as the basis for recruitment and selection, helping managers identify candidates suitable for the position. Additionally, through the evaluation criteria, managers can determine the current competency level and potential for the development of nurses, thereby helping them develop personalized training plans to enhance their professional competence and skill level. For the future development of ERAS, establishing a competency evaluation system for specialized nurses can provide excellent nursing staff for ERAS teams. A highly skilled team of nurse specialists can effectively implement various measures of ERAS, improve the speed and quality of patients' surgical recovery, and reduce the incidence of postoperative complications. Moreover, an excellent nursing team can also provide valuable practical experience and suggestions for the continuous optimization and improvement of ERAS, promoting its broader application and sustainable development in clinical practice. Therefore, establishing a competency evaluation system for nurse specialists is of great significance for the future development of ERAS.

Using a thorough research methodology that included an extensive literature review, semi-structured interviews, and the Delphi expert consultation method, we developed an evaluation index system for assessing the competency of ERAS specialist nurses. This system consists of 7 primary, 20 secondary, and 66 tertiary indicators.

According to available information, this is the first study on the competencies of ERAS nurse specialists. Previous research has focused on the job responsibilities and role positioning of ERAS nurse specialists [17,20,21]. Direct clinical practice skills occupy the most important position among the primary indicators. This outcome underscores the necessity for ERAS specialist nurses to focus on patient-centered care, ensuring individualized and optimal care from admission to discharge. This perspective aligns with Hamric's advanced nursing practice model. Given that ERAS encompasses a multidisciplinary approach involving healthcare professionals from various specialties, specialist nurses must be well-informed about the ERAS-related measures employed by other team members to foster effective interdepartmental collaboration. Additionally, as ERAS is characterized by the continuous update and refinement of evidence-based treatments and care, specialist nurses are required to possess advanced knowledge and skills, as well as the agility to adjust care pathways to the latest evidence [22].

Furthermore, expert coaching and guidance, consultations, leadership, and collaboration were also identified as crucial, which aligns with the roles of ERAS nurse specialists as mentioned in studies by Watson [17], Burch [20], and Balfour [21]. These nurses play a pivotal role in improving patient education and enhancing the implementation of ERAS measures among healthcare staff [23]. Throughout the perioperative period, they ensure patients and families receive current and relevant ERAS education while addressing colleagues' learning needs [20]. With strong consultation skills, they enhance nursing practices and advise on ERAS optimization, fostering clinical understanding and professional growth for better patient outcomes. Effective coordination among patients, colleagues, and the ERAS team relies on their leadership in driving implementation and ensuring its success. Continuous improvement and professional development are essential, given the impact of disparate care approaches on ERAS success [24]. Coordinated multidisciplinary efforts and standardized criteria are crucial for achieving consensus and enhancing ERAS outcomes [10]. ERAS nurse specialists play a vital role in uniting stakeholders—including patients and families—ensuring effective communication and achieving desired outcomes during the perioperative period.

Moreover, research is essential for ERAS nurse specialists to act as pioneers in their field, actively engaging in research and innovation to advance the discipline of ERAS specialist care. Additionally, ethical dilemmas are prevalent in nursing, and inadequate competence in ethical decision-making can place clinical nurses in challenging situations, impacting the quality of care [25]. Consequently, ERAS nurses should be well-versed in ethical considerations relevant to the perioperative period and capable of identifying and addressing these issues. Specifically, they must choose the best nursing options among the protocols used, based on ethical requirements. Additionally, ERAS nurses should communicate effectively with patients and their families about ethical concerns that may arise during care.

Study limitations

This study has some limitations. The professionals selected for the Delphi expert consultation were exclusively from China's economically developed regions, such as Zhejiang and Chongqing, potentially introducing bias into the results. Moreover, an applied study of the evaluation indicator system has not yet been conducted. Consequently, further research is required to implement this system, gather data, and offer insights for its verification, modification, and enhancement.

Conclusions

In this study, the Delphi expert consultation method was employed to create an index system for evaluating the competencies of nurses specializing in accelerated rehabilitation surgical nursing. This system includes 7 primary, 20 secondary, and 66 tertiary indicators. The findings indicate that the experts' opinions on the different levels of indicators were highly focused, scientific, and reliable. This demonstrates that the evaluation index system can act as a foundational tool for the training, assessment, and evaluation of ERAS nurses, facilitating the improvement of their competencies and the overall quality of patient care.

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Conflict of interest

The authors declare no conflicts of interest.

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Research Article

Effects of a Customized Diet Education Program Using a Mobile Instant Messenger for People Undergoing Peritoneal Dialysis: A Feasibility Test

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SUMMARY

Purpose: The study was conducted to develop a customized diet education program using mobile instant messenger for people undergoing peritoneal dialysis (PD). Our goal was to examine the program's effects on diet-related self-efficacy, dietary self-care compliance, and physiological indices (hemoglobin, albumin, potassium, and phosphorus).

Methods: This was a quasi-experimental study with a non-equivalent control group pre-post-test design. We applied the Cox interaction model of client health behaviors. Overall, 43 patients (21 in the experimental group and 22 in the control group) attending the renal clinic and undergoing PD at three hospitals were included. The experimental group underwent a customized diet education program using a mobile instant messenger for five weeks. Patients in the control group received routine care. This study was conducted in the following order: pre-test, treatment, post-test 1 (immediately after), and post-test 2 (four weeks after).

Results: This study showed significant differences in dietary self-care compliance ($F = 15.29$, $p < .001$) and hemoglobin level ($F = 7.55$, $p = .001$) in interactions between times and groups.

Conclusion: The diet education program is an effective strategies to preventing complications and helping PD patients perform dietary self-care compliance through systematic and continuous interactions with educational nurse who is an expert in PD management of people undergoing PD.

Introduction

Chronic kidney disease (CKD) is characterized by irreversible and permanent kidney dysfunction [1]. Patients with chronic kidney disease can prolong their lives by receiving kidney replacement therapy such as hemodialysis (HD), peritoneal dialysis (PD), and kidney transplantation [2]. In Korea, the number of patients undergoing renal replacement therapy has steadily increased to 127,068 by 2021, of which 99,198 underwent hemodialysis, 5,610 underwent peritoneal dialysis, and 22,260 underwent kidney transplantation [3].

PD offers greater hemodynamic stability in patients with cardiovascular complications such as arrhythmia, ischemic heart disease, and congestive heart failure [4] and is preferred as an early kidney replacement therapy for patients with residual kidney function [5]. In addition, compared with HD, it has fewer restrictions on water and food intake [6], can be performed at home, and is simple and easy [7]. Given these advantages, PD results in higher treatment satisfaction than HD [8].

However, because patients perform PD without the help of healthcare professionals [9] and manage their self-care, they experience difficulties and tend to neglect self-care over time. People undergoing PD have identified diet management as the item with the highest educational need [9], as dietary guidelines are strict and challenging to follow, resulting in a loss of appetite and a decrease in overall nutritional intake [10]. In particular, people undertaking PD undergo both dialysis procedures and diet therapy [11,12]. Failure to follow the recommended diet restrictions can lead to malnutrition, occurring in 30% to 50% of patients with PD

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[13], uremic state, and complications, which result in adverse health consequences [14]. Therefore, individuals undergoing PD need to improve their dietary habits. They do not follow their diet adequately because of factors such as a lack of understanding of diet management [15] and failure to control their willingness to maintain adequate intake [11]. Therefore, it is crucial to help dialysis patients manage their diet appropriately. Dialysis care experts have stated that because each patient's eating habits are different, diet recipes should be individualized according to their condition [7].

Since PD is performed at home, there are limits to correcting eating habits through training provided by a healthcare professional once a month or once every two or three months. Repeated and continuous education, rather than one-time education, should be provided to evaluate the effectiveness of education for dialysis patients [16]. Mobile education is gaining popularity in medicine [17] and can be used as an educational medium for people undergoing PD who need constant self-care and proper meal preparation every day. Mobile instant messengers allow immediate text conversation regardless of time, place, and frequency using a smartphone. They can also be used to receive immediate feedback and confirm whether self-care is being implemented correctly, helping patients decide on their self-care. Education using mobile instant messengers can further strengthen social interaction by not only providing accessibility and immediacy but also by creating a feeling of being connected to someone [18].

In a previous study based on The Interaction Model of Client Health Behavior (IMCHB) of Cox, when caring for gynecological cancer patients, nurses encouraged physical activity, imparted nutritional education to the participants, and stimulated an affective response [19]. This shows pragmatic adequacy. The Cox IMCHB [20] suggests that various personal factors are considered in the process of determining and performing health behavior through intrinsic motivation for health behavior, as well as client-professional interaction. This can be a suitable model for improving dietary patterns by considering the individual characteristics of people undergoing PD. To change the health behavior of people undergoing PD, it is essential to identify background variables unique to these individuals. Developing intervention strategies that include affective support, health information, decisional control, and professional/technical competencies is crucial. These factors, related to client-professional interactions, are expected to be effective in maintaining proper dietary restrictions for people undergoing PD.

Previous overseas studies have investigated effective dietary restrictions that can improve dietary compliance in patients with PD [15]. These include the effect of salt restriction on blood pressure, serum sodium levels, and hydration status [21] and protein supplementation on nutritional biomarkers in patients with PD patients and hypoalbuminemia [22]. In addition, international systematic reviews and meta-analyses of nurse-based educational interventions have analyzed the effects of diet restriction, improvement in self-hygiene, and enhancement of dialysis adherence [23]. Korean studies include a phenomenological study on the experience of adapting to a diet for renal failure while undergoing PD [11] and another analyzing the nutritional status of two groups based on two years of peritoneal dialysis [10]. However, no studies have developed diet education programs and identified their effectiveness for people undergoing PD in Korea.

Therefore, this study aimed to develop a customized diet education program using a mobile instant messenger based on the Cox IMCHB [20] for people undergoing PD. We also examined its effects on diet-related self-efficacy, dietary self-care compliance, and physiological indices (hemoglobin, albumin, potassium, and phosphorus).

Methods

Study design

This study was a quasi-experimental research with a nonequivalent control group pretest-posttest design (Figure 1).

Setting and samples

The participants in this study were convenience samples of outpatients receiving peritoneal dialysis for end-stage renal failure at University Hospital A (over 500 beds) in Gwangju City, University Hospital B (over 500 beds) in Jeollabuk-do province, and General Hospital C (440 beds) in Jeollanam-do province in South Korea. The participants understood the purpose of the study and voluntarily agreed to take part. The inclusion criteria were as follows: ≥19 years, a diagnosis of end-stage renal disease, had undergone

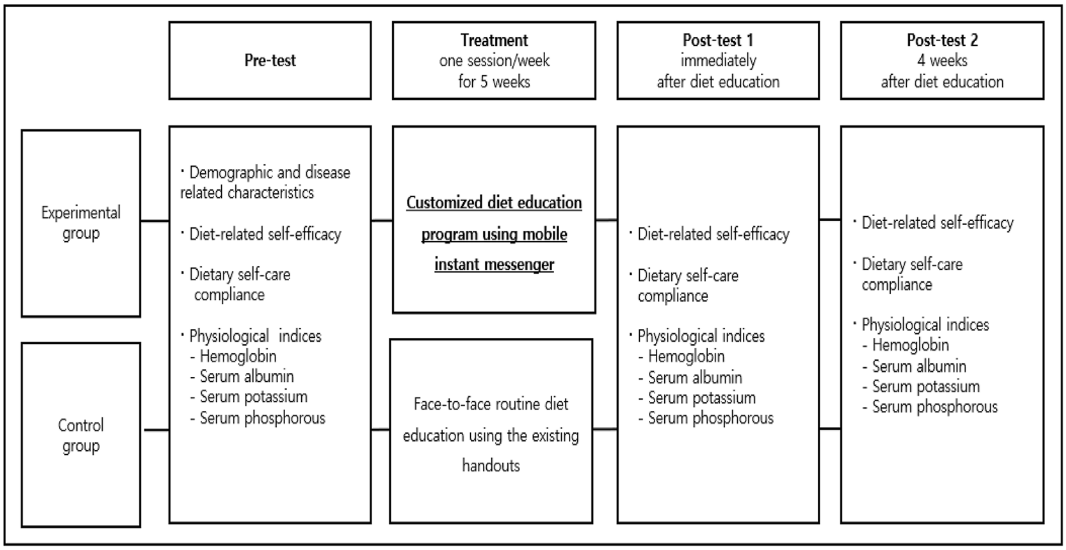


Figure 1. The research design.

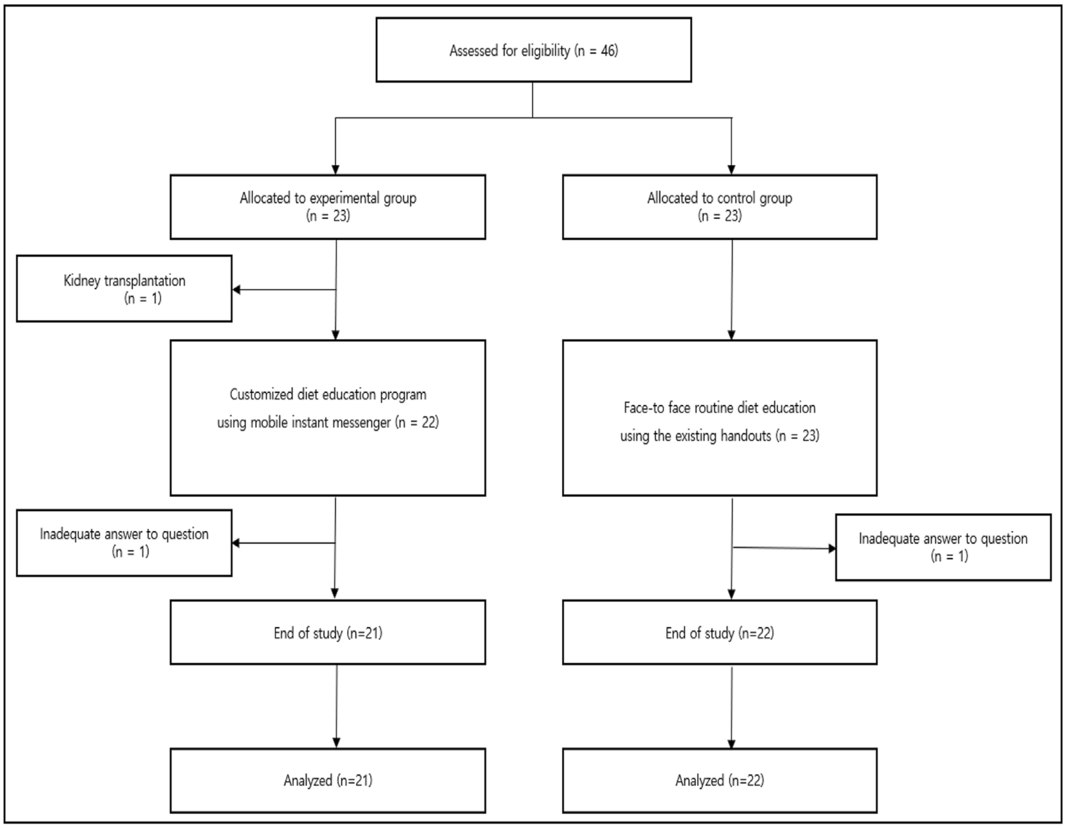


Figure 2. Research progress flow diagram.

peritoneal dialysis for at least three months, could use instant mobile messengers on smartphones, could independently make decisions about their daily lives, including meals, and had no physical or mental health problems that would restrict their participation in the study and dietary education (Figure 2).

The sample size was calculated using the G*Power version 3.1.2 program. In addition, when setting a one-tailed test, a significance level (α) of .05, power (1-β) of .80, number of groups of 2, and number of repeated measurements of 3 based on the effect size of .20 in a previous study [24]. This study applied a video diet education program to patients on hemodialysis, and the number of participants in each group was calculated to be 21. However, considering a dropout rate of 10%, 46 patients (23 in the experimental group and 23 in the control group) were enrolled in our study. During the study, two patients in the experimental group (kidney transplant surgery, inadequate answer to a question) and one in the control group (inadequate answer to a question) dropped out. Consequently, the final analysis included 21 participants in the experimental group and 22 in the control group (Figure 2). To prevent treatment influence, the experimental and control groups were divided by region. The medical institutions were randomly assigned to the experimental and control groups by flipping a coin. The experimental group was located at University Hospital A (over 500 beds) in Gwangju City, South Korea. The control group was located at University Hospital B (over 500 beds) in Jeollabuk-do Province and General Hospital C (440 beds) in Jeollanam-do Province, South Korea.

Development of a customized diet education program

The authors developed a customized diet education program. One of the authors is an educational nurse who is an expert in PD management, and performed this program. And She responded to the messenger and considered diet education customized to the needs and knowledge levels of the individual participants.

The program comprised five sessions based on a previous study [25]. The content included affective support, health information, decisional control, and professional/technical competencies, which are the client-professional interaction elements of the Cox IMCHB [20]. To provide affective support, the researcher listened to the participants' difficulties and concerns about their dietary experiences and encouraged them to support their efforts to manage their diet using the mobile instant messenger. Furthermore, “Healthy Dietary Regimen for Peritoneal Dialysis Patients,” developed by the researcher, was provided to the participants as a reference point while they practiced their dietary regimen. The booklet includes a definition of peritoneal dialysis, the principles of the dietary regimen, an intake guide for the dietary regimen, and food composition data provided by the Ministry of Food and Drug Safety of Korea. In addition, two meal guidance videos (10 minutes per video) for patients with PD produced by the researcher were provided through mobile instant messenger. For decisional control, the researcher approved the participant's decisions using the information received through the messenger. This ensured compliance with appropriate dietary self-care. Regarding professional and technical competencies, the researcher used the messenger to receive photos of food on the meal trays given to the participants. The researcher then offered individual, customized dietary counseling using the messenger (Table 1). Interestingly, according to a survey of patients undertaking peritoneal dialysis patients [26], the higher the self-efficacy, the higher the degree of self-care, which also affects physiological parameters; measuring physiological indices is necessary to reduce the overestimation of compliance

Table 1 *Customized Diet Education Program for PD Patients.*

Session	Theme	Content	Method	Time (minute)	Cox's Client-professional interaction
1	- Orientation Introduction to the program Necessity of diet and how to manage diet	Providing with booklet “A healthy diet for peritoneal dialysis patients” Giving meal tray and training for transferring food photos through MIM Necessity of diet Protein intake control Calorie intake control Control of water and salt Control of potassium and phosphorus Q&A	- Face to face education using booklet	40	- Health information - Affective support
2	Dietary guidance	Preparing rice, soup, and side dishes How to cook and tips for a meal Tips for eating-out Q&A	- Video education - Personal counseling using MIM	15	- Health information - Affective support
3	Dietary guidance	How to control potassium food and tips for low potassium meal How to control phosphorous food and tips for low phosphorous meal Q&A	- Video education - Personal counseling using MIM	15	- Health information - Affective support
4	Dietary compliance	Taking a picture of one's meal tray and sending it to a diet expert using MIM Real-time dietary counseling to MIM Q&A	- Personal counseling using MIM	Several times at every meals for 7 days	- Health information - Professional/technical competencies - Decisional control - Affective support
5	Dietary compliance	Taking a picture of one's meal tray and sending it to a diet expert using MIM Real-time dietary counseling to MIM Q&A	- Personal counseling using MIM	Several times at every meals for 7 days	- Health information - Professional/technical competencies - Decisional control - Affective support

Note. MIM = mobile instant messenger; Q & A = question and answer.

that can occur with self-report data [25]. Based on these findings, diet-related self-efficacy, dietary self-care compliance, and physiological indices were identified.

Five experts, including a nephrologist, two adult nursing professors, one nutrition team manager at the university hospital, and one PD-training nurse, conducted the program's validity test. Content validity was evaluated using a four-point Likert scale to verify the program's accuracy and suitability. The average content validity index was .92.

Measurements

Diet-related self-efficacy

Diet-related self-efficacy is a person's determination and how well they can organize and perform their diet [27]. The diet-related self-efficacy tool was developed by Kim [28], revised by Lee [29], and has five items. The tool has a Cronbach's α of .88, and the Cronbach's α in this study [28] is .85.

Dietary self-care compliance

Dietary self-care compliance means complying with therapeutic regimens [30]. The dietary self-care compliance tool was developed by Song et al. [31] and revised by Kim and Han [32], and it consists of six items. The higher the score, the higher the dietary self-care compliance. The tool has a Cronbach's α of .87, and a Cronbach's α in this study [31] is .82.

Physiological indices

The physiological status of the patients was measured according to The National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) clinical practice guidelines for nutrition [33]. The test items included hemoglobin to assess anemia, serum albumin to assess nutritional status, potassium to assess electrolyte status, and phosphorus to assess abnormalities in bone metabolism. Physiological indices were identified by regular blood tests when participants visited the outpatient, received a copy of the blood test results from the medical records department, and then submitted them to the research assistant.

Data collection and procedures

The data for this study were collected from May 19 to August 28, 2020. The order of this study was pre-test, treatment, post-test 1, and post-test 2. To avoid treatment influence, the experimental and control groups were located at different hospitals, as stated earlier. Before starting the customized diet education program, the research assistant visited University Hospital A, University Hospital B, and General Hospital C and performed a pre-test in the peritoneal dialysis room at a mutual time agreed with the participants. The purpose of the study and the program procedure were explained to each participant, and written informed consent was obtained. During this process, data on demographic and disease-related characteristics, diet-related self-efficacy, dietary self-care compliance, and physiological indices were collected for both the experimental and control groups. Physiological indices were determined by regular blood tests when the participants visited the outpatient clinic at the hospital on the day of the survey, obtained a copy of the blood test results, and submitted them to a research assistant.

One of the authors implemented a 5-session diet education program for the experimental group (Table 1). The program was delivered for five weeks; one, two, and three weeks were performed once a week per session, and four and five weeks were performed at every meal per day. In the first session (40 minutes per person), orientation and education were completed using the booklet. During orientation, the researcher explained the program's format, provided meal trays for diet education and counseling, demonstrated how to use the Kakao-talk mobile instant messenger, and how to send photos using KakaoTalk. The participants also had face-to-face education about the need for diet management using the booklet. A dietary guidance video was sent via a Kakao-talk mobile instant messenger during the second and third sessions. In the second session (15 minutes per person), the participants were taught how to prepare rice, soup, side dishes, and other recipes. They learned the diet tips required when eating out through the dietary guidance video. Personal consultations using Kakao-talk were provided in a question-and-answer format (Q&A). In the third session (15 minutes per person), participants were informed how to control potassium and phosphorus levels related to eating methods through the dietary guidance video. Personal consultations using KakaoTalk were conducted through Q&A. In the fourth and fifth sessions (several times for seven days per week), participants sent photos of food on the meal tray at every meal to the researcher to ensure adequate nutrition. Individual diet education, consultation, and Q&A were performed in real-time using Kakao-talk (Figure 3). Three times per week for two weeks, the message “Start your day with a healthy diet!” was sent to motivate participants to continue taking an adequate diet. In addition, the Kakao-talk message “Maintain a healthy diet for good blood test results!” was sent to participants to encourage their participation. Complimentary messages were sent to those who reliably sent photographs of each meal. For those whose eating habits were not corrected, the researcher listened to their stories about difficulties and provided emotional support through text messages or calls. For the control group, the researcher provided face-to-face routine diet education using existing handouts in the PD room of hospitals.

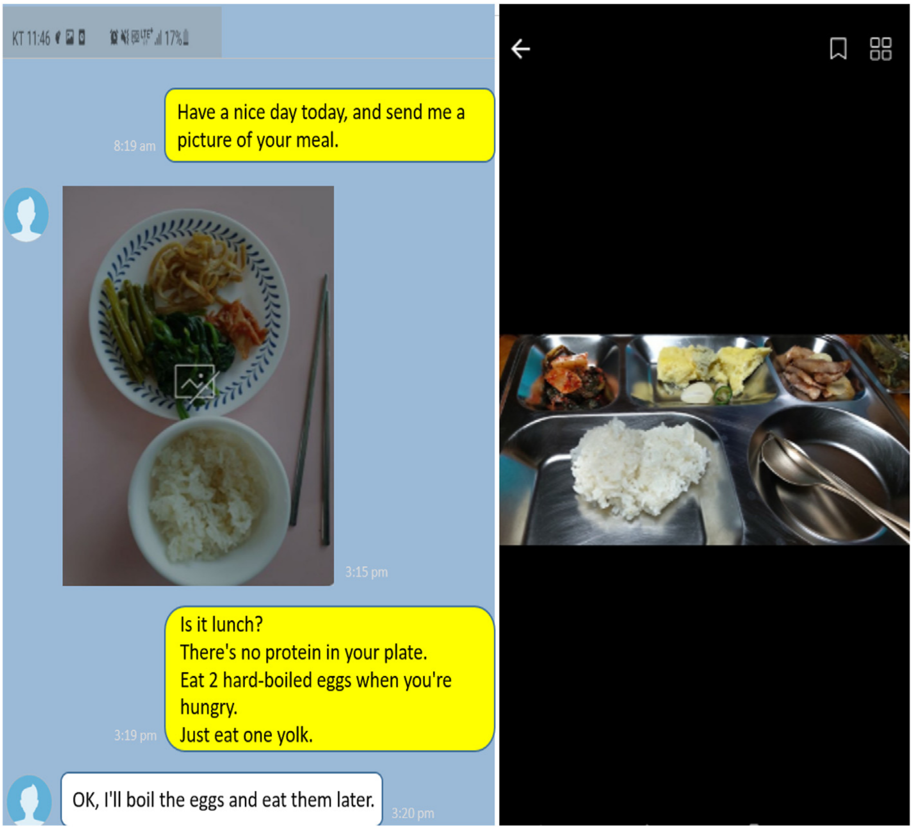
For post-test 1, immediately after completing the treatment, the research assistant met the participants at the same place at a mutually agreed-upon time and surveyed both the experimental and control groups using the same method as in the pre-test. Post-test 2 was four weeks after completing the treatment, and the research assistant surveyed both the experimental and control groups using the same method as in pre-test 1.

Ethical considerations

This study was approved by the Institutional Review Board of Chosun University (IRB No. 2-1041055-AB-N-01-2020-5). Before starting the study, the researcher explained the purpose, necessity, and methods of the study to the directors of the nephrology departments at the three hospitals to obtain permission for the study. The researcher also explained the study purpose and methods to the participants and obtained their voluntary written consent. The participants were informed that all data would be used for study purposes only and that they could withdraw their participation at any time if they wished. The researcher explained that no disadvantages would be associated with those who stopped participating. After completing the study, the control group was provided with a booklet titled “*Healthy Dietary Regimen for PD Patients*” and dietary guide videos.

Data analysis

Data were analyzed using SPSS/WIN version 23.0. The participants' general and disease-related characteristics were analyzed using actual numbers, percentages, means, and standard deviations. The homogeneity of the demographic and disease-related characteristics and dependent variables were analyzed using the chi-square test, the Fisher exact test, and the independent *t*-test. The normality distribution test of the pre- and post-scores for the



Have a nice day today, and send me a picture of your meal.

Is it lunch?
There's no protein in your plate.
Eat 2 hard-boiled eggs when you're hungry.
Just eat one yolk.

OK, I'll boil the eggs and eat them later.

Figure 3. Pictures of phone consultation using Kakao-talk mobile instant messenger.

dependent variables of the experimental and control groups was performed using the Kolmogorov–Smirnov test, and all variables were confirmed to follow a normal distribution. The dependent variables, diet-related self-efficacy, dietary self-care compliance, and physiological indices were analyzed using repeated-measures analysis of variance (ANOVA). The results were analyzed using a multivariate test if the assumption of sphericity was not satisfied. If the interaction between time points and groups was significant among normally distributed variables, the groups were compared by period according to the amount of change in each period by correcting the significance level using the Bonferroni Correction Method ($P < .016$) and performing a post-hoc analysis using an independent t-test.

Results

Homogeneity test of the demographic and disease-related characteristics and dependent variables

In the pre-test, no significant differences were observed between the experimental and control groups in demographic and disease-related characteristics, diet-related self-efficacy ($t = 25.32$, $p = .444$), dietary self-care compliance ($t = 22.32$, $p = .218$), hemoglobin ($t = 28.66$, $p = .327$), serum albumin ($t = 40.99$, $p = .299$), potassium ($t = 25.12$, $p = .621$), and phosphate levels ($t = 38.99$, $p = .425$), indicating that the two groups were homogeneous (Table 2).

Effects of the customized diet education program

Diet-related self-efficacy was analyzed using repeated-measures ANOVA. The sphericity assumption was not satisfied ($W = 0.64$, $p < .001$), and Greenhouse-Geisser's e-correction ($E = 0.737$) was applied. In diet-related self-efficacy scores, although significant differences were observed between the measurement time points ($F = 7.70$, $p = .001$) and between the groups ($F = 5.76$, $p = .021$), no significant difference was observed in the interaction between the measurement time points and the groups ($F = 1.71$, $p = .193$) (Table 3).

Dietary self-care compliance was also analyzed using repeated-measures ANOVA. The sphericity assumption was not satisfied ($W = 0.46$, $p < .001$); thus the Greenhouse–Geisser e-correction ($E = 0.65$) was applied. In the dietary self-care compliance scores, significant differences were observed

Table 2 *Homogeneity Test of Participants' Demographic and Disease-Related Characteristics and Dependent Variables (N = 43).*

Variables	Categories	Exp. (n = 21)	Cont. (n = 22)	t or χ^2 or z	p
		n(%) or M ± SD	n(%) or M ± SD		
Gender	Male	8(38.0)	15(68.2)	3.90	.690
	Female	13(62.0)	7(31.8)		
Age (yr)	20–39	3(14.3)	1(4.5)	27.66	.536
	40–59	13(61.9)	15(68.2)		
	≥60	5(23.8)	6(27.3)		
	M±SD	52 ± 11.37	55 ± 10.57	0.84	.405
Marital status[a]	Married	17(81.0)	20(91.0)	0.89	.420
	Single	4(19.0)	2(9.0)		
Education	≤Middle school	5(24.0)	7(32.0)	1.12	.572
	High school	5(24.0)	7(32.0)		
	≥College	11(52.0)	8(36.0)		
Job	Yes	8(38.0)	7(32.0)	1.81	.582
	No	13(62.0)	15(68.0)		
Family cohabitation status[a]	Alone	4(19.0)	6(27.0)	5.74	.219
	Spouse	9(43.0)	7(32.0)		
	Parents	3(14.0)	1(5.0)		
	Children	0(0.0)	4(18.0)		
	Spouse + children	5(24.0)	4(18.0)		
Cause of end-stage renal disease (ESRD)[a]	Diabetes	10(47.6)	12(54.5)	5.47	.243
	Hypertension	4(19.1)	6(27.3)		
	Glomerular nephritis	6(28.6)	1(4.6)		
	Etc.	1(4.7)	3(13.6)		
Duration of dialysis (yr)[a]	<1	4(19.0)	3(13.6)	2.33	.507
	1–3>	11(52.4)	8(36.4)		
	3–5>	2(9.6)	5(22.7)		
	≤5	4(19.0)	6(27.3)		
Person who prepares a meal	Oneself	15(71.4)	13(59.1)	0.79	.675
	Spouse	5(23.8)	7(31.8)		
	Parents	1(4.8)	2(9.1)		
Eating-out times per a week[a]	No	3(14.3)	4(18.2)	5.46	.487
	1–2	15(71.4)	10(45.5)		
	3–4	2(9.5)	5(22.7)		
	≥5	1(4.8)	3(13.6)		
Subjective view of diet management[a]	Good	8(38.1)	6(27.3)	1.83	.400
	Difficult	12(57.1)	16(72.7)		
	Etc.	1(4.8)	0(0.00)		
Diet-related self-efficacy		59.5 ± 14.86	55.9 ± 18.50	25.32	.444
Dietary self-care compliance		14.00 ± 5.00	14.2 ± 4.18	22.32	.218
Physiological indices					
Hemoglobin (g/dℓ)		9.62 ± 1.05	10.65 ± 1.36	28.66	.327
Serum albumin (g/dℓ)		3.58 ± 0.43	3.72 ± 0.37	40.99	.299
Serum potassium (mEq/L)		4.27 ± 0.72	4.65 ± 0.75	25.12	.621
Serum phosphate (mg/dL)		5.73 ± 1.89	5.83 ± 1.22	38.99	.425

Note. Con. = control group; Exp. = experimental group; M = mean; SD = standard deviation.

[a] Fisher's exact probability test.

between the measurement time points (F = 25.06, $p < .001$), between groups (F = 12.20, $p = .001$), and in the interaction between the measurement time points and groups (F = 15.29, $p < .001$). In the post-hoc analysis, the dietary self-care compliance scores in the experimental group increased by 8.33 ± 0.13 points in post-test 1 and 7.67 ± 0.78 in post-test 2 compared to the pre-test. In the control group, the dietary self-care compliance scores increased by 1.13 ± 0.13 in post-test 1 and 2.42 ± 0.89 in post-test 2 compared to the pre-test. The difference in the amount of change of the dietary self-care compliance scores between the experimental and control groups was significant in post-test 1 (t = 1.87, $p < .001$) and post-test 2 (t = 1.43, $p = .005$) compared to the pre-test (Table 3).

The hemoglobin levels were analyzed using repeated measures ANOVA, and the assumption of sphericity was satisfied (W = 0.91, $p = .165$). Although no significant differences were found between the measurement time points (F = 0.82, $p = .445$) and between the groups (F = 0.00, $p = .973$), a significant difference was observed in the interaction between the measurement time points and the groups (F = 7.55, $p = .001$). In the post-hoc analysis, the hemoglobin levels in the experimental group increased by 1.15 ± 1.38 in post-test 1 and 0.88 ± 1.64 in post-test 2, compared to the pre-test. In the control group, hemoglobin level decreased by 0.58 ± 1.51 in post-test 1 and 0.43 ± 1.81 in post-test 2 compared to the pre-test. The difference in the amount of change in hemoglobin between the experimental and control groups was significant in post-test 1 (t = 3.92, $p < .001$) and post-test 2 (t = 2.49, $p = .017$) compared to the pre-test (Table 3).

Albumin levels were analyzed using repeated measures ANOVA, and the sphericity assumption was satisfied (W = 0.92, $p = .368$), showing a significant difference between the measurement time points (F = 4.76, $p = .011$). In the experimental group, albumin levels increased by 0.07 ± 0.39 in post-test 1 and decreased by 0.06 ± 0.27 in post-test 2 compared to the pre-test. In the control group, albumin level decreased by 0.14 ± 0.25 in post-test 1 and 0.21 ± 0.34 in post-test 2 compared to the pre-test. The difference in the amount of change in albumin between the experimental and control groups was significant in post-test 1 (t = 2.18, $p = .035$) compared to pre-test, whereas it was not significant in post-test 2 (t = 1.69, $p = .098$) compared to the pre-test. In addition, no significant differences were found between the groups (F = 0.40, $p = .843$) and in the interaction between the measurement time points and groups (F = 2.95, $p = .058$) (Table 3).

Serum potassium levels were analyzed using repeated measures ANOVA, and the sphericity assumption was satisfied (W = 0.99, $p = .765$). Regarding serum potassium levels, no significant differences were observed between the measurement time points (F = 0.00, $p = .996$), between groups (F = 1.71, $p = .198$), or between the measurement time points and groups (F = 0.71, $p = .490$) (Table 3).

Serum phosphate levels were tested using repeated measures ANOVA, and the assumption of sphericity was satisfied (W = 0.96, $p = .482$). Regarding serum phosphate levels, no significant differences were observed between the measurement time points (F = 0.81, $p = .446$), between groups (F = 0.90, $p = .349$), or between the measurement time points and groups (F = 1.15, $p = .322$) (Table 3).

Table 3 *Differences of Dependent Variables Among Groups (N = 43).*

Variables	Group	Pre-test	Post-test 1	Post-test 2	source	F	p	Differences (P1−P0)			Differences (P2−P0)		
		M ± SD	M ± SD	M ± SD				M ± SD	t	p	M ± SD	t	p
Diet-related self-efficacy	Exp.	59.50 ± 14.86	73.31 ± 12.14	67.02 ± 16.22	time	7.70	.001	13.81 ± 15.39	1.76	.087	7.52 ± 13.65	1.82	.076
	Con.	55.90 ± 18.50	60.26 ± 14.56	55.45 ± 14.69	group	5.76	.021	4.36 ± 19.53			−0.45 ± 13.65		
					T*G	1.71	.193						
Dietary self-care compliance[a]	Exp.	14.51 ± 8.95	22.84 ± 4.52	22.18 ± 3.78	time	25.06	<.001	8.33 ± 0.13	1.87	<.001	7.67 ± 0.78	1.43	.005
	Con.	14.25 ± 4.18	15.38 ± 3.43	16.67 ± 10.75	group	12.20	.001	1.13 ± 0.13			2.42 ± 0.89		
					T*G	15.29	<.001						
Physiological indices													
Hemoglobin (g/dℓ)[a]	Exp.	9.67 ± 0.22	10.82 ± 0.2	10.57 ± 0.22	time	0.82	.445	1.15 ± 1.38	3.92	<.001	0.88 ± 1.64	2.49	.017
	Con.	10.69 ± 1.35	10.11 ± 1.62	10.26 ± 1.26	group	0.00	.973	−0.58 ± 1.51			−0.43 ± 1.81		
					T*G	7.55	.001						
Serum albumin (g/dℓ)	Exp.	3.58 ± 0.43	3.65 ± 0.32	3.52 ± 0.41	time	4.76	.011	0.07 ±0 .39	2.18	.035	−0.06 ± 0.27	1.69	.098
	Con.	3.75 ± 0.37	3.61 ± 0.34	3.54 ± 0.32	group	0.40	.843	−0.14 ± 0.25			−0.21 ± 0.34		
					T*G	2.95	.580						
Serum potassium (mEq/L)	Exp.	4.32 ±0 .72	4.44 ±0 .90	4.32 ± 0.65	time	0.00	.996	0.12 ± 0.64	1.12	.534	0.00 ± 0.49	0.11	.141
	Con.	4.65 ± 0.75	4.52 ± 0.82	4.44 ± 1.09	group	1.71	.198	−0.13 ± 0.79			−0.21 ± 0.89		
					T*G	0.71	.490						
Serum phosphorus (mg/dL)	Exp.	5.76 ± 0.41	5.21 ±0 .33	5.47 ± 0.39	time	0.81	.446	−0.55 ± 1.55	−1.39	.834	−0.29 ± 1.46	−0.89	.352
	Con.	5.86 ± 1.23	5.91 ± 1.84	5.90 ± 1.27	group	0.90	.349	0.05 ± 1.24			0.04 ± 0.98		
					T*G	1.15	.322						

Note. Exp.= experimental group; Con.= control group; M = mean; SD = standard deviation; P0 = pre-test; P1 = post-test 1; P2 = post-test 2; T*G = time point and group.

[a] Independent t-test: significant differences from one another by Bonferroni correction $p < .016$.

Discussion

This study aimed to improve diet-related self-efficacy for people undergoing PD and to help them implement adequate dietary self-care by developing and applying a customized diet education program and observing outcomes through physiological indices. We developed a customized diet education program using a mobile instant messenger and tailored it to patients with PD who perform dialysis independently at home.

Diet-related self-efficacy differed significantly between measurement points and groups; however, no significant difference was observed in the interaction between measurement time points and groups. Regarding the measurement time points, the score increased in post-test 1 compared to the pre-test score but decreased again in post-test 2, indicating that the self-efficacy score was not maintained until four weeks after a 5-week period of diet education. Similarly, a study examining the effectiveness of a self-management mobile application in patients with PD [34] did not find a significant difference in self-efficacy. We believe that a 5-week diet education program may be insufficient to maintain self-efficacy. Therefore, we recommend that the period for dietary education should be extended to improve diet-related self-efficacy in patients with PD. In a study that applied a dietary program to patients undergoing HD, who wrote a daily diet diary to improve performance accomplishments [35], the dietary adherence score, based on self-efficacy theory, in the experimental group, significantly increased. Therefore, we recommend that future studies record a diet diary for daily self-management and test the effect of diet-related self-efficacy.

Furthermore, this study revealed significant differences in dietary self-care compliance between the experimental and control groups immediately (post-test 1) and four weeks after the experiment (post-test 2). Similarly, in a study that applied a diet management program for eight weeks to hemodialysis patients [35], the dietary self-care compliance score in the experimental group significantly increased. However, in the video dietary instruction program for eight weeks for patients undergoing hemodialysis [24], the scores of both groups increased after 1 and 10 weeks of training, but there was no interaction between the measurement time points and groups. Therefore, the education period was effective for 5 weeks (5 sessions) in this study and Yun and Choi's 8 weeks (8 sessions) study [35], whereas there was no significant difference in Kim et al.'s 8 weeks (8 sessions) program [24]. Therefore, dietary self-care compliance scores must be maintained immediately after the program. Dietary self-care compliance is challenging to consistently practice in patients undergoing peritoneal dialysis. In future studies, it will be necessary to identify the continuing effect of dietary self-care compliance through dietary retraining at an appropriate time in patients undergoing dialysis. Some patients reduce their food intake, resulting in nutritional deficiencies or decreased physical strength [36], whereas others consume excessive amounts of food, leading to complications such as hyperkalemia and hyperphosphatemia [29]. However, this study used a mobile instant messenger to provide diet education according to participant's level of understanding and needs. We believe that the interaction between participants and experts, rather than simply conveying knowledge, leads to positive outcomes. Nurses' education and patient management are essential factors for increasing self-care compliance and reducing the occurrence of complications among patients undertaking dialysis [37]. A lack of reflection on the participants' level of understanding, watching videos of the same content during dialysis, or one-way education may have hindered dietary self-care. Notably, an education program with real-time feedback assessing each participant's vulnerable areas and providing appropriate education on alternative foods based on nutritional content [32], depending on each individual's customized eating habits [15], increased dietary self-care compliance. In addition, a previous study [35] examined the degree of dietary self-care compliance using a 24-hour recall method to write a diet diary and averaged the nutritional content daily, which tended to underestimate intake due to distorted memory. In the present study, the researcher identified the amount and type of food intake and observed the participants' individual eating habits and preferred food patterns. The participants were provided with the same food tray, pictures of their trays were taken before eating, and they were sent to the researcher. However, the intake amount could not be measured; thus, the exact amount of nutrients consumed could not be determined in this study. Further research is suggested to evaluate the effectiveness of application development that can check food intake and nutrients.

We identified physiological indices within the target range of blood tests for the participants. The physiological indices showed partially significant differences. Regarding hemoglobin levels, we observed a significant difference in the interaction of measurement time points and groups between the experimental and control groups. Although this finding does not meet the nutrition guidelines of the KDOQI [33], we believe that the 5-week diet education program showed improved results because of participants' active dietary self-care compliance. However, although the hemoglobin level increased immediately after the intervention in the experimental group compared with the pre-test, it decreased four weeks after the intervention. Since the hemoglobin level of patients on dialysis is influenced by a range of variables, such as hematopoietic hormone administration, degree of iron deficiency, and administration of iron supplements, the influence of these variables on diet education programs cannot be ruled out.

Moreover, no significant difference in serum albumin levels was observed between the experimental and control groups. However, a significant difference was observed between the measurement time points. These results are similar to those of a study that showed that albumin levels of hemodialysis patients significantly increased after applying a self-efficacy theory-based diet management program compared to those before the intervention [35]. We believe that the present study's findings are due to frequent dietary checks between the researcher and participants for two weeks by transmitting dietary photos via mobile devices. These interactions led participants to consume more high-protein foods and improve their dietary self-care consciously. Notably, we observed a substantial increase in albumin levels immediately after the intervention and a decrease four weeks after the intervention, indicating that the effect of the education program was not sustained, implying that the 5-week intervention period was rather short. To maintain the effectiveness of the program, we believe that continuous management and re-education is necessary as an interaction between PD patients and educational nurses who is an expert in PD management as client-professional interaction elements of the Cox IMCHB [20].

In addition, no significant differences in serum potassium levels were observed between the experimental and control groups. Our findings are similar to those of a study [35] that applied a diet management program to hemodialysis patients, which also showed no significant differences. The program had no effect on potassium levels because the participants knew the importance of potassium and controlled it adequately by maintaining it within the normal range in both the pre- and post-tests.

Although no significant difference in serum phosphorus levels was observed between the experimental and control groups, the experimental group showed a decrease immediately after the intervention compared with the pre-test, which is thought to have improved due to the positive influence of this program. Limiting phosphorus intake to 800–1,200 mg/day is crucial for controlling serum phosphorus levels [7]. In addition, preservatives and chemical seasonings contained in processed foods have a higher absorption rate than phosphorus contained in natural foods. Therefore, limiting the consumption of processed foods is vital [38]. This fact was also presented in the booklet and video education provided to the participants, and the education was repeated during dietary counseling regarding the participants' intake of phosphorus-containing foods.

This study had several limitations. First, since this study was conducted on patients undertaking peritoneal dialysis at a single hospital, the results may not be generalizable to other hospitals. Second, the exact amount of nutrients according to the intake amount could not be determined because we did not measure the intake amount of the experimental group that received the customized diet education program. Third, we did not control for exogenous variables, such as hematopoietic agent administration, appetite difference, and potassium and phosphorus binder administration, when interpreting physiological indices. Hence, caution should be exercised when interpreting these results. Fourth, we could not check the number of times the participants in the experimental group used messengers. Therefore, these results should be interpreted cautiously.

Based on the results of this study, we make the following Recommendations: First, repeated studies with more intervention sessions are suggested in the future. Second, assessing a diet education program with a higher number of participants is recommended to identify the effects of physiological indices. Third, further studies should consider participants' medication usage when implementing a diet education program.

Conclusions

This study developed a customized diet education program for patients with PD using a mobile instant messenger and verified its effectiveness. The diet education program improved dietary self-care compliance and hemoglobin levels compared to those in the control group. This diet education program is a component of the IMCHB of Cox [20] that provides affective support, health information, decisional control, and professional/technical competencies through interactions between participants and experts. This is an effective educational intervention method that can support peritoneal dialysis patients in maintaining adequate diet management. In addition, the mobile instant messenger is an accessible and effective education method in situations where face-to-face contact is difficult, allowing two-way communication without time and space constraints, and real-time transmission of photos and videos. Immediate feedback from experts using Kakao-talk can help patients to make appropriate self-care decisions.

Source of funding

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Ethical considerations

This study was conducted with the approval of the Institutional Review Board at Chosun University (IRB No. 2-1041055-AB-N-01-2020-5).

Authorship criteria and responsibility

Study conception and design acquisition: HJL and HYK.

Data collection: HJL.

Data analysis and interpretation of the data: HJL and HYK.

Drafting or Critical revision of the manuscript for important intellectual content: HJL and HYK.

Dissertation

This article is a condensed form of the first author's doctoral dissertation from Chosun University.

I have registered my research with the Clinical Research Information Service (CRIS) of the Korea Disease Control and Prevention Agency (KDCA).

Conflict of interest

The authors declared no conflict of interest.

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None.

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Research Article

Combined Effect of Alcohol Consumption Patterns and Marital Status on All-cause Mortality Among Middle- and Old-aged People: A Longitudinal Study From Korea

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SUMMARY

Purposes: The association between alcohol consumption, health, and mortality is intricate, with marital status being a determinant of drinking behavior. This study investigated the combined effect of alcohol consumption patterns and marital status on mortality in middle-aged and older Korean individuals.
Methods: This prospective longitudinal study used data from the Korean Longitudinal Study of Aging, conducted from 2006 to 2020. The study population comprised individuals who were consuming alcohol around the time of the basic survey and participated in the 1st wave 2006 study. We divided 3,823 drinkers older than 45 into four groups: "normal drinker and married (NM)," "normal drinker and unmarried (NUM)," "excessive drinker and married (EM)," and "excessive drinker and unmarried (EUM)." A Cox proportional hazards regression analysis was performed for survival analysis.
Results: The median survival time of the EUM group was 11.9 years. After adjusting for the covariates, the mortality risk among the NUM, EM, and EUM were approximately 1.67 times, 1.33 times, and 3.10 times higher than that among the NM, respectively.
Conclusion: Middle- and old-aged unmarried people with excessive drinking patterns constitute a high-risk group for mortality. Community healthcare providers should focus on characteristics that differ by age, considering family-related factors, and assessing alcohol consumption patterns to reduce mortality. Among middle- and old-aged people, support for unmarried and excessive drinkers should be strengthened, and consultation on visiting community-based clinics should be promoted to improve firmly established alcohol consumption patterns.

Introduction

The pattern of alcohol consumption has a complex relationship with health outcomes and mortality. Occasional and moderate drinkers have lower mortality rates than lifetime abstainers [1,2], while excessive drinkers have a higher mortality risk than occasional or moderate drinkers [2]. Studies have indicated that moderate drinking patterns are associated with a lower risk of cardiovascular disease [3]. However, it is essential to acknowledge that alcohol consumption is a well-established risk factor for fatal diseases, including stroke [4] and cancer [5].

Excessive alcohol consumption does not necessarily imply alcohol dependence; however, it is inherently harmful and associated with numerous adverse health issues, including unintentional injuries—such as motor vehicle crashes, falls, burns, and alcohol poisoning—as well as violence-related incidents—such as homicide, suicide, intimate partner violence, and sexual assault. Additionally, excessive alcohol consumption is linked to an increased risk of sexually transmitted diseases and can lead to memory and learning problems [6]. Being aware of these potential consequences is crucial to promote responsible alcohol consumption and safeguard public health.

Excessive alcohol consumption is more prevalent among younger adults aged 18–34 years; however, adults aged 35 years or

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older account for over half of all instances of excessive alcohol intake [7]. Even among older individuals, particularly those over 45 years of age, the frequency of drinking remains relatively high, with 29% of men over 75 consuming alcohol at least twice a week in Korea [8]. Despite the fact that excessive drinking tends to increase with age [9], most research has primarily focused on drinking problems among young adults and adolescents, with related problematic behaviors considered relatively more prevalent among young adults. Few studies have examined whether such behavioral mechanisms persist in older adults [10]. Moreover, as individuals age, they face an increasing number of health issues related to their drinking habits [11]. Considering the rapidly aging population worldwide, health-related concerns are likely to increase [12].

Socioeconomic factors play a significant role in the prevalence of excessive alcohol consumption in various countries, including Korea, as demonstrated by numerous studies [9,13–15]. These studies highlight the negative association between excessive drinking and certain demographic characteristics, such as older age, male gender, lower educational level or income, unemployment, smoking, and marital status, particularly living without a partner. Marital status, in particular, has a strong correlation with drinking patterns [15,16]. Generally, it is considered a determinant of individual health outcomes. Research [17] has consistently shown that married individuals tend to receive more economic support, have bigger social networks, have higher standards of living, and have healthier lifestyles. They often have easier access to medical care through their families than single individuals [17,18]. Indeed, single individuals are approximately two to four times more likely to engage in excessive drinking than those living with their partners. Additionally, considering that loneliness is associated with excessive drinking patterns [19], it can be assumed that the absence of a partner and living alone are critical risk factors for excessive drinking.

Mortality disparities related to marital status have become significant in increasingly diverse aging populations [18]. Additionally, over the past few decades, excessive alcohol consumption has been identified as a major cause of mortality and morbidity [20]. However, despite the importance of accumulating knowledge in this area, research on the combined effects of alcohol drinking patterns and marital status remains limited [21]. Furthermore, it is unknown to what extent drinking and marital status are jointly associated with fatal adverse outcomes such as mortality in middle-aged and older adults over time. Therefore, the main objective of this study was to investigate the influence of alcohol drinking patterns and marital status on all-cause mortality in middle-aged and older individuals (Figure 1). This study hypothesized that individuals who are normal drinkers and married will have a lower mortality rate by 14 years than those who are normal drinkers and unmarried, excessive drinkers and married, and excessive drinkers and unmarried.

Methods

Study design

This was a prospective longitudinal study to identify the combined effect of alcohol consumption patterns and marital status on mortality among middle-aged and older drinkers aged 45 years or older.

Study population

Data from the Korean Longitudinal Study of Aging, which were used in this study, have been analyzed every two years in Korea since 2006 to obtain the basic information necessary for establishing effective socioeconomic policies and conducting studies necessary for an aging society. A panel was constructed by allocating 1,000 sample survey districts by province and population proportion, using the household list of the census at the time of the first survey in 2006, it targeted middle-aged and older adults indwelling nationwide, except for Jeju Island. In the first survey conducted in 2006, 10,254 participants were recruited, and the 8th wave was conducted in 2020 [22]. In this study, the study population comprised those participants who were consuming alcohol at approximately the time of the basic survey and participated in the 1st wave 2006 study. At that time, drinkers were defined as those who answered “yes” to the question, “Do you drink alcohol occasionally or often?”

Variables

Survival time

The survival time (years) of the deceased participants was calculated as the interval between the time of death and the time of enrollment in the panel. In this study, right-censored data were defined as either dropped from the survey or survivors. If dropped

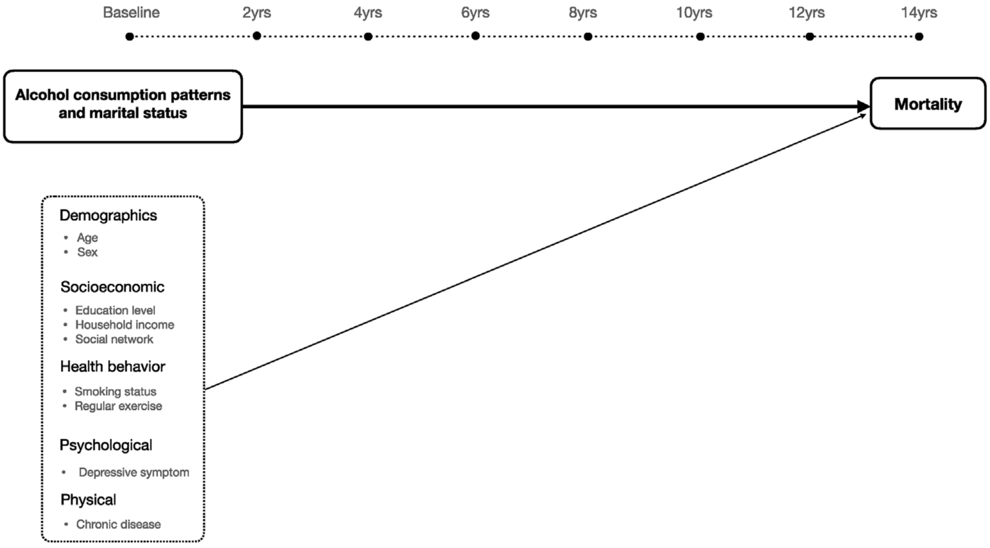

Figure 1. Conceptual framework of all-cause mortality according to the alcohol consumption patterns and marital status.

from the survey, the survival time was defined as the gap between the time of enrollment and the time of the last interview. Participants' survival time was the interval between the time of enrollment and the 8th survey interview.

Excessive drinking and marital status

The Ewing's CAGE questionnaire focuses on Cutting down, Annoyance by criticism, Guilty feelings, and Eye-openers, and was used to define a binge drinker. The questions were [23]: 1) Have you ever felt you needed to cut down on your drinking?, (2) Have people annoyed you by criticizing your drinking?, 3) Have you ever felt guilty about drinking?, 4) Have you ever felt you needed a drink first thing in the morning to steady your nerves or to get rid of hangover? Those who answered two or more questions with "yes" were defined as excessive drinkers [23]. Marital status was classified as follows: according to the data questionnaire of the Korean Longitudinal Study of Aging, when respondents were asked about their current marital status, their responses were divided into five states: married, never married, separated, divorced, and widowed [22]. We classified respondents as either married, indicating they have a spouse, or unmarried, which includes those who are never married, separated, divorced, or widowed, indicating they do not have a spouse. Depending on their alcohol consumption patterns and marital status, participants were divided into four groups: "normal drinker and married (NM)," "normal drinker and unmarried (NUM)," "excessive drinker and married (EM)," and "excessive drinker and unmarried (EUM)."

Baseline characteristics of the study population

We used gender, age, education level, household income, and social networks as demographic and socioeconomic variables. As in previous research, educational level was categorized as below middle school graduation and high school graduation or higher. Household income was categorized into three groups based on the previous year's total household income: below KRW 10 million, KRW 10–25 million, and above KRW 25 million [24]. Social network was defined as a continuous variable with reverse-coded responses to the question, "Do you have any close friends, relatives, or cousins who live nearby? If yes, how often do you meet with them?". The responses ranged from 1 (almost every day) to 10 (no close friends), with higher scores indicating more social relationships and activities in the social network.

Health behaviors included smoking status and regular exercise. Based on their smoking status at the time, individuals were classified as current smokers, past smokers, and never been smokers. Regular exercise was assessed using a categorical variable based on the question, "Do you engage in physical exercise at least once a week?" with a response of "yes" indicating regular exercise [25].

As psychological characteristics, depressive symptoms were assessed using the short form of the Center for Epidemiologic Studies Depression Scale (CESD-10) [26]. The frequency of emotions experienced during the past week was measured using a Likert scale ranging from 1 to 4, with 10 questions in total. The total score ranged from 4 to 40, with higher scores indicating a higher level of depression. Physical characteristics included the number of chronic diseases as a categorical variable, using the sum of the prevalence of the following diseases: hypertension, diabetes, cancer, chronic lung disease, liver disease, heart disease, cerebrovascular disease, psychiatric disease, and arthritis. Individuals were classified as having zero diseases, one disease, or two or more diseases.

Data analysis

Statistical analyses were performed using R, version 4.2.0 [27], and statistical significance was set at $p < .05$. At baseline, the characteristics of the study population were presented as frequencies and percentages for categorical data and means and standard deviations for continuous data. To examine the characteristics of the individuals in the four groups, χ^2 tests and analysis of variance were performed, and Tukey's post hoc test was used for multiple comparisons.

Survival curves were plotted for all four groups using the Kaplan–Meier estimation method, and survival rates were compared using a log-rank test. Survival analysis was performed to determine whether the four groups affected the survival rate over time using the Cox proportional hazards model, and hazard ratios (HR) and 95% confidence intervals (CI) were calculated. Results were interpreted as meaningful if the CI did not include 1. Demographic (age and gender), socioeconomic (education level, household income, and social network), health behavioral (cigarette smoking and regular exercise), psychological (depressive symptoms), and physical characteristics (number of chronic diseases) were input into the model to adjust for their effects on all-cause mortality based on previous studies [24,28]. The fitness of the survival analysis model was confirmed using the likelihood ratio, Wald test, and Score test [29]. For the assumption of proportional hazards, scatter plots were reviewed based on the Schoenfeld residual test, and it was determined that the assumption of proportional hazards was met when the scatter plots appeared randomly [30].

Ethical considerations

The university's Institutional Review Board approved this secondary data analysis and granted an exemption for review (1040460-E–2022-002).

Results

Figure 2 shows the flowchart for selecting the study population. Of the 10,254 individuals enrolled in the 2006 study, we extracted the data from 3,823 individuals after excluding 6,431 non-drinkers. By 2020 (the 8th wave), there were 2,241 survivors, 844 deaths, and 738 dropouts. When the individuals were divided into the four groups, 79.4% were NM, 13.2% were NUM, 6.7% were EM, and 0.7% were EUM.

Baseline characteristics of the study population according to the groups

Table 1 shows the baseline characteristics of the study population and the differences among them according to the groups. The average age of the individuals was 58.85 ± 10.24 years, and approximately 72.8% were men. High school graduates or higher accounted for 48.3%, those with an annual household income of less than KRW 10 million accounted for 41.5%, and the average social network score ranging from 0 to 10 was 7.52 ± 2.74. Most participants had never smoked (47.4%) and did not exercise regularly (56.9%). The average depressive symptoms score, ranging from 4 to 20, was 12.99 ± 4.16, and 59.7% of the participants did not have chronic diseases. Age, gender, education level, household income, smoking status, regular exercise, depressive symptoms, and number of chronic diseases were significantly different among the four groups (all $p < .001$).

Survival probability

The survival curves of the groups are shown in Figure 3. The survival curves of the four groups showed a significant difference ($p < .001$), and the half-survival time for the EUM group was 11.92 years.

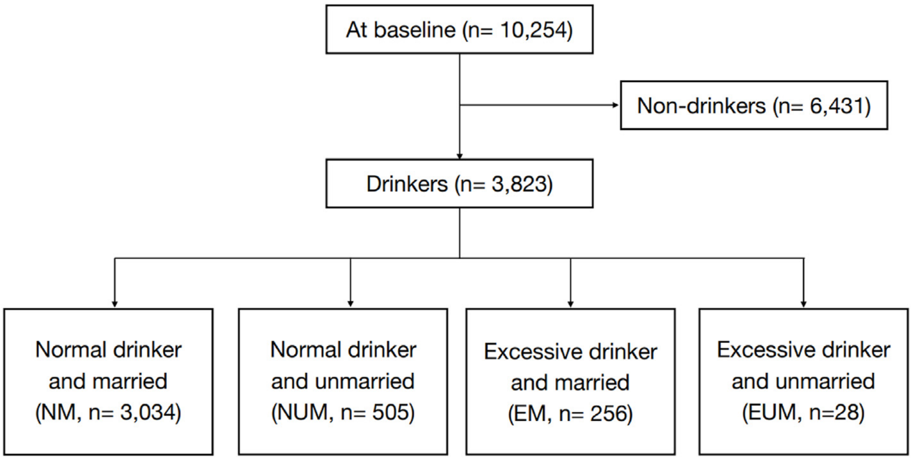

Figure 2. Participant selection flow chart using the Korean Longitudinal Study of Aging 2006.

Table 1 *Baseline Characteristics of the Study Participants by Alcohol Consumption Patterns and Marital Status.*

Characteristics	Overall	Normal drinker and married	Normal drinker and unmarried	Excessive drinker and married	Excessive drinker and unmarried	*p*
	(*n* = 3,823)	(*n* = 3,034)	(*n* = 505)	(*n* = 256)	(*n* = 28)	
Demographic						
Age	58.85 ± 10.24	58.02 ± 9.75^{a}	63.78 ± 12.04^{b}	58.71 ± 9.10	61.00 ± 12.04	<.001 a<b
Gender						<.001
Men	2,783 (72.8)	2,327 (76.7)	197 (39.0)	240 (93.8)	19 (67.9)	
Women	1,040 (27.2)	707 (23.3)	308 (61.0)	16 (6.2)	9 (32.1)	
Socioeconomic						
Education level						<.001
High school or higher	1,846 (48.3)	1,618 (53.4)	110 (21.8)	111 (43.4)	7 (25.0)	
Middle school or less	1,974 (51.7)	1,413 (46.6)	395 (78.2)	145 (56.6)	21 (75.0)	
Household income (yearly, 10,000 KRW)						<.001
<1000	1,588 (41.5)	1,167 (38.5)	307 (60.8)	102 (39.8)	12 (42.9)	
1000-2500	1,129 (29.5)	883 (29.1)	139 (27.5)	93 (36.3)	14 (50.0)	
>2500	1,106 (28.9)	984 (32.4)	59 (11.7)	61 (23.8)	2 (7.1)	
Social network	7.52 ± 2.74	7.53 ± 2.65	7.30 ± 3.15	7.78 ± 2.81	6.93 ± 3.27	.078
Health behavior						
Cigarette smoking						<.001
Current smoker	1,431 (37.4)	1,110 (36.6)	153 (30.3)	153 (59.8)	15 (55.6)	
Ex-smoker	578 (15.1)	489 (16.1)	37 (7.3)	49 (19.1)	3 (11.1)	
Never smoked	1,813 (47.4)	1,435 (47.3)	315 (62.4)	54 (21.1)	9 (33.3)	
Regular exercise						<.001
No	2,177 (56.9)	1,663 (54.8)	338 (66.9)	154 (60.2)	22 (78.6)	
Yes	1,646 (43.1)	1,371 (45.2)	167 (33.1)	102 (39.8)	6 (21.4)	
Psychological						
Depressive symptoms	12.99 ± 4.16	12.44 ± 3.58^{a}	15.53 ± 5.47^{b}	13.95 ± 4.73^{c}	18.25 ± 6.90^{d}	<.001 a<c < b < d
Physical						
Number of diseases						<.001
None	2,281 (59.7)	1,881 (62.0)	243 (48.1)	144 (56.2)	13 (46.4)	
One	1,016 (26.6)	794 (26.2)	155 (30.7)	58 (22.7)	9 (32.1)	
Over two	526 (13.8)	359 (11.8)	107 (21.2)	54 (21.1)	6 (21.4)	

Notes. 1 USD = 1150 KRW.
Education level, cigarette smoking, and depressive symptoms have missing values (respectively, n = 3, 1, and 16). For all continuous variables, Tukey post hoc test was performed for multiple comparisons.
The results of the multiple comparisons are presented as 'a', 'b', 'c', and 'd'.

Association of alcohol consumption and marital status with all-cause mortality

The results of the survival analysis are presented in Table 2. The Cox proportional hazards model was statistically significant in the three fit tests (all models: $p < .001$), and the proportional hazards assumption using Schoenfeld residuals was satisfied; therefore, all variables were constant, regardless of survival time. After adjusting for the covariates, the mortality risk among the NUM and EM groups was approximately 1.67 times (95% CI = 1.37~2.04) and 1.33 times (95% CI = 1.04~1.71) higher than that among the NM group, respectively. Moreover, the mortality risk among the EUM group was approximately 3.10 times (95% CI = 1.80~5.36) higher than that among the NM group.

Discussion

This study utilized national data from Korea, focusing on adults over 45 years of age, to investigate the combined effect of alcohol consumption patterns and marital status on all-cause mortality. It

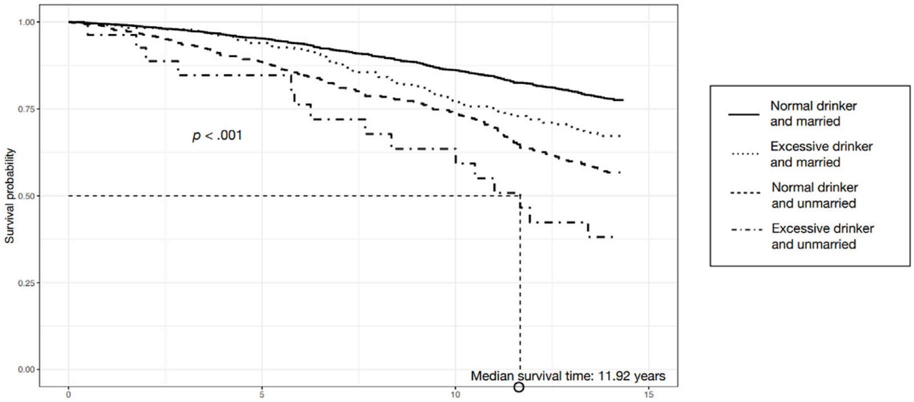

Figure 3. Kaplan−Meier curve by alcohol consumption patterns and marital status.

analyzed an eight-wave dataset collected over 14 years and adjusted for various factors, including demographic, socioeconomic, health behavior, psychological, and physical health factors.

Among the 10,254 participants in this study, approximately 37.3% were identified as drinkers, and approximately 7.4% were classified as excessive alcohol drinkers. This differs from previous nationwide studies conducted in the United States [20] and China [2], which reported a higher proportion of drinkers, ranging from 50% to 55%, and excessive alcohol drinkers, ranging from 6.1% to 11.6%. However, variations in the definition of excessive alcohol consumption as well as differences in age, culture, and ethnicity among the studied populations may account for these discrepancies. Consequently, our results place the rate of excessive alcohol consumption within this range. Despite its lower drinking rate compared to other countries, Korea faces significant public health concerns due to excessive alcohol consumption. According to Organization for Economic Cooperation and Development (OECD) statistics [8], heavy episodic and high-risk drinking have become common and appear to be rising in Korea. In just four years, the average number of drinks consumed in a single sitting has almost tripled, increasing from 2.2 cups in 2013 to 6.0 cups in 2016. Given that binge drinking is defined as five or more drinks in one sitting for men and four or more drinks for women [31], the prevalence of excessive alcohol consumption in South Korea is concerning. Therefore, the results suggest that policies aimed at controlling problematic alcohol consumption among middle-aged and older individuals should prioritize monitoring the frequency and intensity of alcohol consumption rather than focusing solely on whether individuals drink or not, through intimate intervention and personalized education.

Table 2 *The Association of Alcohol Consumption Patterns and Marital Status With All-cause Mortality (n = 3,728).*

Groups	HR	95 CI	*p*
Normal drinker and married	1	1	
Normal drinker and unmarried	1.67	1.37-2.04	<.001
Excessive drinker and married	1.33	1.04-1.71	.023
Excessive drinker and unmarried	3.10	1.80-5.36	<.001
Number of events	837		
Likelihood ratio test	863 on 15 df, <.001		
Wald test	814 on 15 df, <.001		
Log-rank test	928 on 15 df, <.001		

Notes. CI = confidence interval; df = degrees of freedom; HR = Hazard ratio.
Cox regression models were adjusted for age, gender, education level, household income, social network, smoking history, regular exercise, depressive symptom, and number of chronic diseases.

The results revealed a gradual increase in mortality risk; people with excessive drinking patterns were at a higher risk of mortality than those with normal drinking patterns. These results are consistent with those of previous studies [2,20,32]. Additionally, the highest risk was observed in those with a combined presence of excessive drinking patterns and unmarried status. One striking finding was that when drinking patterns and marital status are mixed, marital status has a higher effect than alcohol consumption pattern on all-cause mortality, indicating that people with normal alcohol consumption and unmarried status have higher mortality than those with excessive alcohol consumption and married status. Previous studies have confirmed that married individuals are less likely to engage in excessive drinking, and this behavior has an impact on mortality rates [18,33].

To the best of our knowledge, this study is the first to explore the combined effect of drinking patterns and marital status on mortality rates. Marital status carries valuable information about personal and social aspects, such as familial social roles [33], living arrangements [34], and social isolation [35]. Unmarried individuals often live without the opportunity of having a partner or becoming parents, which leads to a higher likelihood of living alone and experiencing loneliness. They are also less engaged in social participation than married individuals [33,34]. Our findings are also consistent with a previous study conducted in China, which emphasized marital status as an individual characteristic within the nursing paradigm [36]. It revealed that among older patients with hypertension, those who were married and living with their spouse had higher self-rated health scores, which was one of the health promotion indicators [37] compared to unmarried respondents. Marriage, indicating having a spouse, facilitates mutual support, emotional sharing, and timely feedback on health issues, highlighting its role in promoting well-being. In other words, being unmarried, indicating having no spouse, may increase the risk of an unhealthy lifestyle due to the absence of these spousal benefits [36].

The results suggest that the combined effect of health-related behaviors, as indicated by personal drinking patterns, and social vulnerability, represented by marital status, among middle-aged and older individuals can have significant consequences for all-cause mortality. These results emphasize the significance of considering not only drinking patterns but also marital status when evaluating and addressing public health concerns related to mortality in middle-aged and older individuals. For example, older adults who have experienced the loss of a spouse who has a higher possibility of the risk of an unhealthy lifestyle should be more attentive to their emotional fluctuations to uphold better health

[36]. Understanding the combined impact of these factors can provide valuable insights for developing effective interventions and policies to promote healthier behaviors and improve the overall well-being of this population group.

Another notable result is the identification of the median survival time for the highest-risk mortality group, consisting of individuals who engage in excessive drinking and are unmarried, which was found to be 11.9 years. Considering that the mean age of this group was 61 years, this survival span was significantly lower than the general expected average lifetime of over 65-year-olds, which is 21.5 years in Korea and 19.3 years in the OECD countries [38]. This indicates that individuals in this high-risk group experience a much shorter life expectancy than the average life expectancy for their age group in the country and even internationally.

Mortality caused by problematic alcohol consumption results in a tremendous financial burden for their families as well as the government. Indeed, according to a recent study in the United States in 2019 [39], excessive drinking costs nearly USD 8 billion, which almost doubled when compared in 2010. Specifically, regarding healthcare, private insurance and out-of-pocket payments covered 7.7% (USD 607.5 million) of the total medical costs. However, the second-largest share of the burden, totaling USD 3.17 billion (40.3% of the total cost), was borne by excessive alcohol drinkers and their families. Previous studies have established that excessive alcohol drinkers often face family-related issues over time, leading to separation and divorce [40]. Therefore, early intervention for excessive drinkers could prove beneficial not only in reducing mortality rates but also in addressing the financial and family burdens caused by alcohol-related problems.

This study had several limitations. First, it estimated alcohol consumption patterns, marital status, and other adjusted variables of the study population only at baseline, without considering potential changes over time. Therefore, further studies are required to confirm how changes in drinking patterns and marital status affect patient mortality and health-related outcomes. Second, the results should be cautiously interpreted because of variations in the definition of excessive drinking across different studies. Third, the use of self-reporting methods to define excessive drinkers may have introduced potential bias in the study. Fourth, variables affecting mortality, such as frailty [24] and nutritional status [41], were not considered; these should be considered in future studies. Despite these limitations, this study analyzed data from a nationally representative sample of Koreans aged 45 years or older, which makes it relevant. Furthermore, given the current societal and national concerns regarding excessive drinking as a prominent issue, this study's investigation of its impact on mortality, along with the examination of marital status and their combined effect hold significant implications for healthcare providers and policymakers.

Conclusion

This study showed that middle-aged and older adults with excessive drinking patterns and those who are unmarried constitute a high-risk group for mortality. Modifying older people's firmly established drinking patterns is likely to be challenging [12]; marital status is also difficult to change through intervention. However, this study identified high-risk groups and proposed strategies to enhance their health. Conducting frequent monitoring and routine health checks, as well as offering personalized education could prove effective. Additionally, providing opportunities for individuals to play an active social role, such as engaging in leisure activities or part-time work, may help modify their drinking patterns. Comprehensive approaches at various levels, from individual to social, will likely yield more effective results in promoting healthier behaviors.

Ethics approval statement

The university's Institutional Review Board approved this secondary data analysis and granted an exemption for review (1040460-E−2022-002).

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Data sharing statement

The data that support the findings of this study are openly available in the Korea Employment Information Service (KEIS) at http://survey.keis.or.kr/eng/klosa/databoard/List.jsp.

Conflict of interest

The authors declare that there are no conflicts of interest.

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Research Article

Developing a Chain Mediation Model of Recurrence Risk Perception and Health Behavior Among Patients With Stroke: A Cross-sectional Study

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SUMMARY

Purpose: To understand the recurrence risk perception of stroke patients and develop a chain mediation model of recurrence risk perception and health behavior.

Methods: A cross-sectional study and convenience sampling were used. Stroke survivors were recruited from the neurology departments of three tertiary hospitals. Their recurrence risk perception, behavioral decision-making, social support, self-efficacy, recurrence worry, and health behavior were measured by relevant tools. Data was analyzed through one-way analysis and regression analysis, and the AMOS 21.0 software was used to explore the mediating relationships between variables.

Results: Of the 419 participants, 74.7% were aware of stroke recurrence risk. However, only 28.2% could accurately estimate their own recurrence risk. Recurrence risk perception was significantly correlated with behavioral decision-making, social support, self-efficacy, and health behavior ($r = .19 \sim .50$, $p < .05$). Social support and recurrence risk perception could affect health behavior indirectly through self-efficacy, behavioral decision-making, and worry. Behavioral decision-making acted as a main mediator between recurrence risk perception and health behavior, while the path coefficient was .47 and .37, respectively. The chain mediation effect between recurrence risk perception and health behavior was established with a total effect value of .19 ($p < .01$).

Conclusion: Most stroke survivors could be aware of recurrence risk but failed to accurately estimate their individual risk. In the mediation model of recurrence risk perception and health behavior, social support seemed to be an important external factor, while self-efficacy, behavioral decision-making, and worry seemed to act as key internal factors.

Registration: The research project was registered on 29 June 2020 (CTR2000034244).

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Introduction

Globally, advancements in the clinical management of acute stroke over the last decade have resulted in a higher survival rate among individuals following a stroke compared to previous periods [1,2]. There are over 101 million survivors of stroke worldwide, and 12.2 million new strokes occur each year [3]. Compared to the general population, stroke survivors face a 15-fold higher risk of experiencing recurrent strokes [4]. The cumulative rates of stroke recurrence at six months, one year, and two years are aggregated at 9.5%, 10.4%, and 16.1%, respectively [5]. Notably, the potential fatality associated with recurrent stroke, with a mortality rate of 25.0% within 28 days [6]. It remains notably challenging in preventing stroke recurrence, particularly in low-to-middle-income countries (LMICs) [7]. Health behavior has been a well-established determinant of stroke recurrence and is the most cost-effective prevention strategy [8]. More than 80 percent of strokes can be prevented by modifying risk factors, such as adherence to taking medications [9], and adopting healthy lifestyles [10,11]. Encouraging stroke survivors to adopt and maintain health behavior remains challenging [12–14]. A prospective study revealed that 22.4% of stroke survivors continued smoking after recovery [2]. Additionally, some stroke survivors developed multiple new risk factors; for instance, 16.4% became obese, and some patients engaged in heavy drinking [2]. Even so, more than half of these stroke survivors were satisfied with their lifestyle and felt no urgency to change [15].

Motivation has been approved to be an essential trigger that could influence the internalization and maintenance of health behavior [16]. Past evidence showed that risk awareness could affect peoples' intrinsic motivation for health behavior [17]. The influence of risk perception in the motivation and volition process has also been emphasized in relevant theory [18]. Risk perception is defined as patients' understanding of risk exposure level, relevant risk factors, and consequences of recurrence [19]. Studies have shown that inaccuracy in perceived stroke risk hinders the formation and change of health behavior in daily life [20]. Patients who are aware of symptoms and risk factors intend to modify unhealthy lifestyles after recovering from a stroke [21]. However, studies also illustrated that the role of risk perception as a prevention strategy might be overestimated. Even though an accurate perception of recurrence risk might motivate patients to change their behavior [22,23], patients might be more prone to worry, affecting their intention to behave when they perceive risk [24]. Overestimating the risk may lead to chronic stress, while underestimation can lead to ignoring the risk and affecting coping motivation and adherence [25]. Furthermore, recurrent events may affect stroke patients' perceived benefits of behavior change and reduce their confidence in changing health outcomes accordingly [17]. Therefore, further exploration of the relationship between recurrence risk perception and health behavior among stroke survivors is needed.

Additionally, decision-making has been approved to be a critical process of health behavior change [26]. The importance of healthy decision-making was identified, but the relevant influential factors are also complex [27–29]. It has always been difficult to change habitual behavior, especially for adults, so behavioral change is closely related to trade-offs in decision-making [30]. According to the Behavioral Decision Theory [31], health behavior is fraught with complexity when people may face certain or uncertain situations [32]. For example, self-efficacy, as a person's belief in their ability to accomplish a specific task, can influence one's decision in intention and actual change behavior [33]. Social support, as an external factor, might also affect the motivation and volition phase of health behavior change. Nevertheless, evidence of the link between social support, recurrence risk perception, and behavioral decision-making among stroke survivors is still limited.

The Situation-Specific Theory Model (SST) is a theoretical framework that centers on a particular nursing phenomenon, is confined to a specific demographic or clinical context, and potentially provides a novel viewpoint for tackling the behavioral management challenges encountered in the care of a specific cohort of stroke patients [34]. Given the significance of health behavior promotion in the secondary prevention of stroke, and the growing international scholarly interest and anticipation for the development of situational theories, this study aims to understand the perception of recurrence risk among stroke patients, explore the relationship and the mechanism of recurrence risk perception and health behavior with stroke patients. This may provide a new practice framework for clinical and community health behavior promotion and secondary prevention of stroke. At the same time, it can also provide new research evidence for the theory of health behavior.

Hypothesized model

A hypothetical model is derived from our previous study [35]. We have integrated methods such as literature review, qualitative research, and theoretical analysis to preliminarily construct a theoretical model for the perception of stroke recurrence risk and the context of behavioral decision-making. This model further verifies the close relationship between perception and behavior, emphasizing that behavioral decision-making is an inevitable process in the generation and dynamic change of behavior. There exists a complex pathway of influencing factors between risk perception and health behavior. Therefore, in this study, the inputs encompass personal factors and external factors, including social support, risk perception, self-efficacy, and concerns about recurrence. The core variable is the behavioral decision, and the outcome is health behavior. We hypothesize that these personal and external factors influence the health behavior of stroke patients by directly or indirectly affecting the behavioral decision-making process (Figure 1).

Methods

Study design and participants

This cross-sectional study was conducted from November 2020 to February 2021. Participants were recruited from the neurology departments of three tertiary hospitals in three cities in Henan Province, China. The inclusion criteria comprised survivors of stroke [36] with specified communication ability (Token test $\geq$17 points) and self-care capability (Activities of Daily Living $\geq$40); [37] without obvious cognitive dysfunction (Mini-Mental State Examination $\geq$17 points).

Data collection

Three trained investigators conducted the investigation. The investigation tools consisted of the following two sections: (1) The demographic and disease-related questionnaire, which was designed by the research team to collect the characteristics of study participants, including demographic and disease-related information related to age, gender, educational background, marital status, stroke type, and combined disease. (2) Structural questionnaires or scales for outcome variables about recurrence worry, recurrent risk, and recurrence risk perception, et al. All stroke patients who met the inclusion criteria were informed of the detailed information (e.g., survey aims, research significance, expected time of investigation).

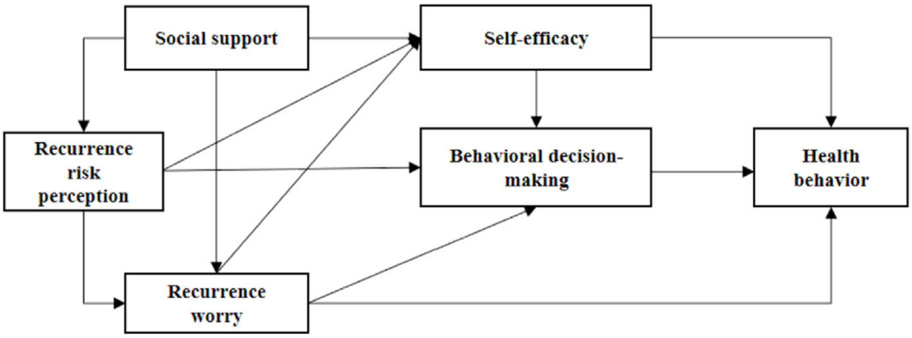


Figure 1. Hypothesized model.

In preparation for administering questionnaires, we collaborated with ward nurses to explain the purpose and significance of this study to the participants, disclosing the required number of questionnaires and estimated duration upfront, and secured written consent from each individual. To reduce the cognitive burden on hospitalized patients, we solicited feedback after piloting the questionnaire, refining it iteratively, and providing clear instructions for its completion. Participants filled out the survey in a quiet hospital room, with the option to pause as needed to manage their workload. If they had any questions about the manual, the investigators showed great patience to provide help. Upon finishing, the researcher ensured the questionnaire's completeness. As a gesture of gratitude, participants were given manuals as a gift, regardless of their questionnaire completion status. It is important to note that no financial compensation was offered to the study participants.

Outcome variables

Recurrence risk of stroke patients

The objective risk of recurrent stroke was measured using the Essen Stroke Risk Scale (ESRS). The ESRS is a globally recognized tool for predicting ischemic stroke recurrence [38], and it is effective in predicting the risk of recurrent stroke in Chinese patients [39]. The total score of a combination of eight criteria was used to assess the risk of recurrent stroke: age, hypertension, diabetes, previous myocardial infarction, other cardiovascular diseases, peripheral arterial disease, smoking, and previous ischemic stroke or TIA history, which is under 65 years old (0 point), 65 to 75 years old (1 point), and over 75 years old (2 points). The total score of ESRS is 0 ~ 9, while the low-risk, moderate-risk, and high-risk group scores were 0 ~ 2, 3 ~ 6, and 7 ~ 9 points, respectively.

Recurrence worry

The Recurrence Worry Questionnaire was a single-item questionnaire, and it was designed based on literature [40,41]. The patient's worry level was measured by a question: “To what degree do you worry about your recurrence risk?” The responses include “strongly worry, worry, neutrality, not worry, strongly not worry”, and scored as 5, 4, 3, 2, and 1, respectively.

Recurrence risk perception

The Stroke Recurrence Risk Perception Scale [42,43] is a self-report scale, and it was developed based on a rigorous literature review procedure, qualitative interviews, and expert consultation. It contains two parts: the first part is a self-assessment of recurrence risk with the question, “Compared with most people your age and gender, what would you say your chances are for developing another stroke?” The response was classified as unknown, no, low, moderate, and high. The second part comprises three dimensions with 17 items: “recurrence severity perception,” “disease risk factor perception,” and “behavioral risk factor perception.” The Cronbach's α and content validity index (CVI) of the total scale are .85 and .95.

Self-efficacy

The 13-item Stroke Self-Efficacy Questionnaire was designed by Jones [44], and it has been translated by native researchers [45]. It is an 11-point Likert scale, which is a psychometric scale commonly used in questionnaire-based research, with scores ranging from 0 (“not confident at all”) to 10 (“completely confident”). The scores reflect the self-efficacy level of the respondent, with higher scores indicating greater confidence. The Cronbach's α index of the scale is .97.

Health behavioral decision-making

The Health Behavioral Decision-Making Scale (HBDMS) was designed mainly for patients with or at high risk of stroke [46]. It is a self-reporting scale containing 30 items with four dimensions: “motivation of behavioral change,” “intention of behavioral change,” “decision-making relevant factors,” and “decision balance.” The HBDMS is a five-point Likert scale, assigning a score of 1, 2, 3, 4, and 5 points according to the responses from "strongly disagree" to "strongly agree." Each dimension can be scored separately, with higher scores indicating that an individual is more inclined to adopt health behavior. The Cronbach's α and CVI of the scale are .93 and .98.

Social support

The Social Support Rating Scale was developed by Xiao and has been widely used [47]. It consists of 10 items measuring three dimensions: subjective support (four items), objective support (three items), and support-seeking behavior (three items). The SSRS scale can be used in two ways. First, raw scores within each of the three domains are summed, giving a subjective (range: 8 ~ 32) and objective (range: 1 ~ 22) support score and a support-seeking behavior score (range: 3 ~ 12). Second, item scores are added, generating a total support score ranging from 12 ~ 66. The Cronbach's α of the scale is .92.

Health behavior

The Health Behavior Scale for Stroke Patients was designed by Wan and has been widely used among stroke patients [48,49]. The scale is a self-reporting scale with six subcategories (i.e., exercise, medication adherence, guideline adherence, nutrition, health responsibility, smoking, and alcohol abstinence). The HBS-SP comprises 25 items, and it is a 4-point Likert scale, on which a rating of 1, 2, 3, and 4 points indicate “never,” “sometimes,” “often,” and "usually," respectively. The "medication adherence" and "smoking and alcohol abstinence" subcategories are reverse-scored. A higher total score indicates better health behavior. The average score of the scale is calculated. The Cronbach's α and CVI of this scale are .89 and .85.

Data analysis

We investigated the participants' demographic characteristics and conducted statistical analysis using IBM SPSS (version 21.0). The descriptive statistics (means, standard deviations, and percentages) were calculated to represent the demographic characteristics. The mean scores of two unrelated groups were compared using a two-independent-sample t-test. Differences among three or more groups' scores were tested using a one-way analysis of variance (ANOVA). The relationships between the predictive factors and health behavior were analyzed using Pearson correlation coefficients. Stepwise linear regression was performed to identify the predictors of health behavior. Multicollinearity was checked using the tolerance test and variance inflation factors (VIF), VIFs between 1 and 5 suggest a moderate correlation. However, it was not severe enough to warrant corrective measures, while VIFs greater than 5 represented critical levels of multicollinearity where the coefficients were poorly estimated [50]. The results were checked for accuracy, and two-tailed p-values <.05 were considered significant.

In addition, mediation analysis, widely used in medical research [51], was used to understand the mechanism between variables [52]. The hypothesized model was tested using AMOS 21.0 software. The mediation analysis involved modelling indirect and direct effects and hypothesizing the effects' parameters [53]. The direct effect is the pathway from the exogenous variable to the outcome while controlling for the mediator. While the indirect effect describes the pathway from the exogenous variable to the outcome through the mediator [54]. The model's path was shown by squares and arrows, a single-headed arrow pointed from cause to effect. The model predicted the regression weight and the unexplained variance and measurement error were shown using the residual error terms [53]. Then, the goodness-of-fit statistic was calculated to test the consistency of the hypotheses included in the model. Given the sensitivity of these criteria, alternative incremental fit indices are considered, including a root-mean-square error approximation (RMSEA) < .05, goodness-of-fit index (GIF) > .90, comparative fit index (CFI) and adjusted goodness of fit index (ACFI) > .90 [55].

Ethical considerations

This study was approved by the Institutional Review Board of the Zhengzhou University in August 2020 (Approval No. ZZURIB2020-08), and participants gave informed consent at the beginning of the survey.

Results

Characteristics of the Participants

A total of 450 patients were recruited, and 419 completed the questionnaires (effective response rate: 93.1%). The average health behavior was at a medium level. Among the 419 stroke survivors, the average age was 65 years old, and 65.2% were men (Table 1). More than 60.0% of participants completed education up to junior school or below, and 84.1% claimed to worry about recurrence (Table 1).

Accuracy of recurrence risk perception

Out of 419 participants, 313 (74.7%) demonstrated awareness of their potential stroke recurrence risk. Among these individuals, 4.4%, 21.2%, 23.4%, and 25.3% estimated their risk levels respectively as no risk, low, moderate, and high. For the patients with ischemic stroke, the actual risk of recurrent stroke calculated from ESRS showed that 50.9% had a moderate risk, 48.3% had a low risk, and 0.8% were classified as having high risk. Among the 387 patients with ischemic stroke, 25.6% claimed that they had no idea about recurrence risk at all, and only 28.2% could estimate their risk accurately. Nearly half of the participants (46.3%) inaccurately perceived their risk of recurrent stroke. Within this subgroup, 12.1% underestimated their stroke risk, while 34.1% overestimated it.

The correlation between variables and health behavior

Patients with less recurrence worry had relatively higher health behavior scores (Strongly not worry: 2.93 ± 0.81, Not worry: 2.65 ± 0.32, Neutrality: 2.66 ± 0.32, Worry: 2.51 ± 0.35, Strongly worry group: 2.63 ± 0.48, $F = 3.60$, $p = .007$). In addition, the Pearson correlation analysis demonstrated that recurrence risk perception was positively correlated with self-efficacy, behavioral decision-making, social support, and health behavior. Self-efficacy was negatively correlated with the recurrence worry and positively correlated with behavioral decision-making, social support, and health behavior. Recurrence worry was positively correlated with behavioral decision-making. behavioral decision-making was positively correlated with social support and health behavior. Social support was positively correlated with health behavior (Table 2).

The regression model of health behavior and relevant influential factors

The linear regression model was developed to explore the possible influential factors of health behavior. Results showed that the constant term was 6.39, but there was no statistical significance. The recurrent stroke had a significant direct predictive effect on health behavior ($\beta = 3.55$, $p = .003$). The recurrence worry positively predicted perceived social support ($\beta = 2.19$, $p = .004$). The self-efficacy positively predicted perceived social support ($\beta = 0.07$, $p < .001$). The social support positively predicted perceived social support ($\beta = 0.25$, $p = .014$). The behavioral decision-making positively predicted perceived social support ($\beta = 0.42$, $p < .001$). The adjusted R^2 of the regression model was 0.334 ($F = 14.99$, $p < .001$), which means that the eight factors in Table 3 could explain a 33.4% variance in health behavior.

The mediator model of recurrence risk perception and health behavior

The mediating model and relevant path coefficients are the regression weights analyzed by Amos 21.0 software; the model indexes are well ($X^2/df = 1.24$; RMSEA = .02; GFI = .97; AGFI = .98). As shown in Figure 2, the arrows indicate the potential direct effect of a causal variable on an effect variable; e1 to e5 are residuals (error terms) that are uncorrelated with the variables in the model and with each other. The numbers represent path coefficients, which are standardized versions of the linear regression weights used to examine the possible causal linkages between the statistical variables. Social support was an indirect factor that affected behavioral decision-making and health behavior via the direct effect of recurrence risk perception ($\beta = 0.22$, $p < .01$). Recurrence risk perception was an indirect factor that affected behavioral decision-making via the mediating effect of self-efficacy ($\beta = 0.15$, $p < .01$)

Table 1 *The Health Behavior of Stroke Patients with Different Characteristics (N = 419).*

Characteristics/n/%			$\bar{x}\pm s$	*t/F*	*p*	Characteristics/n/%			$\bar{x}\pm s$	*t/F*	*p*
Region	Rural	144 (34.4)	2.58 ± .36	0.46[b]	.645	Gender	Men	273(65.2)	2.53 ± .40	−2.91[b]	.004**
	Urban	275 (65.6)	2.56 ± .39				Women	146 (34.8)	2.64 ± .35		
Education background	Primary school and below	107 (25.5)	3.86 ± .32	3.58[c]	.014*	Age group	<45	24 (5.7)	4.05 ± .52	2.60[c]	.076
	Junior school	147 (35.1)	3.98 ± .41				45~	176 (42.0)	3.98 ± .39		
	High school or equal	97 (23.2)	3.93 ± .38				65~	219 (52.3)	3.91 ± .36		
	College and above	68 (16.2)	4.04 ± .44			Marital status	Married	364 (86.9)	3.95 ± .38	.69[c]	.560
Income (monthly/RMB)	<1000	27 (6.4)	3.84 ± .44	4.90[c]	.002**		Single	4 (01.0)	3.77 ± .72		
	1000~	60 (14.3)	3.82 ± .41				Divorced	11 (2.6)	3.83 ± .34		
	2000~	122 (29.1)	3.93 ± .35				Widowed	40 (9.6)	3.92 ± .45		
	3000~	210 (50.1)	4.01 ± .39			Main caregivers	Spouse (S)	200 (47.7)	3.98 ± .38	2.31[c]	.057
Stroke type	Ischemic	366 (87.4)	4.01 ± .53	1.00[c]	.369		Children (C)	81 (19.33)	3.95 ± .42		
	Hemorrhagic	32 (7.6)	3.94 ± .38				S and C	80 (19.1)	3.93 ± .31		
	Mixed	21 (5.0)	3.86 ± .40				Self	39 (9.3)	3.78 ± .47		
BMI	Lean	13 (3.1)	2.93 ± .37	0.16[c]	.926		Other	19 (4.5)	3.95 ± .39		
	Normal	181 (43.2)	3.96 ± .41			Complication number	One	273 (65.2)	3.94 ± .37	.67[c]	.515
	Overweight	172 (41.1)	3.93 ± .36				Two	94 (22.4)	3.94 ± .40		
	Obesity	53 (12.7)	0.43 ± .06				Three or more	52 (12.4)	4.00 ± .47		
Accuracy of recurrence risk perception[a]	Didn't know	106 (25.3)	2.55 ± .32	4.93[c]	.002**	Activity of daily life	Mostly dependent	81 (19.3)	3.99 ± .52	1.31[c]	.272
	Underestimate	50 (11.9)	2.72 ± .43				Partially dependent	67 (16.0)	3.95 ± .35		
	Accurate	120 (28.6)	2.60 ± .35				Partially dependent	109 (26.0)	3.89 ± .34		
	Overestimate	143 (34.1)	2.49 ± .42				Independent	162 (38.7)	3.95 ± .37		
Recurrence time	First-ever stroke	242 (57.8)	2.92 ± .38	0.95[c]	.389	Hypertension	No	131 (31.3)	2.60 ± .36	1.33[b]	.184
	Recurrent stroke	103 (24.6)	3.97 ± .43				Yes	288 (68.7)	2.55 ± .39		
	Multiple-recurrent stroke	74 (17.7)	3.98 ± .35			Diabetes	No	297 (70.9)	2.56 ± .37	−0.32[b]	.746
Recurrence worry	Strongly worry	79 (18.9)	2.63 ± .48	3.60[c]	.007**		Yes	122 (29.1)	2.57 ± .41		
	Worry	273 (65.2)	2.51 ± .35			Myocardial infarction	No	401 (95.7)	2.56 ± .38	−2.09[b]	.037*
	Neutrality	34 (8.1)	2.66 ± .32				Yes	18 (4.3)	2.74 ± .39		
	Not worry	29 (6.9)	2.65 ± .32			Other cardiovascular diseases	No	361 (86.2)	2.53 ± .38	−4.64[b]	<.001**
	Strongly not worry	4 (1.0)	2.93 ± .81				Yes	58 (13.8)	2.78 ± .35		
Hospital follow-up	No	255 (60.9)	2.54 ± .42	−0.92[b]	.359	Smoking history	No	301 (71.8)	2.64 ± .35	6.88[b]	.001**
	Yes	164 (39.1)	2.57 ± .36				Yes	118 (28.2)	2.37 ± .39		
Hemiplegia	No	322 (76.8)	2.54 ± .37	−2.31[b]	.021*	Community follow-up	No	306 (73.0)	2.52 ± .43	−1.53[b]	.126
	Yes	97 (23.2)	2.64 ± .41				Yes	113 (27.0)	2.58 ± .37		

Note: BMI = Body Mass Index; $*p < .05$; $**p < .01$.

[a] Bonferroni corrections tests showed significant differences between the overrated and underrated groups ($p < .05$).

[b] t-test.

[c] Analysis of variance.

Table 2 *The Correlation Between Variables and Health Behavior of Stroke Patients (N = 419).*

Variables	RRP	SE	RW	BDM	SS
Recurrence risk perception/RRP	1.00				
Self-efficacy/SE	.19*	1.00			
Recurrence worry/RW	.08	−.18**	1.00		
Behavioral decision-making/BDM	.50**	.151**	.20**	1.00	
Social support/SS	.23**	.14**	−.06	.12*	1.00
Health behavior/HB	.19**	.17**	−.05	.36**	.15**

Note: *$p < .05$; **$p < .01$.

Table 3 *The Linear Regression of Factors Influencing Stroke Patients' Health Behavior (N = 419).*

Variables	*B*	SD	*t*	*p*	95.0%CI (L,U)
Constant	6.39	7.14	.90	.371	−7.64, 20.42
Smoking history	−7.28	1.28	−5.71	<.001	−9.79, −4.77
Recurrent stroke	3.55	1.19	2.98	.003	1.21, 5.88
Income[a]	0.05	0.02	2.78	.006	0.02, 0.09
Hemiplegia	0.15	0.04	3.73	<.001	0.07, 0.23
Recurrence worry	2.19	0.76	2.88	.004	0.69, 3.68
Self-efficacy	0.07	0.02	3.85	<.001	0.03, 0.10
Social support	0.25	0.10	2.46	.014	0.05, 0.44
Behavioral decision-making	0.42	0.05	8.58	<.001	0.33, 0.52

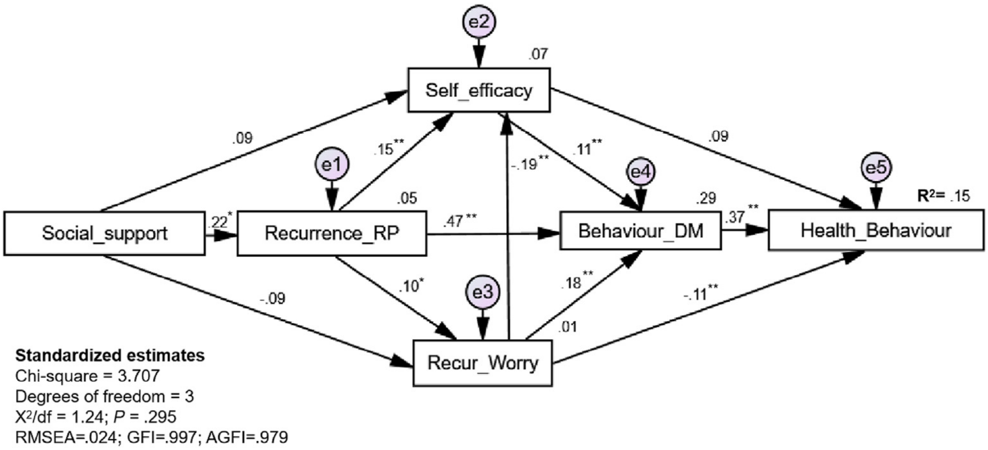
[a] Be analyzed as grade data; SD = standard deviation; CI = confidence interval; L = lower; U = upper.

and recurrence worry ($\beta = 0.10$, $p < .05$). Self-efficacy and recurrence worry can indirectly affect health behavior via the direct effect of behavioral decision-making ($\beta = 0.11, 0.18$, $p < .01$), and recurrence worry was an indirect factor of health behavior by the mediating effect of self-efficacy as well ($\beta = -0.19$, $p < .01$). The direct effects among the variables were confirmed as well, including social support to recurrence risk perception ($\beta = 0.22$, $p < .05$), recurrence risk perception to behavioral decision-making ($\beta = 0.47$, $p < .01$), behavioral decision-making to health behavior ($\beta = 0.37$, $p < .01$), recurrence worry to health behavior ($\beta = -0.11$, $p < .01$), and all relevant results were presented in Table 4 and Figure 2.

Discussion

This study's most meaningful and encouraging finding is that patients with stroke demonstrated awareness of recurrence risk, which is not precisely consistent with previous qualitative study [17]. The majority of stroke patients (74.7%) in this quantitative study claimed that they knew the risk of recurrence. However, the remaining 25.3% said they did not know the recurrent risk, which differs from the studies from Boden-Albala et al [56] and Saengsuwan J [23]. Those two studies did not report the percentage of stroke patients who "did not know risk". It may be explained by the reason that they assumed all the participants knew stroke recurrent risk and directly compared patients' perceived risk with the actual risk of further stroke. However, based on the previous qualitative study [17], not all first-ever strokes were aware of the risk of stroke recurrence, so providing a 'do not know' option is necessary in future surveys. In terms of recurrence risk perception accuracy, only the results of patients diagnosed with ischemic stroke were analyzed in this study. However, the consistency between subjective and objective assessments of the recurrence risk is less than satisfactory, which means a small number of stroke patients' subjective self-rated risk was consistent with the objective risk level. Only 28.2% could accurately perceive their recurrence risk, 34.1% of the patients were overestimated, and 12.1% were underestimated, this will lead to individuals not being able to objectively and accurately assess the risk, affecting the right behavior decisions. Our findings are similar to the results of rural stroke patients [57], but quite different from the results in other countries. The American scholar Boden-Albala et al interviewed patients with different ethnic backgrounds after their first stroke or TIA in acute care settings [56]. Their findings revealed that 70.0% of patients overestimated their risk, and 10.0% underestimated it. At the same time, another study conducted by Saengsuwan J in Thailand found that over 40.0% of patients underestimated and nearly one-fifth (17.1%) overestimated their risk [23]. To some extent, these differences could support the existing evidence that risk perception is a contextual topic. Further multi-center studies are needed to explore the necessity of employing standardized measurements and to analyze the complex influencing factors.

The results of this study showed that health behavior is positively associated with recurrence risk perception. However, no direct relationship was detected between health behavior and recurrence risk perception, and the relationship was found to be relatively weak (r = .19, $p < .01$). On the one hand, our findings are consistent with many health behavior change theories that state that disease risk perceptions are a critical determinant of health behavior [58]. Conversely, our findings suggest that risk perception's role in promoting health behavior change has been overestimated. However, this finding did not extend to the correlation



Standardized estimates
Chi-square = 3.707
Degrees of freedom = 3
X^2/df = 1.24; *P* = .295
RMSEA=.024; GFI=.997; AGFI=.979

Figure 2. The mediator model of recurrence risk perception and health behavior of stroke patients. *Note:* RP = risk perception; Recur = recurrence; DM = decision-making; *$p < .05$; **$p < .01$.

Table 4 *The Direct and Indirect Effect Between Variables of Stroke Patients (N = 419).*

Pathways	EV	Boot SE	Boot CI LCI	Boot CI UCI	*p*
SS → RRP	.23	.05	.13	.32	.001**
SS → RRP → RW	.02	.00	.00	.01	.035*
SS → multiple factors → BDM	.11	.03	.05	.17	.001**
SS → multiple factors → HB	.06	.02	.03	.10	.001**
RRP → BDM	.47	.04	.38	.54	.001**
RRP → RW → SE	−.02	.01	−.04	−.00	.041*
RRP → multiple factors → BDM	.03	.01	.01	.06	.010*
RRP → multiple factors → HB	.17	.03	.13	.25	.001**
SE → BDM → HB	.04	.18	.01	.08	.020*
SE → HB	.09	.05	−.01	.19	.077
RW → SE	−.19	.04	−.26	−.10	.001**
RW → SE → BDM	−.02	.01	−.04	−.00	.016*
RW → multiple factors → HB	.04	.02	.00	.08	.036*
RW → HB	−.11	.05	−.21	−.01	.036*
BDM → HB	.37	.05	.26	.46	.001**

Note: EV = effective value; SE = standard error; LCI = lower confidence interval; UCI = upper confidence interval; SS = social support; RRP = recurrence risk perception; RW = recurrence worry; BDM = behavioral decision-making; SE = self-efficacy; HB = health behavior; multiple factors = more than one factor work in one path; *$p < .05$; **$p < .01$.

between recurrence risk perception and health behavior. We think the outcome might be linked to the model's design. In our model, health behavior is not only affected by recurrence risk perception, but also by recurrence worry, self-efficacy, behavioral decision-making, etc. These factors may potentially mask the link between recurrence risk perception and health behavior, leaving a seemingly negligible correlation. The results indicated that patients who can accurately estimate their recurrence risk showed better health behavior (Mean (SD):2.60 ± 0.35) than someone who overestimated risk (Mean (SD): 2.49 ± 0.42). Surprisingly, the result revealed that patients who underestimated their recurrence risk had the best health behavior (Mean (SD): 2.72 ± 0.43) compared to those who accurately estimated or overestimated their recurrence risks. Meanwhile, for the patients who claimed “did not know”, their health behavior score was moderate (Mean (SD): 2.55 ± 0.32). Whatever these findings provide new evidence to uncover the relationship between recurrence risk perception and health behavior. Therefore, future study is still needed to understand the possible causal mechanism of risk perception and health behavior.

Mediation analysis could provide convincing information on understanding the mechanism and developing theory, then facilitate nursing research [52]. The mediation analysis of this study confirmed a chain mediating effect between social support, recurrence risk perception, behavioral decision-making, and health behavior. It indicated that social support could positively affect stroke patients' awareness of recurrence risk, promote individuals to make health behavior decisions, and help them modify unhealthy habits or maintain health behavior. Regarding self-efficacy, this study found that it was mediated by behavioral decision-making and indirectly influenced health behavior, while the direct effect did not exist. This result is consistent with previous studies that self-efficacy was a determinant of health behavior [59]. However, it also illustrates a new finding that even when patients have the confidence to act, they must go through the decision-making process. Recurrence worry, defined as fear, was also approved to be an important influencing factor of health behavior; its indirect effect through self-efficacy and behavioral decision-making was first confirmed in this study. Based on the relationship between recurrence risk perception and recurrence worry found in this study, the role of emotional response factors should be fully considered when carrying out recurrence risk education-related interventions in the future. After all, it has been confirmed that risk information can stimulate intrinsic motivation and cause worry and fear, which might reduce self-confidence [60].

Overall, the direct impact of relapse risk perception on health behavior may be overestimated, and there exists a complex mechanism between the two. Establishing a specific situational theoretical model is necessary. This study enriches the existing theoretical framework by introducing mediating variables such as social support, self-efficacy, relapse concerns, and behavioral decision-making, thereby opening new avenues and methods for subsequent research. Future studies could employ a combination of quantitative and qualitative approaches to explore the mechanisms underlying health behavior in different cultural and social contexts, providing a basis for developing more targeted intervention strategies.

Limitations

This study innovatively explored the correlation between recurrence risk perception and health behavior in stroke patients, and the intrinsic and extrinsic factors were analyzed using mediation analysis. There are still some limitations. Firstly, the low correlation between recurrence risk perception and health behavior might not provide strong evidence for targeting risk perception, but did arouse the importance to explore the relationship between various variables, which emphasizes the necessity of developing health behavior theory, and provide evidence for developing multi-aspects interventions. Secondly, stroke severity was not fully considered while it could be a possible confounding variable, even if we reported the activity of daily life or hemiplegia as alternatives, some other index (i.e., NIHSS) should be collected as well. Finally, a cross-sectional survey can infer correlation but is not always sufficient to determine a direct cause, this had potential implications for the robustness of our findings. The mediation analysis was used, but more data are still needed to prove the causal relationship.

Conclusions

Most stroke patients are aware of recurrence risk, but are unable to accurately perceive their personal risk. There exists a complex chain mediation pathway between risk perception of recurrence and health behavior, where social support serves as an important external factor, behavioral decision-making is a key internal influencing variable, and self-efficacy and concerns about recurrence are significant factors influencing health behavior as well. The establishment of this model can enrich the content of health behavior-related theories from a contextual perspective and provide a new framework for the development of intervention measures for specific populations.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author LBL.

Funding statement

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Ethics approval statement

This study was approved by the Institutional Review Board of the Zhengzhou University in August 2020 (Approval no. ZZURIB2020-08), and participants gave informed consent at the beginning of the survey.

Clinical trial registration

The study project has been registered in the Clinical Trials Registry (Reg. No: ChiCTR2000034244)

Statement conferring

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Conflict of interest

None.

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Research Article

Exploring the Lives of Korean College Students Who Attempted Suicide: A Qualitative Study

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SUMMARY

Purpose: This study was conducted to obtain in-depth understanding of the life experiences of college students who attempted suicide.
Methods: This study employed qualitative methods involving in-depth interviews, where researchers and participants met one-on-one to capture personal experiences and perspectives. Data were analyzed using Colaizzi's phenomenological approach, providing a systematic interpretation aligned with the lived experiences and challenges shared by the participants.
Results: The following six themes reflected participants' experiences: “A family that has left behind deficiencies and wounds that are not easy to overcome”, “Lingering struggles even as college students”, “Seeking self-worth through relationships”, “Achievement at all costs: The search for self-worth in a life obsessed with success”, “The irony of those aspiring to live: suicide” and “The fight still continues”
Conclusions: The results underscore the necessity of broadening our interpretive framework to better understand and address the concealed complexities of mental health in this demographic. Mental health professionals are urged to consider these nuanced dynamics when developing targeted interventions to support students through their unique challenges.

Introduction

The average life expectancy of Koreans is 83.6 years, ranking second among the Organization for Economic Co-operation and Development countries [1]. However, despite this high life expectancy, South Korea has the highest suicide rate in the world [2]. In 2021, suicide was the leading cause of death among individuals in their 20s, accounting for 56.8% of the deaths [3]. College years represent a crucial developmental stage, in the transition from late adolescence to early adulthood, when identity becomes distinct and individuals achieve psychological independence from parents and form a crucial sense of career identity [4]. College students carrying the burden of such development and tasks may struggle with adapting to college life and experience negative emotions [5]. South Korean college students experience significant academic stress due to the highly competitive educational environment, which is a major source of stress and has been linked to negative emotions such as anxiety, depression, and even suicidal ideation [6]. The high youth unemployment rate in South Korea exacerbates anxiety and stress among college students as they approach graduation [7]. Due to the traditional and conservative nature of South Korean parent-child relationships, compared with Western countries, parents' expectations on academic success and social status adds to students' already high stress levels [8]. Despite the high prevalence of mental health issues among South Korean college students, many are reluctant to seek professional help due to the stigma associated with mental health services [9]. This reluctance worsens students' mental health conditions and their ability to cope with stress [9].

Recent studies on suicide among college students have primarily focused on quantitative research identifying risk factors associated with suicidal idea [10–12]. Previous quantitative studies have highlighted various factors, such as self-efficacy, resilience, and positive coping strategies [11]; and studies on Korean college students have emphasized parent-child relationship stress [13], job-seeking stress [14], and stigma [15] as influencing factors for suicidal idea. While quantitative research provides broad and generalizable insights, exploring personal narratives is crucial in understanding the dynamic of suicide in the unique social and

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cultural context of South Korea. Considering approximately 36.5% of suicide attempters had made previous suicide attempts [16], effective interventions with these individuals can significantly reduce death by suicide [17]. Therefore, it is important to examine the experiences from the perspective of suicide attempters. This in-depth understanding of suicide attempters can contribute to developing effective interventions for suicide prevention. This study explored the lived experiences of college students who have attempted suicide using Colaizzi's phenomenological approach, which deeply reveals vivid life experiences [18].

Purpose

The objective of this study was to obtain in-depth understanding of the experiences of college students who have attempted suicide.

Methods

Study design

This study design was a qualitative research that used Colaizzi's phenomenological method [18] to explore the essential meaning in the experiences of college students who have attempted suicide. The study adhered to the Standards for Reporting Qualitative Research guidelines.

Participants

A purposive sampling method was used to intentionally select cases that could provide information about the experience of life. Participants were approached through a recruitment announcement at the psychiatric clinic where the researcher was employed. The participants were current college students with at least one suicide attempt; we excluded those currently feeling suicidal impulses. A total of nine college students who understood the purpose of the study and voluntarily expressed their willingness to participate were included. The background information of the research participants is presented in Table 1.

Table 1 *Characteristics of the Participants (n = 9).*

Variables	Categories	*n*
Gender	Women	9
	Men	0
Age range	21–24 years	7
	25–28 years	2
Major	Korean language and literature	1
	Administration	1
	Political science and diplomacy	1
	History of art	1
	Information sociology	1
	Christian studies	1
	Business administration	2
	Computer engineering	1
Economic level	Good	2
	Fair	3
	Poor	4
Residential status	Living alone	4
	Living with parents	5
Diagnosis[a]	Major depressive disorder	3
	Personality disorder	3
	Bipolar disorder	3
	Not diagnosed at a medical facility	3
Treatment type[a]	Psychiatric counseling	6
	Medication	6
	Psychological counseling	4
	Hospitalization	2
Suicide method[a]	Wrist cutting	7
	Falling	3
	Drug intoxication	3
	Hanging	1
	Jumping in front of cars	1
Suicide attempts	$\leq$3 (times)	6
	>3 (times)	3
Age of onset range	>18 (years)	6
	$\leq$18 (years)	3
Receipt of academic excellence scholarship	Recipient status	6
	Non-recipient status	3

[a] Multiple responses.

Data collection

Individual in-depth interviews were conducted, where the researcher met with each participant one-on-one. The interviews were conducted from September 6, 2022, following institutional review board (IRB) approval, to July 31, 2023. To ensure a comfortable and conducive environment for participants, interviews were held in quiet places where they felt at ease, such as private meeting rooms in hospitals, quiet corners of cafes. Given the sensitive nature of the research topic, sufficient time (approximately 90 to 120 min) was spent to allow the participants to share their experiences. The authors asked questions to understand the participants' experiences and perspectives in the context of the study. The interview questions like “Do you remember the first time you had thoughts of suicide? If so, can you tell me about that time?”, “In your current situation or at the time you attempted suicide, what did you feel was most needed?” focused on understanding the participants' experiences and perspectives in the context of the study. With predetermined questions, interviews were conducted in a semi-structured manner. Non-verbal reactions of the participants and the researcher's feelings at the time were documented. Field notes were taken during the interviews and were utilized during the analysis and writing phases to enhance the understanding of the data. The interviews were recorded using a voice recorder to ensure accurate capture of the participants' narratives. After the interview, the content was immediately transcribed. To protect participant anonymity, names were coded during transcription. Due to concerns about participants' potential psychological distress, repeat interviews were not conducted. Any additional questions were addressed through follow-up phone calls. Data saturation was discussed and achieved when no new themes or information emerged from the interviews. To ensure saturation, the researcher continued interviewing until the data became repetitive and redundant, indicating that no new insights were being gained. This was carefully monitored through continuous data analysis and review of interview transcripts.

Ethics approval and consent to participate

This study has ethical permission from Hanyang University Institutional Review Board, South Korea (Approval Ref No: HYUIRB-202209-001). Written consent from all participants was obtained prior to their involvement in the research.

Ensuring the quality of research results

To ensure the quality of this study, four criteria proposed by Sandelowski [19]—credibility, fittingness, auditability, and confirmability—were applied. Interviews continued until thematic saturation, ensuring study credibility. A triangulation process, cross-validating results with an experienced co-researcher in qualitative research, was employed to enhance the credibility of the analysis. The lead author, an experienced clinical psychiatric nurse, provides valuable insights. Additionally, external experts in phenomenological studies, independent of the authors, provided feedback on the research results to enhance credibility. Feedback on the research results was obtained from college students with suicide attempt experiences who did not participate in the study, ensuring fittingness. Auditability was ensured by analyzing the data using the data analysis method proposed by Colaizzi [18] and providing original data through quotations. The data collection method and duration were specified, and the process of deriving meaning and categorizing themes was presented by providing a table with themes, theme clusters, and meaningful phrases. A detailed audit trail was maintained, documenting all stages of the research process, including interview transcripts, field notes, data analysis procedures, and decisions made during the study. This audit trail allows for transparency and traceability of the research process. Reflexivity was maintained by documenting personal reflections and potential biases throughout the research process, and peer debriefing sessions were conducted to review the findings and interpretations.

Data analysis

This study adhered to Colaizzi's data analysis method [18]. Initially, recorded interviews were repeatedly listened to and transcribed to extract distinctive passages related to college student suicide, utilizing the MAXQDA program. Extracted statements were then reformulated into general expressions. Through these expressions, we derived organized meanings significant to college student suicide. The meaningful statements were further organized into themes and theme clusters, ultimately presenting clear descriptions relevant to the research topic.

Researcher preparation

The primary researcher had training in qualitative research. This includes coursework in qualitative research methods during graduate studies and five years of professional experience working in a psychiatric ward. Additionally, the researcher regularly attends seminars and workshops of Korean Association for Qualitative Research to stay updated on the latest methodologies and best practices.

The co-researcher is a professor of nursing and has experiences in qualitative research and has mentored graduate students in conducting phenomenological studies. The co-researcher has published in the field of nursing qualitative research methodologies, providing a strong foundation for guiding and supporting the research process. As an active member of the Korean Association for Qualitative Research, the co-researcher regularly attends seminars and gives lectures. The collaboration between the primary researcher and the professor ensured a comprehensive and methodologically sound approach to the study.

Results

This study explored the experiences of college students with a history of suicide attempts to understand their meaning. A total of 69 meaningful statements, 14 clusters of themes, and 6 themes were derived (see Table 2).

Table 2 *Themes and Theme Clusters.*

Theme	Theme clusters
1. A family that has left behind deficiencies and wounds that are not easy to overcome	Burdensome expectations and neglect for the wounds Complex emotions toward family
2. Lingering struggles even as college students	Lingering impact of past trauma Navigating college life alone without a safety net Entering adulthood unprepared
3. Seeking self-worth through relationships	Relationship focused on romantic interactions Obsession with relationships Half-hearted efforts to form meaningful relationship
4. Achievement at all costs: The search for self-worth in a life obsessed with success	Life obsessed with achievement The deficiency that can't be filled with accomplishments.
5. The irony of those aspiring to live: suicide	My sole choice over life A desire to be understood through suicide
6. The fight still continues	The will to live gained through suffering The unending allure of suicide.

Theme 1. A family that has left behind deficiencies and wounds that are not easy to overcome

Participants shared that the wounds inflicted by their families during childhood played a significant role in their decisions to attempt suicide. These wounds, often described as deep and lasting, emerged repeatedly as pivotal factors in their feelings of despair and isolation. The homes, meant to be places of warmth, protection, and relaxation, were filled with fear and tension. The participants felt an overwhelming absence of love from their families.

Theme cluster 1-1. Burdensome expectations and neglect for the wounds

Participants made efforts from a young age to meet their parents' high expectations. Therefore, expressing genuine emotions was difficult. The parents tried to dictate the participants' careers and marriage partners. However, when the participants faced difficulties, they were neglected or even scolded. These reactions left them feeling disappointed and betrayed.

> *P1: My parents had these huge expectations of me. They thought of me as this prodigy, like "the pride of the family," always saying I needed to read more, win awards, be polite to adults, and all that. They set the bar so high. And my mom was super intense about me doing housework, taking care of myself, losing weight, and everything. I just really want to retire now. I want to stop. I'm so fed up with all of it.*
>
> *P9: They pushed me so hard with the whole grades thing. And they wanted me to marry someone they picked. They kept laying into me for that and I just wish they could understand how hard it is for me.*

Theme cluster 1-2. Complex emotions toward family

Participants bore deep emotional scars from childhood family experiences, where painful memories coexisted with tender emotions. Despite indelible wounds, they couldn't bring themselves to hate or blame their family, viewing them as an integral part of themselves.

> *P1: I was actually dying of thirst for the attention I never got from my parents. With my stepmom, there's this weird mix of love. I owe her big time for being there when I didn't have my mom. But, at the same time, she made my life a struggle. My dad, too. I feel bad because it seems like my dad's been living his life just for me.*
>
> *P3: Honestly, I could've just left, but the only reason I couldn't leave was my mom. I felt so sorry for her back then. So now, I'm focusing on studying hard because I want to get a professional job and eventually take my mom on a trip. But at the same time, I feel both understanding and resentment towards my mom for not leaving my dad.*

Theme 2. Lingering struggles even as college students

The participants eagerly awaited becoming college students hoping to escape from the environment that drove them to commit suicide. The transition brought some changes, but without support, college life was challenging and lonely, contrary to their expectations; and their emotional deprivation from childhood persisted, heightening their despair and frustration.

Theme cluster 2-1. Lingering impact of past trauma

Their wounded heart from their difficult childhood did not heal with a change in environment. Although separated from brutal violence, the trauma remained and prevented them from moving forward. Instead of being nurtured as individuals with unique personalities, they grew up competing based on standardized criteria. Even in college, they remained fixated on credentials, constantly comparing themselves with others based on societal standards, leading to a sense of failure and entrapment.

> *P8: In high school, I gave up on my studies and pretty much everything. Eventually, I went to a college far from home to start fresh. I was doing okay. But during a break, I went home and ran into someone from my old high and I felt like my heart was going to explode. After that, I couldn't even think about going back to that area. I constantly worry if the people I'm with now have heard about my past, or if they secretly think I'm a loser. It stops me from really opening up to anyone. I can't control these thoughts, and it's just so scary.*

> *P9: When I was getting bullied, my parents would blame me, which made me feel super lonely. So, around twelve, I started meeting older guys online. When my mom found out, she called me a slut and threatened to report the guys. I felt so ashamed and isolated. Even now, I feel guilty when I meet guys my age, like I'm doing something gross. I feel like my mom always sees me that way. I even self-harmed and tried to jump off something in front of her. I still feel so lonely…*

Theme cluster 2-2. Navigating college life alone without a safety net

Because there was no one to provide financial support, participants had to juggle their studies and work. This was driven not by a passion for life but by the necessity for survival. The participants' loneliness deepened as they compared their situation with that of other students attending college with parental support. The participants had to endure their sorrow alone as they had no one to share their difficulties.

> *P5: I'm kind of doing college on my own. Like, when my classmates suggest grabbing a meal, I end up calculating the costs in my head. Honestly, I'm jealous of those who can easily go to school with the tuition and allowance their parents gave. It's like I have no one to lean on…*

> *P8: When I was struggling so much in high school, my parents were just there for me then. And now, I'm working at a factory while going to school, with no one to help me. Every day is so hard, and I don't have anyone to talk to or anyone who would understand. It just feels like I'm really alone in this tough world … (sobbing heavily) Every day is such a struggle … It's so hard trying to survive on my own.*

Theme cluster 2-3. Entering adulthood unprepared

The participants were thrust into adulthood without serious reflection on how to shape their lives. Under South Korea's education system, they were simply focused on getting into college. As a result, they had difficulty planning their life and making career choices independently.

> *P2: Back in high school, everything was just spoon-fed during classes. And to start with, I ended up choosing a major I wasn't even excited about … When I got to college, making friends felt so different. I had like nothing in common with them.*

> *P4: I somehow made it to college, but I'm already too old and totally wrecked, both physically and mentally. I have to plan my week around hospital appointments, and keeping up with my major is nearly impossible. To my peers, I'm just the "sick girl." Simply making it to college didn't fix anything. It wasn't just about getting in; I needed to be ready to become a healthy adult.*

Theme 3. Seeking self-worth through relationships

Relationships had an immense influence on the participants. It was both the driving force that propelled them and the major factor that completely shattered their zest for life. The participants invested a significant amount of time and energy in portraying themselves favorably to others. They tried to find meaning in life through interpersonal connections.

Theme cluster 3-1. Relationship focused on romantic interactions

Due to the feelings of inferiority and vulnerability in nonromantic relationships, participants always felt uncomfortable. Difficulty in connecting with peers of similar age made it hard for them to feel a sense of belonging in school or at work. Since childhood, participants only expressed sincere feelings through romantic relationships instead of family or school friends. However, loneliness and emptiness were not resolved through romantic relationships. Despite wanting to expand their connections, their relationships were limited to romantic relationships.

> *P1: I've always had a boyfriend since middle school, but I can't really rely on him, and he's no help at all. Being at home is unbearable, and I could never talk about this with my girl friends. Once I experienced being in a relationship where someone accepted everything about me, I couldn't stop it. So, when my first boyfriend wanted to break up, I tried to kill myself and even threatened him. He was the only person I depended on, and when he wanted to leave, it felt like my whole world was ending.*

> *P9: I used to get picked on a lot, and my family situation wasn't great either. Even now, I mostly just hang out with my boyfriend. But honestly, it doesn't really make a difference. When I'm with my classmates, I can't help but think, "They're all so slim, doing well in their studies, and have great personalities. What about me?" But I really wanted to make female friends.*

Theme cluster 3-2. Obsession with relationships

The participants were in a perpetual quest to fill the black hole in their hearts, striving to find fulfillment through relationships. They prioritized how they appeared to others over personal contentment. They spared no effort in presenting a flawless image, even resorting to bulimia. For the participants, a life of meaning meant being treasured by someone. Yet, even in their desperate pursuit of affection, their hearts remained restless and unsatisfied.

> *P4: So, I transferred to a new school, but there was someone there who didn't like me. Still, I had a few close friends. They were the only reason I lived for. I needed to go to school because of them.*

> *But I missed a few days, and I found myself trying to kill myself. I see my school friends more often than my own family. So if things fall apart with them, then I'm done for.*

> *P6: I thought studying was the only way to get any sort of recognition in society. Back then, my eating disorder was at its worst, getting the best grades. But the more I pushed for it, the more I felt this weird emptiness.*

Theme cluster 3-3. Half-hearted efforts to form meaningful relationships

Participants were always anxious, fearing that their true self would be discovered and that any love they had painstakingly obtained might disappear. The rupture of relationship was as terrifying as dying for them. They felt fatigue from the constant effort to present a cheerful and strong façade. Yet, participants found it difficult to trust others and were unable to share their pain, concealing their troubled inner world.

> *P1: I don't want people to see me like this. Always gotta put up a front … It's awful … Truth is, this is who I am … I'm afraid if I show this side, people might not be the same as they are now.*

> *P3: If people knew how pathetic I really am, I don't think they'd treat me the same. It feels like they like me because they don't actually know me. So, I always try to be polite and cheerful around others. It's like I'm determined to never let anyone see this side of me, even if it kills me. I love how people treat me warmly, even if it's just an act.*

Theme 4. Achievement at all costs: The search for self-worth in a life obsessed with success

Participants sought to find self-worth by meticulously managing themselves and striving for success. However, achievement did not bring peace to their minds, and they still could not find answers about life.

Theme cluster 4-1. Life obsessed with achievement

Participants found it difficult to spend time alone. They felt dismal, lethargic, and worthless when alone. As a result, they constantly tried to fill their daily lives with hectic schedules aimed at achieving something. They attempted to bury agonizing thoughts about life and death with fevered life and sought to feel valued through recognition and praise from others.

> *P4: I just wanna be better than the average person my age. But it gets tough when it feels like I'm not hitting that mark. Taking breaks from school makes me feel like I'm falling behind. Honestly, I've starved myself because I'm not worth it.*

> *P7: The only escape from this loneliness has always been studying. Right now, the only way to change my and my mom's situation is for me to work harder and get better grades. That's why I'm always buried in work and study. At least I'm a good student and got into a good college, which is why I can earn this much money as a college student. I've done everything that pays, not just tutoring. I'm always hustling to build up my resume because if I don't, I'll start thinking about everything again and feel like a failure.*

Theme cluster 4-2. The deficiency that couldn't be filled with accomplishments

The participants achieved academic success without parental support, obtained scholarships, and enhanced their credentials through various extracurricular activities. However, these achievements could not heal the participants' low self-esteem and deeply ingrained wounds. Instead of addressing this emotional emptiness directly, the participants channeled their energy into external activities, avoiding a confrontation with their inner struggles.

> *P1: Life's kind of pointless. Like, you're putting in all this effort, but what's the real meaning of trying so hard to impress people or stay busy all the time?*

> *P8: I had to keep my GPA high to keep my scholarship, so I worked really hard, juggling part-time jobs and studying until dawn. Thankfully, I managed to get the scholarship. But it's not like I felt happy and wanted to live more or anything. That's it. It's not like anyone was there to celebrate or congratulate me, and I have to keep struggling again tomorrow. I'm not doing this because I love it; I'm doing it to survive. I don't even know how much longer I can keep this up, and that makes me even more anxious.*

Theme 5. The irony of those aspiring to live: suicide

Participants blamed their parents, God, and those who tormented them for forcing them to live this unhappy life. In the midst of agony and hardship, they felt there was nothing they could change. Suicide was not only a desperate attempt to solve a problem but also a last plea for help.

Theme cluster 5-1. My sole choice over life

For the participants, suicide attempts were an expression of anger at having to endure a life devoid of love and marked by failure. Suicide was an expression of anguish over the meaninglessness they felt about their existence, and it was the only way to resolve this worthlessness. The participants resented the suffering they did not choose, being born and existing, and felt that the right to end it was a choice they should have.

> *P3: I think life just begins without any choice, so, at least ending it should be considered personal right.*

> *P8: I just can't get why I had to be born into this world. Why do I have to deal with all this tough stuff? If they were gonna treat me like this, why'd they even bring me into the picture? Like, I never asked for any of this.*

Theme cluster 5-2. A desire to be understood through suicide

Participants described their suicide attempts as a cry for help, intended to communicate their distress to others. Suicide was used as an immature and extreme last method to restore relationships.

> *P7: It could've been a wake-up call for my mom, hitting her hard. she'd finally break free from my dad. I wanted her to know how hard it's been for me.*

> *P4: I told the dude messing with me that I even popped some pills to kill myself. Just wanted to send that message.*

Theme 6. The fight still continues

Experiencing a suicide attempt led to significant changes in participants' lives. However, the close encounter with death led them to feel emptiness more frequently, ultimately making it easier for them to reconsider suicide than before the attempt.

Theme cluster 6-1. The will to live gained through suffering

Through the experience of a suicide attempt, the participants realized that life is not eternal and shifted their focus toward their own happiness. Moreover, experiencing physical pain during the suicide attempt made them realize that their attempt to solve problems through suicide was inappropriate and extreme. They learned that even the most challenging problems eventually pass.

> *P2: When the toughest times pass, it does get better. Right now, I'm all about living happily. Learned the hard way it's more important to be happy with myself than how I look.*

> *P4: Lying in the emergency room, seeing people surviving and dead … It's not like living or dying is at my disposal. Learned the hard way dying solves nothing.*

Theme cluster 6-2. The unending allure of suicide

The participants still harbored the option of suicide in part of their mind. The participants were disheartened, as they couldn't get over the thought of dying. The painful emotions experienced during the suicide attempt and the sense of failure after the attempt continued to haunt the participants, making it difficult for them to move forward.

> *P6: It just won't let up, this constant pull towards seeing suicide as the way out when something doesn't go my way and it's been persisting until now.*

> *P8: After that, I'm more messed up. It was really horrible, seriously terrifying, and just downright awful at the time. I remember every single second of it even now. I can't even die, you know? I'm such a coward.*

Discussion

The first theme shows how early-life experiences, particularly negative interactions within the family, play a critical role in shaping vulnerability to suicidal tendencies. Participants expressed how childhood wounds carried forward into their adult lives, affecting their mental health and susceptibility to suicide. This aligns with previous research indicating that negative emotions formed through dysfunctional family experiences in early childhood can lead to difficulties in social life, heightening the susceptibility to adult suicide [20,21].

College students face unique challenges due to their transitional stage of life, where they are navigating independence while still being somewhat dependent on their families for emotional and sometimes financial support [4]. This duality can exacerbate the impact of early family experiences. The transition to college often involves renegotiating parental involvement, which can create tension as students strive for autonomy while still needing parental support [22]. These transitions can be particularly challenging for those with a history of negative family interactions [23]. Addressing these issues requires a nuanced approach that considers the ongoing influence of family while supporting the student's journey toward independence [24].

The second theme revolves around evident economic and academic challenges faced by college students, with participants describing how these pressures contributed to their mental health struggles. According to data from the American College Health Association [25], more than 75% of college students undergo moderate to severe economic stress, supporting the results of this study. In the previous research, college students, who cannot work full-time, were indicated to frequently require not only tuition loans but also living expense loans [26]. This suggests that college students should be considered a financially vulnerable group. The college years, characterized by significant developmental tasks and changes, can negatively affect mental health when individuals struggle to balance their academic and work responsibilities [4,27]. Therefore, it is crucial to implement programs that support a balance between academic and work responsibilities, coupled with financial education and planning. Thus, programs promoting prioritization, organization, and balance in various life domains are needed.

The third theme focuses on interpersonal relationships. Participants in this study reported that they frequently concealed their vulnerabilities due to fear of negative judgment. This is consistent with the previous research indicating that individuals with high social anxiety might control their self-presentation by emphasizing their strengths and concealing negative aspects to prevent negative evaluations and be positively perceived by others [28].

Building new social networks in an unstable setting, such as college, can increase anxiety about fitting in and being accepted [5]. This fear of stigma serves as a substantial barrier to help-seeking behavior among college students, further compounding their mental health struggles [29]. The Cognitive Behavioral Model of Social Phobia explains that excessive anxiety and fear in social interactions, coupled with avoidance behaviors, can reinforce difficulties in interpersonal relationships [30]. Research has shown that appropriate self-disclosure and help-seeking behaviors can enhance coping abilities and ultimately reduce the risk of suicide [31]. Therefore, interventions are necessary to help suicide attempt survivors overcome passivity in their interpersonal relationships and engage actively in social interactions. Training programs focused on alleviating tension in situations that cause social anxiety and the formation of peer support groups, essential for recovery at this stage, could be beneficial [32].

The fourth theme highlights an excessive dedication to achievement. There is a complex relationship between achievement and self-worth among the participants. While striving for high standards often leads to academic and professional success, it can also result in significant emotional strain. All participants in this study were enrolled in a four-year university in Seoul that is considered prestigious in Korea, and among the nine participants, six were recipients of academic excellence scholarships. According to Baumeister's escape theory, the dissatisfaction in life that arises from setting excessively high standards for oneself and comparing oneself with others is an initial stage leading to suicidal behavior, explaining the results of this study [33]. Although previous studies have indicated connections between excellent performance and stable emotional states [34,35], good performance does not necessarily indicate emotional stability. Therefore, there is a need to expand attention and care to individuals with high and stable performance.

The participants in this study were motivated by the desire for approval from others rather than their own interests. According to Deci and Ryan's Theory of Motivation, the driving forces of achievement can be divided into intrinsic motivations, based on internal desires, and extrinsic motivations, which rely on external factors such as recognition from others [36]. Thomson and Jaque suggested that relying solely on extrinsic factors could lead to negative emotions such as anxiety, and the research by Martin et al. indicated that intrinsic motivation enhances perceived competence and promotes healthy behaviors [37,38]. Therefore, programs that empower suicide attempt survivors to pursue and attain their own life goals are needed to foster internal rewards and satisfaction.

The fifth theme explores the intrinsic meaning behind suicide attempts. Participants often viewed their suicide attempts as a form of communication, aligning with the previous research indicating that suicide attempts can serve as a means to signal the need for support rather than a direct desire for death [39]. In other words, the purpose of suicide attempts might not necessarily be death. According to the results of psychological autopsies conducted in Korea, 94.0% of suicide attempters exhibited suicide risk signals [40]. Thus, effectively addressing the difficulties expressed by individuals before they attempt suicide might be enough to prevent suicide attempts. However, even if the people around an individual recognize suicide signals, professional intervention is necessary because friends, colleagues, and family members might not be able to provide adequate support for suicide attempters by themselves [20].

The sixth theme is related to the aftermath of a suicide attempt which can leave lasting psychological impacts. After their suicide attempts, participants felt guilt and a sense of failure and still considered suicide. This aligns with the previous studies reporting that suicide attempters feel they cannot return to their pre-suicidal selves [41] and that suicide attempters persistently struggle with suicidal impulses even after their attempt [42].

The way they came to perceive life after suicide attempts; however, varies among different demographic groups, reflecting their unique developmental characteristics. Considering that college students' suicidal behaviors are frequently driven by the immense academic and social pressure to succeed [43,44], it could be said that their life values are closely tied to external evaluations from others, making them more vulnerable to feelings of failure and isolation after the attempt. College students, typically aged 18—24, are in a transitional stage marked by autonomy and independence, career exploration, and forming new social networks [23]. In adolescents, like college students, their perception of self-worth was heavily influenced by immediate social relationships and acceptance from others [45]. This stage involves identity formation and emotional regulation, heavily influenced by peer groups [46]. Suicide attempt of middle-aged adults often leads to a re-evaluation of their lives and surroundings, appreciating what they have and accepting themselves [42,47]. This stage often involves reflecting on life accomplishments and setting new goals [48], which can lead to opportunities for personal growth and spiritual development [42,47]. Struggle for elderly suicide attempters are deeply related to past traumas and social disconnection, resulting in feelings of abandonment and severe depression [49]. For many, maintaining connections with loved ones and addressing past traumas become central in finding purpose of life and peace in their remaining years [50]. Erikson [46] describes this stage as a time for sharing and reflecting on their life.

These unique reactions after suicide attempt among different demographic groups shows that a more tailored approach according to life stage is important for supporting individuals. Therefore, college students may benefit from programs that support academic and social balance, emphasizing peer support. Additionally, consistent education and counseling to establish a healthy identity independent of social recognition are essential; and programs that develop career paths aligned with their aptitudes, forming the basis for healthy self-esteem, would also be beneficial.

Limitation

This study was limited to only female college students and did not explore the life experiences of male college students. Additionally, the study only targeted college students attending a four-year university in Seoul, which is considered to be top ranked education tier in South Korea. This may have influenced the research results.

Conclusions

This study explored the multifaceted nature of challenges in the context of suicide among college students. The findings of the provides valuable insights for mental health professionals in developing targeted strategies and support systems to assist students in navigating the complexities of college life in a healthy way. The significance of this study lies in expanding our perspective to encompass even seemingly stable and high-achieving students, ensuring that we do not overlook their unique challenges.

Ethics approval and consent to participate

This study was approved by the IRB of Hanyang University, South Korea (Approval no. 202209-001). Written consent from all participants was obtained prior to their involvement in the research. Data collection took place from October 20, 2022, to February 15, 2023. The IRB approval was granted on September 6, 2022.

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Authors' contributions

KMS contributed to the literature search, screening, quality assessment, analysis and interpretation of data, and manuscript writing and revision. JHY contributed to the conception and design of the study, data extraction, quality assessment, analysis and interpretation of data, and manuscript writing and revision. Each author has participated sufficiently in the work to take public responsibility for appropriate portions of the content.

Consent for publication

Consent for publication was obtained from all individual participants included in the study. All participants understood the purpose of the study and voluntarily agreed to participate. The consent forms are available upon request.

Availability of data and materials

The consent for publication was obtained from all individual participants included in the study. All participants understood the purpose of the study and voluntarily agreed to participate. The consent forms are available upon request.

Conflict of interest

The authors declare that they have no competing interests.

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Research Article

Evaluation of the Psychometric Properties of the Translated Physical Self-Perception Profile Among Chinese Breast Cancer Survivor

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SUMMARY

Purpose: The purpose of this study was to translate the original English version of the Physical Self-Perception Profile into Cantonese Chinese, while considering linguistic and socio-cultural characteristics, and to evaluate its psychometric properties among Chinese breast cancer survivors in Hong Kong, China, thus providing a valid, culturally relevant tool for assessing physical self-esteem among this population.
Methods: The 30-item, 5 subscale Physical Self-Perception Profile was translated into Chinese by the combined translation technique. The psychometric properties of the Cantonese version of the Physical Self-Perception Profile were examined in 292 Hong Kong Chinese breast cancer survivors for internal consistency and test–retest reliability. A confirmatory factor analysis was conducted to evaluate the structural validity. A panel of five experts examined its content validity. The concurrent validity was examined by correlating the Physical Self-Perception Profile and a validated global self-esteem measure.
Results: The Cantonese version of the Physical Self-Perception Profile demonstrated satisfactory content validity, also satisfactory internal consistency with Cronbach's α ranging from .64 to .80, as well as good test–retest reliability, with an intraclass correlation coefficient ranging from .77 to .81. The confirmatory factor analysis showed a fairly good fit of the four-factor subdomain structure, namely, physical condition, physical strength, body attractiveness, and sports competence. The concurrent validity of the Chinese version Physical Self-Perception Profile was demonstrated by a significant positive correlation between the physical self-worth domain and four subdomains with global self-esteem. In addition, the four subdomains had statistically significant positive correlations, with the physical self-worth domain indicating the instrument's hierarchical structure.
Conclusion: The study translated the Physical Self-Perception Profile from English to Cantonese and demonstrated its desirable psychometric properties among Chinese Hong Kong breast cancer survivors. The linguistical and cultural adaptation of this instrument can serve as a valid and reliable tool for assessing physical self-esteem among breast cancer survivors in Hong Kong, China.

Introduction

Breast cancer is the most common cancer affecting women around the world, with approximately 2.3 million new cases diagnosed globally in 2020 [1]. In China, the number of new female breast cancer cases has been increasing from 0.3 million in 2015 to 0.42 million in 2020, accounting for 18% of breast cancer cases globally [2]. The rate of breast cancer is also on the rise in Hong Kong Special Administrative Region (SAR) of China, where it is the most commonly diagnosed cancer among women, comprising

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28.5% of all new cancer cases in females diagnosed in 2021 [3]. The crude incidence rate of female breast cancer was 138.1 per 100 000 women [3]. Moreover, breast cancer stands as the third most prevalent cause of cancer-related deaths among women in Hong Kong, China, with 12.5% female cancer deaths attributed to breast cancer in 2022 [3].

Meanwhile, with the advancement of effective treatment, an increasing number of breast cancer patients are experiencing longer survival [4]. However, among breast cancer survivors (BCSs), breast cancer and its treatment can cause negative consequences, including reduced psychological and physical functioning, increased risk of comorbidities, and cancer recurrence [5]. The challenging treatments, changes in body self-image, and the fear of recurrence can cause psychological distress in BCSs, which in turn can affect their self-esteem [6]. Self-esteem refers to the overall affective evaluation of one's worth or value [7], which has significant influences on the way BCSs thrive and return to normal lives. It has been recognized as a crucial factor affecting BCSs' well-being [8–10]. In fact, due to its subjective nature, self-esteem has been commonly assessed using self-report scales. Thus, a reliable and valid self-esteem assessment tool specifically designed for BCSs is needed [11]. More than that, people's overall self-evaluation can vary systematically across cultures, leading to different assessments of self-esteem based on cultural differences [12]. Hence, a culturally sensitive and contextually tailored self-esteem assessment tool is required for BCSs. Currently, there is a lack of an accurate, systematic, and culturally sensitive self-esteem assessment applicable to BCSs in Hong Kong, China.

The Physical Self-Perception Profile (PSPP) scale was developed based on the theoretical framework of the Exercise and Self-Esteem Model. In this model, physical activity acts on a parallel level with exercise self-efficacy, mediated by four subdomains of physical condition, strength, attractive body, and sports competence as well as the domain of physical self-worth to enhance global self-esteem [13–15]. Thus, the PSPP comprises a superordinate physical self-worth domain and four subdomains, hypothesised to form a hierarchical structure, and each measured by six items. In a study of physical activity and self-esteem among young adults, the original PSPP (the English version) demonstrated good internal consistency, with Cronbach's α coefficients ranging from .81 to .92 [13]. The PSPP has also been validated in different countries, such as the United Kingdom, Spain, and Belgium [16–18]. Among BCSs in the United States, the PSPP showed Cronbach's α coefficients ranging from .80 to .84 for each subscale [19]. However, this scale has not been applied to Cantonese BCSs.

The existing Mandarin Chinese version of the PSPP [20] has only been used in a group of college students in Mainland China. Considering cultural differences, the Mandarin version of the PSPP has been revised for college students in Mainland China, specifically regarding the physical strength dimension. Factors such as physical speed and endurance, which might affect physical self-worth for the college students, were incorporated into the dimension of physical strength to form a new dimension of physical fitness. The Mandarin version demonstrated good internal consistency (range of Cronbach coefficients: .75–.82). Nevertheless, during the exploratory factor analysis, several items displayed cross-loading on different factors. Due to the distinct physiological and psychological characteristics of the population, it appears that the existing Mandarin version of the PSPP for college students in Mainland China may not be suitable for the BCSs in Hong Kong, SAR. Besides, the Mandarin version may not be suitable for Cantonese speakers due to linguistic differences (e.g. pronunciation, words, and grammar) between Cantonese and Mandarin [21]. Additionally, Cantonese is the most widely used language in Hong Kong, China, with over 99% of residents over the age of 40 years speaking Cantonese. However, less than half of the residents over the age of 60 years can speak English [22]. According to the 2021 report on female breast cancer cases from the Hong Kong Cancer Registry, the incidence of breast cancer in females is much higher in those over the age of 45 years and increases with age [23]. Moreover, despite shared cultural values, the healthcare systems in Mainland China and Hong Kong, SAR differ. Previous evidence indicates that women with breast cancer in these regions have different preferences for psychosocial care [24]. Given this situation, a Cantonese version of the PSPP is required in Hong Kong, China.

The physiological and psychological characteristics of BCSs are unique from those of the university students; moreover, among BCSs, their psychological characteristics differ across cultures. Thus, this study aims to translate the original PSPP into Cantonese and establish its psychometric properties among BCSs in Hong Kong, China. This study will provide evidence about the validity and reliability of the instrument, contributing to a better understanding of the perceived physical self-perception among BCSs, as well as future implementation of interventions to improve self-esteem among BCSs.

Methods

With permission from the original author, the original PSPP was translated to Cantonese through the combined translation technique, including forward-translation and back-translation method and the committee approach to establish equivalence [25].

Three bilingual nursing PhDs, whose first language is Chinese, independently translated the English version into Cantonese. Discrepancies in the translated versions were deliberated upon during a committee meeting. The iterative procedures continued until a consensus was reached among the translators. The agreed translated Cantonese version was then back-translated into English. A proficient bilingual nursing professor, fluent in English, independently conducted the back-translation. Due to linguistic and cultural considerations, minor differences were identified between the original English version and the back-translated version from Cantonese to English. The back-translated version was compared with the original version by the original author, a native English speaker, to assess any discrepancies. This process functioned to establish content equivalence for the translated Cantonese version of PSPP. The detailed translation and validity verification processes are shown in Supplementary Figure 1.

Design

From February 16 to June 12, 2023, a cross-sectional study was conducted to validate the Cantonese version of PSPP among BCSs in Hong Kong, China. Community-dwelling BCSs were recruited from the local patient support groups. The study complied with the Strengthening the Reporting of Observational Studies in Epidemiology checklist [26].

Participants and settings

After receiving potential participants' contacts, participants were requested to meet at their recruitment centers for study screening. In Musanti's randomized controlled trial, which aimed to investigate the effects of exercise modality on physical self-esteem in the BCSs in the United States, the PSPP was utilized and demonstrated satisfactory internal consistency [19]. Musanti's study included women diagnosed with stage I–IIIB breast cancer. To test the psychometric properties of PSPP among BCSs in Hong Kong, China, the inclusion criteria in this study were as follows: (1) women aged >18 years; (2)

diagnosed with stage I–III breast cancer within the past 5 years; (3) able to understand and speak Cantonese; and (4) able to give informed consent. The participants who took <1 minute or >60 minutes to complete the survey or who only partially completed the questionnaire were excluded from the analyses.

The sample size was determined to provide sufficient subjects for examining factor structure, test–retest reliability, and criterion-related validity of the translated PSPP. Regarding factor analysis, 300 participants were needed for the 30-item PSPP based on the rule of thumb (1 item: 10 subjects) [27]. Furthermore, a sample size of 300 participants could enable the detection of a significant correlation coefficient as small as .16 with 80% power at 5% level of significance, which would be adequate to examine concurrent validity. Moreover, according to Bonett's method [28], a sub-sample size of 50 participants was deemed sufficient to validate the test–retest reliability, with an intraclass correlation coefficient (ICC) of ±.10 at 5% significance and an expected reliability of ICC ≥.80.

Study instruments

The original 30-item PSPP includes a physical self-worth domain (items: 5, 10, 15, 20, 25, 30) and four subdomains: perceived physical condition (items: 2, 7, 12, 17, 22, 27), strength (items: 4, 9, 14, 19, 24, 29), body attractiveness (items: 3, 8, 13, 18, 23, 28), and sports competence (items: 1, 6, 11, 16, 21, 26) [13]. The scale uses a structured alternative item format with four choices to minimize socially desirable responses. Response options for each item are from 1 to 4, and the total score for each subscale is from 6 to 24. A higher subscale score represents higher levels of self-perception in the domain and subdomain levels [13].

Ten subjects were invited to assess the clarity of the scale [27]. Those who rated the instructions, response format, or any scale item as unclear were asked to provide suggestions for clarifications. Any aspects of the scale found unclear by at least 20% of the participants were re-evaluated, ensuring semantic and content equivalence of the Cantonese version scale.

As the PSPP was developed to measure the physical elements of self-esteem [13], the Rosenberg Self-Esteem Scale was used in this study to evaluate the concurrent validity of the PSPP. The 10-item Rosenberg Self-Esteem Scale, a validated measure of global self-esteem, has been validated and widely used in various populations including Hong Kong, China [29]. Scores on the scale range from 10 to 40, with higher values indicating greater self-esteem. The Cronbach's α of the Rosenberg Self-Esteem Scale among BCSs was .87 [19].

Data collection

The study followed the Declaration of Helsinki and received ethical approval from the university's ethics committee on November 29 2022 (No. SBRE-22-0265). Prior to participation, study details were fully explained to and informed consent was obtained from all participants.

Self-reported sociodemographic data, such as age, educational level, and marital status, and medical history were collected. Repeated administrations of PSPP took place two weeks later among at least 50 participants for test–retest reliability assessment.

Data analysis

Descriptive statistics, such as mean, standard deviations (SDs), frequency, and percentage, were used to summarize the study data, as appropriate. The normality of continuous variables was assessed using skewness and kurtosis statistics, and the acceptable range was between −2 and +2 [30].

Validity

Content validity

A group of five experts was engaged to value the content equivalence on a four-point scale (1 = not relevant, 2 = necessary revisions or not relevant, 3 = relevant but need minor revision, 4 = highly relevant). Content validity was explored by calculating the content validity index (CVI) at both the item (I-CVI) and subscale (S-CVI) levels, with I-CVI ≥.78 and S-CVI ≥.90 considered acceptable [27].

Structural validity

A confirmatory factor analysis (CFA) was conducted to examine the structural validity of the translated Cantonese version of PSPP based on the 4-subdomain factor structure of the original PSPP. The goodness of fit was deemed acceptable if the ratio of the Chi-squared statistic to degrees of freedom (χ^2/df) was less than 3, standardized root mean squared residual ≤ .10, a root mean square error of approximation value ≤ .08, both the comparative fit index and non-normed fit index ≥ .90.

Concurrent validity

Concurrent validity was assessed by examining the correlation between the scores of the PSPP and the Rosenberg Self-Esteem Scale.

Reliability

Internal consistency

Internal consistency of each subscale was assessed using Cronbach's α, with a range of .60–.80 considered acceptable [31]. The corrected item–total correlation was utilized to detect items that exhibited heterogeneity from others [32]. Items were considered nonhomogeneous and were excluded if the corrected item–total correlation was below .40 and the removal of the item increased the alpha coefficient of the entire scale by .10 or more [33].

Test–retest reliability

The test–retest reliability was assessed using intraclass correlation coefficient (ICC). ICCs ranging from .75 to .90 indicate good reliability, while values exceeding .90 suggest excellent reliability [34].

IBM SPSS 25 was used for statistical analyses and LISREL 8.8 (Scientific Software International, Inc., Chicago, IL, USA) for CFA. The significance level in this study was set at .05 (2-sided).

Results

Translation and cultural adaptation

Most items were retained with subtle adjustments in several terms consistent with the Hong Kong Chinese cultural background. For example, in the original English version, the term “fitness” in item 2 and 12, which belong to the physical condition subscale, was changed into “exercise capacity” [體能水平]. In the Mandarin version of the PSPP, “fitness” was translated to “constitution” [体质]. However, “constitution” refers to “Body Constitution” in Chinese Medicine in Hong Kong, China. To avoid the confusion and misunderstanding among the Hong Kong population, we used the “exercise capacity” to indicate fitness. The original English version and Cantonese Chinese versions are shown in the Supplementary Table 1.

Characteristics of study participants

In total, 305 community-dwelling BCSs were recruited. After eliminating invalid questionnaires, data from 292 participants were included in the analysis. The characteristics of the participants are demonstrated in Supplementary Table 2. The mean age of the participants in this study was 53.76 years. The mean score of physical self-worth domain was 14.01 (SD = 3.13), while mean scores on the four subdomains ranged from 11.53 (SD = 3.57) to 12.62 (SD = 3.56). The scores for each domain are presented in Table 1.

Validity

Content validity

Table 2 summarizes the content validity, including the CVIs for each item and scale. Rating from the five-member experts suggested an acceptable content validity, showing I-CVIs ranging from .80 to 1 and an S-CVI of .98.

Structural validity

To validate the four-factor structure of the four subdomains, a CFA was performed. Figure 1 presents the results of the structural validity analysis. The CFA results demonstrated a fairly good fit, with $\chi^2 = 632.16$, df = 246, $p < .001$, $\chi^2/\text{df} = 2.57$, root mean square error of approximation = .07, comparative fit index = .97, non-normed fit index= .97, and standardized root mean squared residual = .07.

Concurrent validity

Table 3 displays the concurrent validity, showing the correlations among global self-esteem and the PSPP subdomains. The scores of four subdomains were all significantly positively correlated with the total score of the Rosenberg Self-Esteem Scale (r ranged from .23 to .58, all $p < .001$). Meanwhile, all four subdomains were significantly positively correlated with the physical self-worth domain. These findings demonstrated the concurrent validity of the translated PSPP.

Furthermore, the four subscales showed lower correlations with global self-esteem measured by the Rosenberg Self-Esteem Scale than physical self-worth had, while all four subscales showed stronger correlations with physical self-worth (Table 3). This supported the instrument's hierarchical structure that physical self-worth was at an intermediary level between global self-esteem and the four PSPP subscales.

Reliability

Internal consistency

Table 4 summarizes the internal consistency and test–retest reliability of the scales. The internal consistency of the four subdomains and the domain were satisfactory, showing Cronbach's α .80 (sports competence), .77 (physical condition), .76 (body attractiveness), .77 (physical strength), and .64 (physical self-worth) (as indicated in Table 4). Furthermore, item analysis showed that Cronbach's α of the translated scale did not change for more than .10 after deleting any items.

Table 1 *Mean Scores for PSPP Scale (n = 292).*

Items	Mean ± SD
Sport competence	11.53 ± 3.57
Physical condition	12.62 ± 3.56
Body attractiveness	12.60 ± 3.45
Physical strength	12.50 ± 3.50
Physical self-worth	14.01 ± 3.13

Note. PSPP = Physical Self-Perception Profile; SD = standard deviation.

Table 2 *Content Validity Indexes of PSPP.*

Subscale	No. rating 3/4	I-CVI
Item 1	5	1.00
Item 2	5	1.00
Item 3	5	1.00
Item 4	5	1.00
Item 5	4	.80
Item 6	4	.80
Item 7	5	1.00
Item 8	5	1.00
Item 9	5	1.00
Item 10	4	.80
Item 11	5	1.00
Item 12	5	1.00
Item 13	5	1.00
Item 14	5	1.00
Item 15	5	1.00
Item 16	5	1.00
Item 17	5	1.00
Item 18	5	1.00
Item 19	5	1.00
Item 20	5	1.00
Item 21	5	1.00
Item 22	5	1.00
Item 23	5	1.00
Item 24	5	1.00
Item 25	5	1.00
Item 26	5	1.00
Item 27	5	1.00
Item 28	5	1.00
Item 29	5	1.00
Item 30	5	1.00
S-CVI		.98

Note. I-CVI = item-level content validity index; PSPP = Physical Self-Perception Profile; S-CVI = scale-level content validity index.

Test–retest reliability

Regarding the test–retest reliability, 70 participants were reassessed in a 2-week interval. The ICC for the physical self-worth domain (.81) and the four subdomains were .77 (sports competence), .81 (physical condition), .78 (body attractiveness), and .80 (physical strength), respectively, showing good test–retest reliability (as indicated in Table 4).

Discussion

To the best of our knowledge, this was the first study to translate the PSPP from English to Cantonese and evaluate its psychometric properties for use among Hong Kong Chinese BCSs. When using an instrument originally developed in one culture for another culture, it is important to undergo a cross-cultural adaptation process to ensure the equivalence between the original and newly adapted versions [35]. The desirable psychometric properties of the Cantonese PSPP and its linguistical and cultural acceptability among Cantonese speakers in Hong Kong, China, indicate that it can serve as a valid and reliable tool for assessing physical self-esteem among BCSs in Hong Kong, China.

BCSs often experience lower levels of self-esteem and mental health due to challenging treatments they undergo, changes in body image, and physical fitness. Self-esteem plays a crucial role in understanding the mental health benefits of physical activity engagement, and thus, assessing physical self-esteem in BCSs is valuable for both clinical practice and research. The multidimensional PSPP serves as a standardized, valid, and reliable tool to

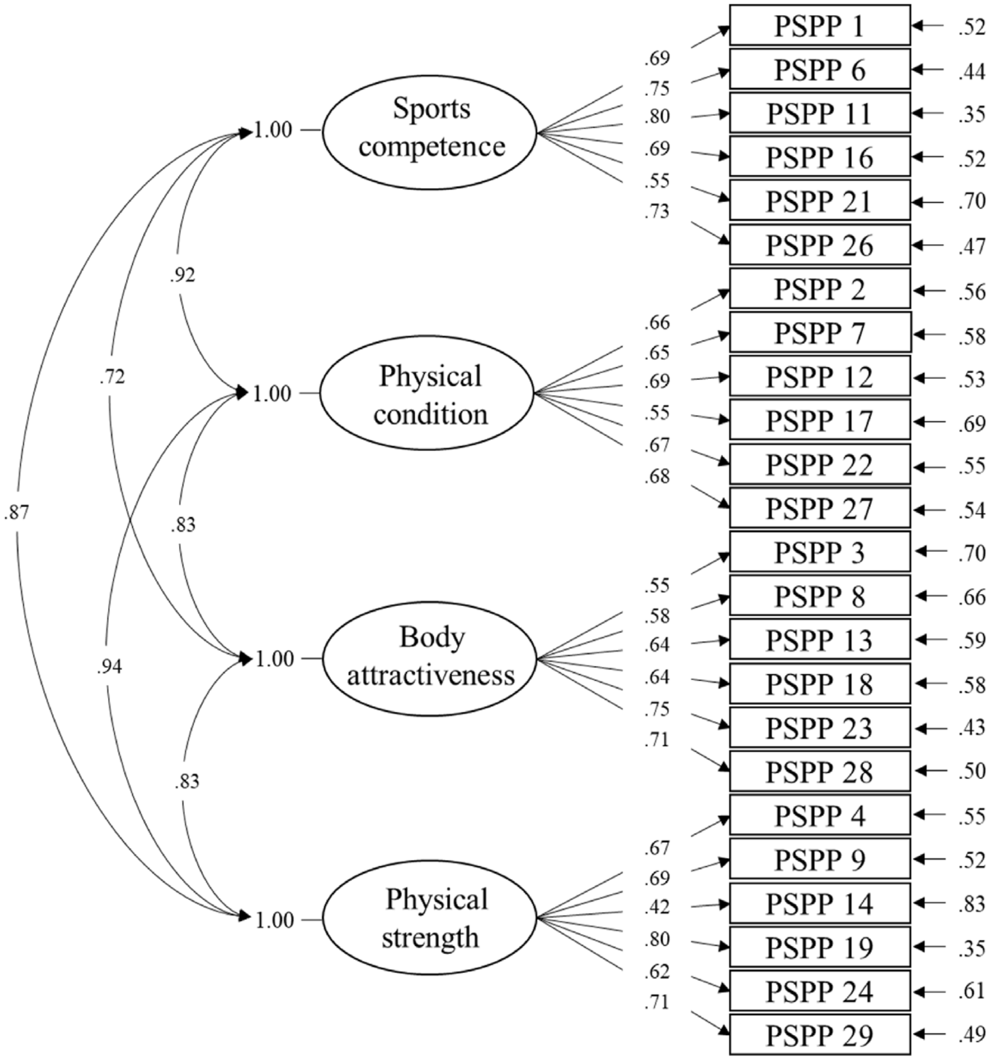

Figure 1. Confirmatory factor analysis model for structural validity of the Physical Self-Perception Profile scale.

Table 3 *Concurrent Validity of PSPP Subscales and Global Self-Esteem (n = 292).*

	Global self-esteem	Physical self-worth	Sport competence	Physical condition	Body attractiveness
Physical self-worth	.58 *p* < .001				
Sport competence	.23 *p* < .001	.47 *p* < .001			
Physical condition	.36 *p* < .001	.61 *p* < .001	.72 *p* < .001		
Body attractiveness	.45 *p* < .001	.65 *p* < .001	.56 *p* < .001	.63 *p* < .001	
Physical strength	.35 *p* < .001	.57 *p* < .001	.67 *p* < .001	.70 *p* < .001	.62 *p* < .001

Note. Pearson correlation coefficients; PSPP = Physical Self-Perception Profile.

evaluate the effect of physical activity intervention on the levels of physical self-esteem in BCSs. It also provides a vehicle for understanding the mechanism and the influence of physical self-perceptions on global self-esteem. Furthermore, healthcare providers are better equipped to design physical activity interventions to optimize physical self-perceptions and influence BCSs' beliefs regarding benefits of maintaining regular physical activity. By improving self-perceptions in the physical domain, motivation to participate is likely to increase.

The content validity values were high at both the scale and item levels, indicating sufficient content validity. The PSPP was derived based on the Exercise and Self-Esteem Model, where global self-esteem is related to physical self-worth at the domain level, which in turn is related to its four subdomains [13,15]. The results of

Table 4 *Internal Consistency and Test–Retest Reliability for PSPP Scale.*

Items	Cronbach's α[a]	Intraclass correlation coefficient[b]
Sport competence	.80	.77
Physical condition	.77	.81
Body attractiveness	.76	.78
Physical strength	.77	.80
Physical self-worth	.64	.81

Note. PSPP = Physical Self-Perception Profile.

[a] $n = 292$.

[b] $n = 70$.

the CFA supported the structure of the four subdomains with consistency with the original English version. The PSPP had only been used in the BCS population in Musanti's study [19] in the United States. Our study findings further support that the four subdomain's conceptualization and structure were pertinent to measuring physical self-esteem among BCSs in Hong Kong, China.

The hierarchical structure of the PSPP was also demonstrated in the Cantonese version. The physical self-worth was at the intermediary level, serving as a link between global self-esteem and the four subdomains. This hierarchical structure is significant because it suggests that even the whole instrument could not be administered, the 6-item physical self-worth would provide a summary measure of perceptions in the physical domain.

Additionally, the Cronbach's α of the scale ranged from .64 to .80, and no item deletion resulted a change greater than .10 in Cronbach's α. All ICCs exceeded .75, indicating good test–retest reliability. These results from all the reliability analyses demonstrate that the scale is reliable.

Our participants showed similar PSPP scores to BCSs in the United States [19] and lower PSPP scores than female college students in Mainland China [36]. This suggests that there is room for improvement in the physical self-esteem level of BCSs in Hong Kong, SAR of China. Our participants revealed a mean age of 53 years, with close to half receiving hormone therapy and over 30% ($n = 99$) suffering from other long-term illnesses. These factors may limit the BCSs' perception of and confidence in their ability to engage in athletic activities. This especially matters as BCSs may experience changes in physical appearance, affecting perceived attractiveness and perceptions of and satisfaction with their physical selves.

The findings of this study not only expand the generalizability of the PSPP and contribute to the expansion of its use but also facilitate cross-cultural comparisons. Moreover, these results are expected to benefit other researchers, nurses, and other health professionals in Hong Kong, SAR of China and around the world who serve Cantonese-speaking populations. The methods used in the translation may also provide guidance for translations for other populations.

Limitations

There are certain limitations that need to be accounted for when interpreting the results of our study. First, this study enrolled a convenience sample from community-dwelling BCSs, which limited the generalization of the findings. Second, there were no specific restrictions on the duration of time the adjuvant therapy was completed. Despite the limitations, we provided preliminary evidence of the validity and reliability of the Cantonese version of the PSPP scale in BCSs in Hong Kong, China. It is recommended to further investigate the psychometric properties of the Cantonese version of the PSPP among other cancer survivors or adults with other chronic illnesses.

Conclusion

The physical changes experienced by BCSs due to the disease and treatment have highlighted the importance of examining physical self-esteem of this population. The study examined the internal consistency, test–retest reliability, structural validity, content validity, and concurrent validity of the Cantonese version of the PSPP, demonstrating its favorable psychometric properties to measure physical self-esteem among BCSs in Hong Kong, China. Our study confirmed the structure of one dimension and four subdimensions of the PSPP. Overall, by establishing a concise, easily understandable, valid, and reliable tool to assess physical self-esteem, our study contributes to future design of exercise interventions tailored to motivate BCSs to begin and maintain routine exercise.

Ethics approval statement

Ethical approval was obtained from the Survey and Behavioral Research Ethics Committee of the university (No. SBRE-22-0265). Written consent was obtained from the participants before data collection.

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Authors' contribution

Conceptualization: SYC, AWKC, and TL; Methodology: SYC, AWKC, KCC, TL, RTG and KRF; Validation: TL; Formal analysis: KCC, and RTG; Investigation: AWKC; Writing—original draft preparation: SYC and RTG; Writing—review and editing: SYC, AWKC, KCC, TL, WKWS, RTG and KRF; Supervision: AWKC and SYC; Project administration: AWKC and SYC. All authors have read and agreed to the published version of the manuscript.

Data availability statement

The data presented in this study are available on request from the corresponding author.

Conflict of interest

None.

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Appendix A. Supplementary data

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Review Article

Efficacy of Mind-body Exercise to Reduce Sleep Disturbance and Depression Among Older Adults: A Systematic Review and Meta-analysis

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SUMMARY

Purpose: Mind-body exercise is a promising non-pharmacological approach for managing sleep disturbance and depression that are prevalent among older adults, but its efficacy remains inconclusive across the studies. This study aimed to systematically evaluate and quantify the overall effectiveness of mind-body exercises on sleep disturbance and depression in older adults.
Methods: We searched eight databases to identify relevant articles from their inception to April 2024. Experimental studies that evaluate the effects of mind-body movement therapy on sleep disturbance and depression in older adults were included. The Cochrane Risk of Bias tool version 2.0 was used to appraise included studies. The pairwise meta-analysis was performed through the software Comprehensive Meta-Analysis Version 3.0. Moreover, subgroup analysis was utilized to understand the effect size on each form of mind-body exercise and to determine the source of heterogeneity.
Results: A total of 27 studies were eligible and synthesized. The mind-body exercise appears statistically significant in reducing sleep disturbance (SMD = −0.60, 95% CI: 0.76 ~ 0.44) and depression (SMD = −0.56, 95% CI: 0.75 ~ 0.36) among older adults. Each form of mind-body exercise, including pilates, yoga, qigong, and tai-chi, effectively decreases sleep disturbance and depression, but there were no significant differences in the effects between these practices.
Conclusion: The cumulative evidence concludes that older adults who participated in mind-body exercise programs showed potential improvements in sleep disturbance and depression. This finding may serve as evidence for professionals to use this approach as a non-pharmacological approach to help older adults in the community and long-term care facilities who are having sleep disturbance and depression. More clinical trials are needed for an in-depth meta-analysis that can rank and compare the efficacy of each mind-body exercise practice.

Introduction

Older adults are currently the fastest-growing segment of the population, while at the same time, the prevalence of mental illness in older adults is increasing [1,2]. Sleep disturbance and depression are the predominant mental disorders reported by older adults worldwide [3]. Daytime drowsiness, sleep fragmentation, and insomnia are examples of sleep disturbances that are estimated to affect 35% of the general population [4]. However, the prevalence of sleep disturbances is much higher in older adults, which accounts for 50% of this sub-population [5]. According to the findings of previous studies, sleep disturbances in older adults are linked to an increased likelihood of unfavorable outcomes, such as accidents, falls, deteriorating health, and even mortality [6,7]. Depression, on the other hand, is another prevalent mental health problem that affects older adults; between 3.8 and 15% of them reported suffering symptoms of depression. Moreover, previous research conducted on older adults suggests that depression is linked to several negative outcomes, including a lack of social skills [8], an increased number of disabilities, a decline in physical functioning, and greater perceptions of poor health status [9,10].

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The present approach to addressing sleep disturbance and depression among older adults primarily centers around pharmaceutical intervention. Nevertheless, drugs may carry the risk of adverse effects that may exacerbate physical and psychological health issues, including the deterioration of emotional states and a decline in psychomotor and cognitive functioning [11,12]. Exercise is well-known for tackling these problems [13], and its alternative forms, such as mind-body exercise (MBE), may provide a potential strategy. MBE is a form of exercise encompassing activities integrating physical movement, mental concentration, and regulated breathing techniques to enhance strength, balance, flexibility, and overall well-being [14]. This therapeutic approach is particularly beneficial within holistic health practices as it addresses the interconnectedness of mind and body, which is crucial for fostering comprehensive well-being [15]. Some common MBE examples are yoga, pilates, Tai Chi, and Qigong. These modalities of physical activity are appropriate for older persons since they have low impact, low muscle demands, and require less energy consumption [16], MBE encompasses a range of motions, including skeletal muscle stretching and relaxation, body coordination, heightened concentration, regular breathing patterns, and breathing techniques [17,18]. These activities not only help mitigate physical ailments but also enhance mental health [16], thereby supporting older adults' overall quality of life [19]. Promoting MBE thus aligns with holistic health principles, advocating for preventive and integrative strategies to manage and improve health among older adults [15].

Building upon this holistic foundation, several forms of MBE, including yoga, pilates, Tai Chi, and Qigong, not only target physical and mental integration but also engage key neurobiological mechanisms that support mental health and sleep regulation [20–23]. For instance, yoga practices induce Serotonin (5-HT) regulation in the hippocampus [24], which potentially influences mood (antidepressant effect) and aids sleep-wake cycle regulation. On the other hand, the Brain-Derived Neurotrophic Factor (BDNF) that is released during the MBE activity, supports neuronal growth and adaptation, contributes to mental well-being [21–23,25], and potentially influences sleep quality [26]. Thus, promoting MBE as a modality for the management of sleep disturbance and depression is deemed suitable for older adults.

Several clinical trials conducted among older adults have shown positive findings regarding the effectiveness of MBE for managing sleep disturbance [19,27,28], and depression [29–31]. However, some trials found opposing results regarding the effectiveness of MBE [32–34], which led to inconclusive evidence. In order to provide robust evidence to clinical practice, a review and meta-analysis of the current body of knowledge regarding the effect of MBE on sleep disturbance and depression is definitely needed. Therefore, the present review aimed to systematically evaluate and quantify the overall effectiveness of MBEs on sleep disturbance and depression in older adults.

Methods

This review was reported under the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines [35]. This systematic review and meta-analysis protocol was prospectively registered and approved by the PROSPERO (registration number: CRD42023476741).

Eligibility criteria

The articles that were included had to meet certain criteria based on the population, intervention, comparison, outcome, and study design (PICOS framework) [36].

Population

This review included older adults aged 60 years old or older living in the community or any type of long-term care facility.

Intervention

This review included studies that implemented MBEs such as tai chi, yoga, qigong, and Pilates, either as standalone or combined practices. Yoga is a holistic practice combining physical poses, breathing techniques, meditation, and mindfulness to enhance physical flexibility, strength, and balance while promoting mental clarity and emotional stability [37]. Tai chi was characterized by fluid, dance-like movements involving ongoing body and trunk rotations, hip and knee flexion and extension, and coordinated arm movements, all unified by mental focus and controlled breathing [38]. Qigong is a traditional Chinese MBE incorporating blended physical postures, breathing techniques, and focused intention, featuring symmetrical postures and mindful movements based on traditional Chinese medicine principles [39,40]. Pilates emphasizes core stability, strength, and flexibility with meticulous attention to muscle control, posture, and breathing, following principles such as centering, concentration, control, precision, flow, and breath. These exercises could involve specialized equipment or be performed on a mat using body weight. [41]. Studies that were not a kind of MBE, such as art therapy, meditation, mindfulness-based stress reduction, mindfulness-based cognition, coping, music relaxation, spirituality, and religion, were excluded from this study. Studies with complex/multiple interventions (a combination of more than 2 types of non-MBE intervention) that positioned MBE as a complementary intervention were excluded from this study.

Comparison

The control groups were administered either usual care or non-exercise interventions.

Outcomes

Studies that focused on sleep disturbance and depression as their research outcomes were measured using psychometrically validated outcome instruments.

Study design

Intervention studies were included when designed as either randomized controlled trials or experimental studies. Exclusion criteria included studies published only as abstracts, monographs, theses, conference papers, case reports, protocols, pilot/preliminary studies, and review articles. Additionally, studies not published in English or in peer-reviewed journals were not considered for inclusion.

Information sources

Published articles were retrieved from eight databases, including MEDLINE, Embase, Cochrane Trials, CINAHL, Web of Science, AgeLine, SPORTDiscus, and APA PsycTests. They were searched from their inception to April 2024. Moreover, reference lists of retrieved articles were also searched to identify additional potential studies.

Search strategy

The search terms were controlled by title, abstract, keywords, MeSH, and vocabulary terms, including terms that were equivalent to “older adults,” “mind-body exercise,” “tai-chi,” “yoga,” “qi-gong,” “pilates,” “sleep disturbance,” “depression,” experimental,” and “randomized controlled trial”. These terms were also put together with Boolean operators (“AND,” “OR”). More information about the database search strategy used in this work is included in Appendix 1.

Selection process

A reference management tool was utilized to import all retrieved studies to manage and eliminate duplicate studies. Subsequently, two independent reviewers assessed the remaining research to determine their suitability. In cases where the two reviewers could not reach a consensus, a third reviewer was requested. Lastly, eligibility was determined by screening and evaluating the full text.

Data collection process

Two reviewers independently extracted the characteristics of the studies, including the author, publication year, country, design, population, interventions/comparators, outcomes, measuring tools, and findings from all included studies. Disagreements between the two reviewers and any additional data identified after the initial extraction were resolved through meetings involving all review team members.

Study risk of bias assessment

Using Version 2 of the Cochrane Risk of Bias (ROB-2) tool for randomized trials, two reviewers independently evaluated the quality of each study included in this review. This was done to evaluate the quality of the methodology. The domains in the study included the randomization method, deviations from the intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result [42]. During the procedure, any discrepancies that occurred were handled through consensus between the two reviewers under the supervision of the third author. Additionally, the certainty of evidence of each outcome was graded using the system developed by the GRADE collaboration. This approach has five domains: risk of bias, imprecision, consistency, indirectness, and publication bias. The level of evidence was divided into four categories: extremely low, low, moderate, and high [43].

Effect measures

The data obtained from each study were converted into a predetermined effect size using the equation employed by the Campbell Collaboration [44]. This is done with an equation that looks at the mean gain scores, the standard deviation (*SD*) between the results before and after the intervention, and the correlation coefficient (r) between the results before and after the intervention. It was decided to use a conservative estimate ($r = .5$) since most studies did not give the r values between the scores before and after the intervention [45]. The standardized mean difference (SMD) was utilized in order to calculate the magnitude of the effect that each research outcome had on a metric scale that was relatively comparable.

Statistical analysis

Version 3.0 of Comprehensive Meta-Analysis software (Biostat, Englewood, New Jersey, United States) was utilized to compute the pooled effect size with the confidence interval (95% CI) and generate the forest plot. Heterogeneity was evaluated using Cochran's Q and the I-squared (I^2) statistic. Substantial heterogeneity was identified when the p-value <.100 and an I^2 value exceeding 75% [46], which suggests the utilization of a random-effect model [47]. However, the sampling frame between the studies pooled together was also used to decide whether to adopt a random-effects model or a fixed-effect model, and a random-effects model was used if the sampling frames were distinct from each other as a conservative approach [47].

Low, moderate, and high heterogeneity in meta-analyses refers to the degree of variation or inconsistency in the results of the included studies. Low heterogeneity indicates that the study results are relatively similar and consistent, suggesting that the intervention has a similar effect across different studies. Moderate heterogeneity indicates some variability among the study results, which may be due to differences in study populations, interventions, outcomes, or methodologies, but it is not substantial. High heterogeneity indicates considerable variability among the study results, possibly due to significant differences in study populations, interventions, outcomes, or methodologies. An I^2 value of 25% or lower is considered low heterogeneity, between 25% and 50% is considered moderate heterogeneity, and 75% or higher indicates high heterogeneity [46].

Subgroup analysis was performed to understand the effect size on each form of MBE and explore whether the variety of MBE's form was the source of heterogeneity in this study. Publication bias was assessed visually through inspection of funnel plot asymmetry and statistically using Egger's regression test. A small-study effect was identified if the p-value was less than .05, indicating asymmetry in the funnel plot. This generally suggests that smaller studies deviate from the effect sizes estimated by larger, more precise studies [48]. When publication bias was present, the trim and fill method was used to estimate the number of missing studies and impute their effect to create a simulated symmetrical funnel plot [49]. Additionally, sensitivity analysis was carried out using the remove-one study method to assess the stability of the effect size magnitude [50].

Results

Identification of studies and study selection

Initially, 15,530 records were identified from the eight databases. After removing 5790 duplicates, 9740 records remained and were subsequently screened for titles and abstracts. However, 9700 were deemed unsuitable due to their disagreement with the PICOS criteria, even after deleting duplicates. This left 40 studies that underwent full-text screening. Among these, thirteen studies were deemed ineligible for inclusion in the review because nine did not match the study design, and four did not provide adequate data. Finally, a total of 27 studies were considered for inclusion in the meta-analysis (Figure 1).

Study characteristics

Among the twenty-seven studies (Table 1), five were conducted in Taiwan [51–55], five studies from Hong Kong [31,32,56–58], five were conducted in China [19,30,59–61], three studies from Iran [27,62,63], two studies from Spain [33,64], two studies from the USA [65,66], and one each in South Korea [34], Lithuania [29], India [28], Malaysia [67], and Brazil [68]. The publication dates of these investigations span from 2003 to 2024. The sample size of 30 participants was the smallest [29], while 456 was the largest [54]. In the twenty-seven studies, 2701 older adults were analyzed in total. Among the participants, 1376 were assigned to the control group and 1325 to the intervention group. In the intervention group, the participants' mean ages varied between 64.25 and 82.11 years, while in the control group, they spanned 63.75 to 82.74 years.

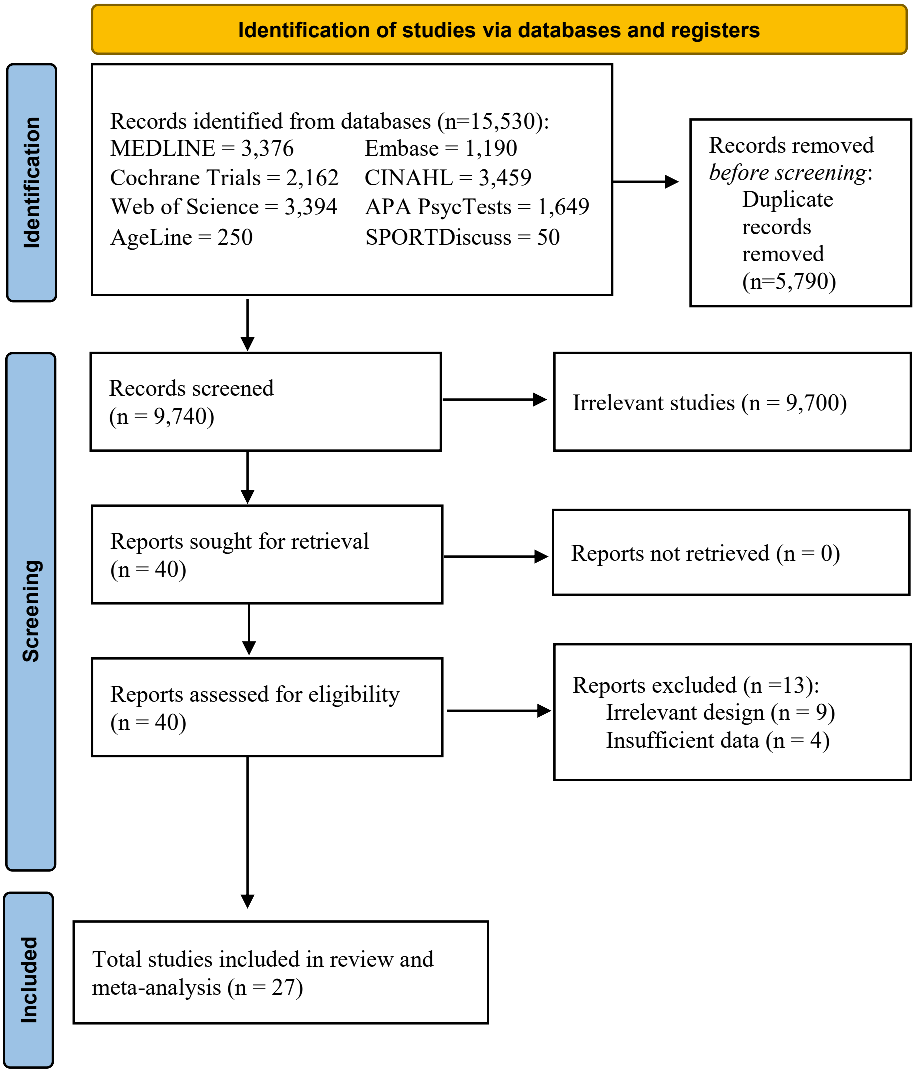


Figure 1. PRISMA flow chart.

The trials included older adults with a variety of characteristics, such as being healthy, frail, or having a chronic illness. There have been no reports of adverse effects associated with the intervention in any of the included studies. The investigations were conducted in a variety of settings, including long-term care facilities such as nursing homes, daycare, geriatric centers, community centers, and social assistance organizations. Among the 27 studies, 12 studies provided Tai chi [27,29,30,32,53,54,56,60,61,65–67], eight studies administered Qi-gong [19,31,52,55,57–59,64], four studies performed yoga [28,34,51,63], and three studies provided pilates [33,62,68]. According to the study results, each session lasted between 30 and 90 minutes on average. The MBE is typically conducted one to five times each week. MBE has an average program duration of roughly 16 weeks. Table 1 shows the detailed features of the included studies.

Methodological quality of the reviewed study

The ROB-2 tool was used to check for bias in the included randomized controlled studies (RCTs). Figure 2 shows a summary of the bias risk for each area, both for each study individually and for all the studies that were part of the analysis as a whole. Out of the 27 studies, more than half demonstrated some concerns regarding bias, with one being identified as being at a high risk.

Efficacy of mind-body exercise on sleep disturbance

Twelve studies involving 1158 older adults examined the effects of MBE on sleep disturbance measured by the Pittsburgh Sleep Quality Index (PSQI). Under the random-effects model, the forest plot demonstrated the pooled SMD was −0.60 (95% CI: −0.76 ~0.44; $p < .001$), with low heterogeneity ($Q = 18.23$; $p = .08$; $I^2 = 39.6\%$) (Figure 3). Moreover, a moderate level of certainty was noted for the evidence of sleep disturbance (Appendix 2). Overall, these results suggest that MBE statistically significantly had a greater reduction in sleep disturbance compared with routine care.

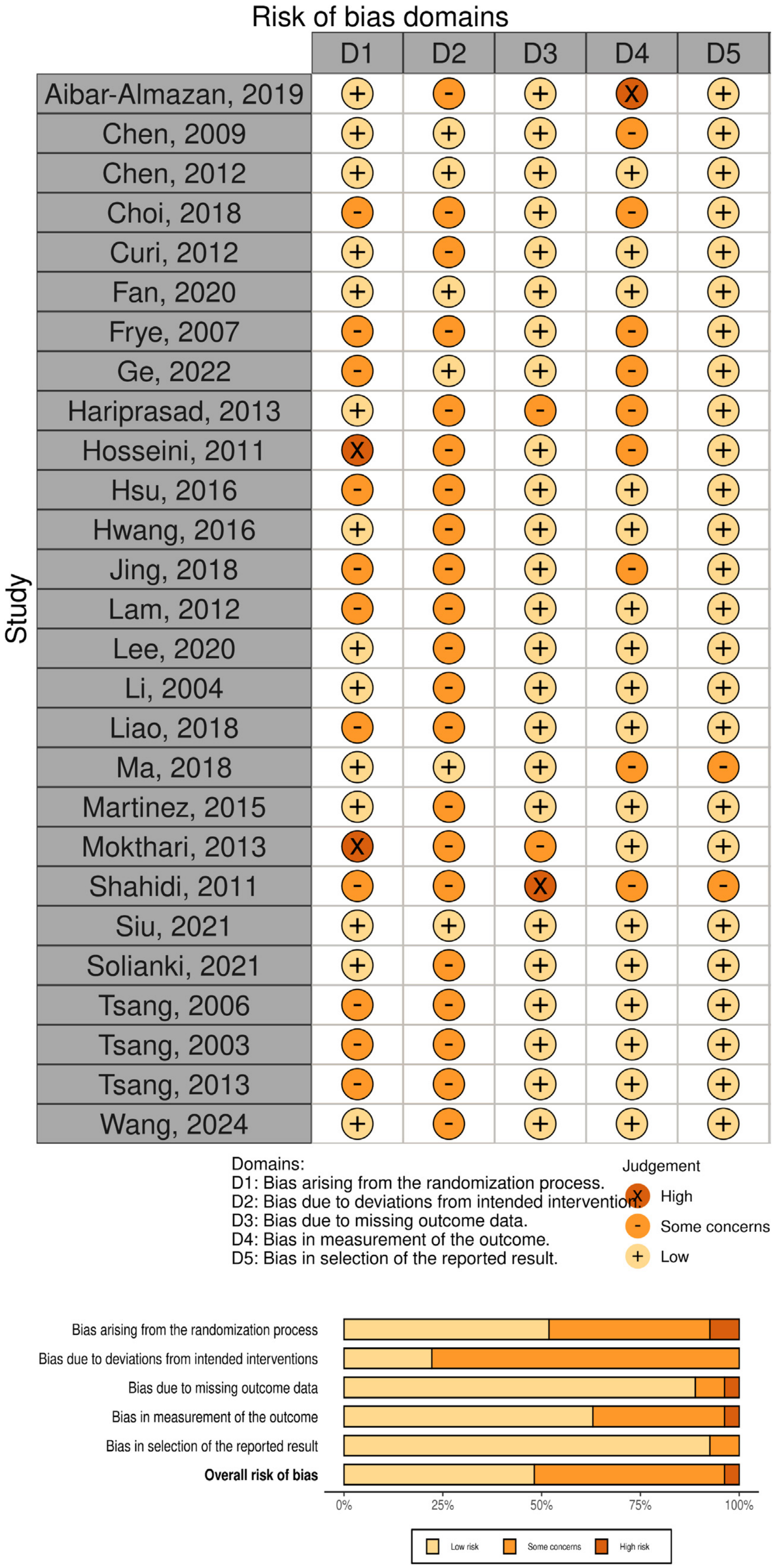
Subgroup analysis showed that the pooled effect size did not vary by type of MBE ($Q = 1.72$; $p = .630$). However, subgroup analysis also showed that four types of MBE modalities had a statistically significant effect on reducing sleep disturbance. Interventions delivered through qigong had the highest effect size (SMD = −0.79; 95% CI: −1.08 ~ −0.49; $p < .001$), followed by tai chi (SMD = −0.64; 95% CI: −0.83 ~ −0.45; $p < .001$), yoga

Table 1 *Characteristics of Included Studies.*

Author, year; country	Study design; population; setting	Number of participants (mean age ± SD)	Experimental group (EG: mind-body exercise)		Control group (CG)	Outcomes	Tools	Findings
			Modalities	Frequency/duration				
Fan et al., 2020 [19]; China	RCT; community-dwelling older adults with sleep disturbance; community	EG = 67 (70.30 ± 5.70) CG = 72 (71.80 ± 6.70)	Qigong	45 min/time, 5 times/wk, for 24 wk	Maintained original lifestyle	Sleep disturbance	PSQI	Sleep disturbance was significantly improved in EG.
Hosseini et al., 2011 [27]; Iran	RCT; poor sleep quality older adults (PSQI $\geq$ 5); elderly homes	EG = 27 (68.74 ± 5.48) CG = 29 (69.42 ± 5.34)	Tai chi 10-stage tai chi	30 min/time, 3 times/wk, for 12 wk	Maintained normal daily activities	Sleep disturbance	PSQI	Sleep disturbance was significantly improved in EG.
Hariprasad et al., 2013 [28]; India	RCT; older adults in elderly homes; elderly homes	EG = 62 (75.74 ± 6.46) CG = 58 (74.78 ± 7.35)	Yoga	60 min/time, daily for 4 wk	Waitlist	Sleep disturbance	PSQI	Sleep disturbance was significantly improved in EG.
Solianik et al., 2021 [29]; Lithuania	RCT, older adults with inactive physical activity; community	EG = 15 CG = 15 Total mean age = 67.00 ± 5.90	Tai chi 8-form of Yang style	60 min/time, 2 times/wk, for 10 wk	Maintained their daily routines	Depression	HADS	Depression was not reduced in EG.
Ge et al., 2022 [30]; China	RCT; pre-frail older adults; senior communities	EG = 32 (70.16 ± 5.40) CG = 33 (72.91 ± 6.61)	Tai chi 24-form of Yang style	60 min/time, 3 times/wk, for 2 wk	Maintained normal daily activities	Depression	GDS	Depression was significantly reduced in EG.
Tsang et al., 2013 [31]; Hong Kong	RCT; depressed elders with chronic illness; day care centers and care and attention homes	EG = 21 (80.00 ± 7.00) CG = 17 (81.00 ± 8.00)	Qigong (36 sessions)	45 min/time, 3 times/wk, for 12 wk	Participated in newspaper reading group; 45 min/time, 3 times/wk, for 12 wk	Depression	GDS	Depression was significantly reduced in EG.
Siu et al., 2021 [32]; Hong Kong	RCT; older adults with chronic insomnia;	EG = 105 (66.50 ± 6.40) CG = 110 (68.00 ± 8.20)	Tai chi 24-form of Yang style	60 min/time, 1 time/wk, for 12 wk	Maintained normal daily activities	Sleep disturbance	PSQI	Sleep disturbance was insignificantly improved in EG.
Aibar-Almazan et al., 2019 [33]; Spain	RCT; women older adults; community	EG = 55 (69.98 ± 7.83) CG = 52 (66.79 ± 10.14)	Pilates	60 min/time, 2 times/wk, for 12 wk	Maintain daily activities	Sleep disturbance, depression	PSQI; HADS	Sleep disturbance and depression were significantly improved in EG.
Choi et al., 2018 [34]; South Korea	RCT; older adults aged $\geq$65; senior community centers	EG = 33 (77.60 ± 5.69) CG = 30 (78.80 ± 5.83)	Yoga (Sitting yoga program)	30–40 min/time, 4 times/wk, for 12 wk	Continued usual care without any exercises	Sleep disturbance, depression	PSQI; GDS	Depression was significantly reduced in EG. No significant on sleep disturbance.
Chen et al., 2009 [51]; Taiwan	RCT; older adults aged $\geq$60; senior activity centers	EG = 62 CG = 66 Total mean age = 69.20 ± 6.23	Yoga (Hatha yoga)	70 min/time, 3 times/wk, for 24 wk	Maintained regular activities	Sleep disturbance, depression	PSQI; depression state	Sleep disturbance and depression were significantly improved in EG.
Chen, 2012 [52]; Taiwan	RCT; older adults with independent self-care; community	EG = 27 (70.48 ± 7.90) CG = 28 (72.96 ± 8.30.)	Qigong	30 min/time, 3 times/wk, for 12 wk	Maintain daily activities	Sleep disturbance	PSQI	Sleep disturbance was significantly improved in EG.
Hsu et al., 2016 [53]; Taiwan	RCT; Long-term care residents; long-term care facilities	EG = 30 (80.73 ± 9.68) CG = 30 (81.77 ± 6.32)	Tai chi (12-movement of seat simplified tai chi)	40 min/time, 3 times/wk, for 26 wk	Received usual standard care	Depression	GDS	Depression was significantly reduced in EG.
Hwang et al., 2016 [54]; Taiwan	RCT; older adults with fall-related; community	EG = 228 (72.00 ± 8.10) CG = 228 (72.70 ± 8.10)	Tai chi 18-movement Yang style	60 min/time, 1 time/wk, for 24 wk	Lower extremity training 60 min/time, 1 time/wk, for 24 wk	Depression	GDS	Depression was significantly reduced in EG.
Lee et al., 2020 [55]; Taiwan	RCT; older adults with depressive symptoms and chronic physical illness; nursing homes	EG = 14, NA CG = 16, NA	Qigong 8-section brocades qigong	2 times/wk, for 12 wk	Cognitive training; 2 times/wk, for 12 wk	Depression	PHQ	Depression was significantly reduced in EG.
Lam et al., 2012 [56]; Hong Kong	RCT; older adults with risk of cognitive decline; community centers and residential homes	EG = 92 (77.20 ± 6.30) CG = 169 (78.30 ± 6.60)	Tai chi 4-form simplified Tai Chi	30 min/time, 3 times/wk, for 48 wk	Trained with stretching and toning exercise	Depression	Cornell depression score	Depression was not reduced in EG.

Tsang et al., 2006 [57]; Hong Kong	RCT; Elderly with depression; non-government care and attention homes	EG = 48 (82.11 ± 7.19) CG = 34 (82.74 ± 6.83)	Qigong	30 to 45 min/time, 3 times/wk, for 16 wk	Participated in newspaper reading group; 30–45 min/time, 3 times/wk, for 16 wk	Depression	GDS	Depression was significantly reduced in EG.
Tsang et al., 2003 [58]; Hong Kong	RCT; elderly with chronic physical illnesses; geriatric care of hospital and elderly home	EG = 24 (72.93 ± 9.53) CG = 26 (76.27 ± 8.40)	Qigong	30 min/time, daily for 12 wk	Basic rehabilitation activities	Depression	GDS	Depression was not reduced in EG.
Jing et al., 2018 [59]; China	RCT; housebound older adults; homes	EG = 39 (75.25 ± 6.82) CG = 40 (75.08 ± 5.26)	Qigong	60 to 90 min/time, 1–2 times/month, for 24 wk	Cognitive-behavior therapy	Depression	GDS	Depression was not reduced in EG.
Ma et al., 2018 [60]; China	RCT; Older adults with hypertension; Community	EG = 79 (70.24 ± 10.25) CG = 79 (69.71 ± 10.84)	Taichi 24-form of simplified tai chi	90 min/time, 2 times/wk, for 24 wk	Usual care of hypertension from community health care	Depression	CES-D	Depression was significantly reduced in EG.
Wang et al., 2024 [61]; China	RCT; community-dwelling older adults; community	EG = 30 (66.00 ± 4.97) CG = 25 (69.10 ± 4.56)	Taichi 24-pattern of simplified tai chi	60 min/time, 3 times/wk, for 8 wk	Maintained normal daily activities and engaged in online health lectures once every two wk	Sleep disturbance	PSQI	Sleep disturbance was significantly lower in EG.
Mokthari et al., 2013 [62]; Iran	Two groups experimental study; elderly women; community rehabilitation center	EG = 15, NA CG = 15, NA	Pilates	60 min/time, 3 times/wk, for 12 wk	Maintained their daily activities	Depression	GDS	Depression was reduced in EG.
Shahidi et al., 2011 [63]; Iran	RCT; depressed older women; community	EG = 20 (65.50 ± 4.80) CG = 20 (68.40 ± 6.30)	Yoga (laughter yoga)	10 sessions, NA	Maintained normal daily activities	Depression	GDS	Depression was significantly reduced in EG.
Martinez et al., 2015 [64]; Spain	RCT; Older adults with preserved mobility and cognitive intact; geriatric care of hospital	EG = 29 (76.10 ± 8.10) CG = 25 (72.50 ± 8.00)	Qigong	90 min/time, 2 times/wk, for 4 wk	Usual care	Depression	GDS	Depression was not reduced in EG.
Frye et al., 2007 [65]; USA	RCT; community-dwelling; community	EG = 23 CG = 21 Total mean age = 69.20 ± 9.26	Tai chi 10-posture of Yang style	60 min/time, 3 times/wk, for 12 wk	Continuous usual exercise	Sleep disturbance, depression	PSQI; CES-D	Sleep disturbance was significantly improved in EG. Depression was insignificantly improved in EG.
Li et al., 2004 [66]; USA	RCT; community-dwelling with moderate sleep complaints; community	EG = 62 (75.30 ± 7.80) CG = 56 (75.45 ± 7.80)	Taichi 8-form easy tai chi of a simplified Yang style	60 min/time, 3 times/wk, for 24 wk	Low-impact exercise; 60 min/time, 3 times/wk, for 24 wk	Sleep disturbance	PSQI	Sleep disturbance was significantly improved in EG.
Liao et al., 2018 [67]; Malaysia	RCT; older adults with depressive symptoms; community	EG = 55 (71.84 ± 7.30) CG = 52 (71.75 ± 8.20)	Tai chi 24-movement of Yang style	50 min/time, 3 times/wk, for 12 wk	Received routine health education	Depression	GDS	Depression was significantly reduced in EG.
Curi et al., 2018 [68]; Brazil	RCT; elderly women; community	EG = 31 (64.25 ± 0.14) CG = 30 (63.75 ± 0.08)	Pilates	60 min/time, 2 times/wk, for 16 wk	Maintained normal daily activities	Sleep disturbance, depression	PSQI; GHQ-12	Sleep disturbance was significantly improved in EG. Depression was significantly improved in EG.

Note: CES-D = center for epidemiologic studies depression scale; GDS = geriatric depression scale; GHQ-12 = general health questionnaire-12 items; HADS = hospital anxiety and depression scale; NA = not applicable; PSQI = Pittsburgh Sleep Quality Index; PHQ = patient health questionnaire; RCT = randomized controlled trial.

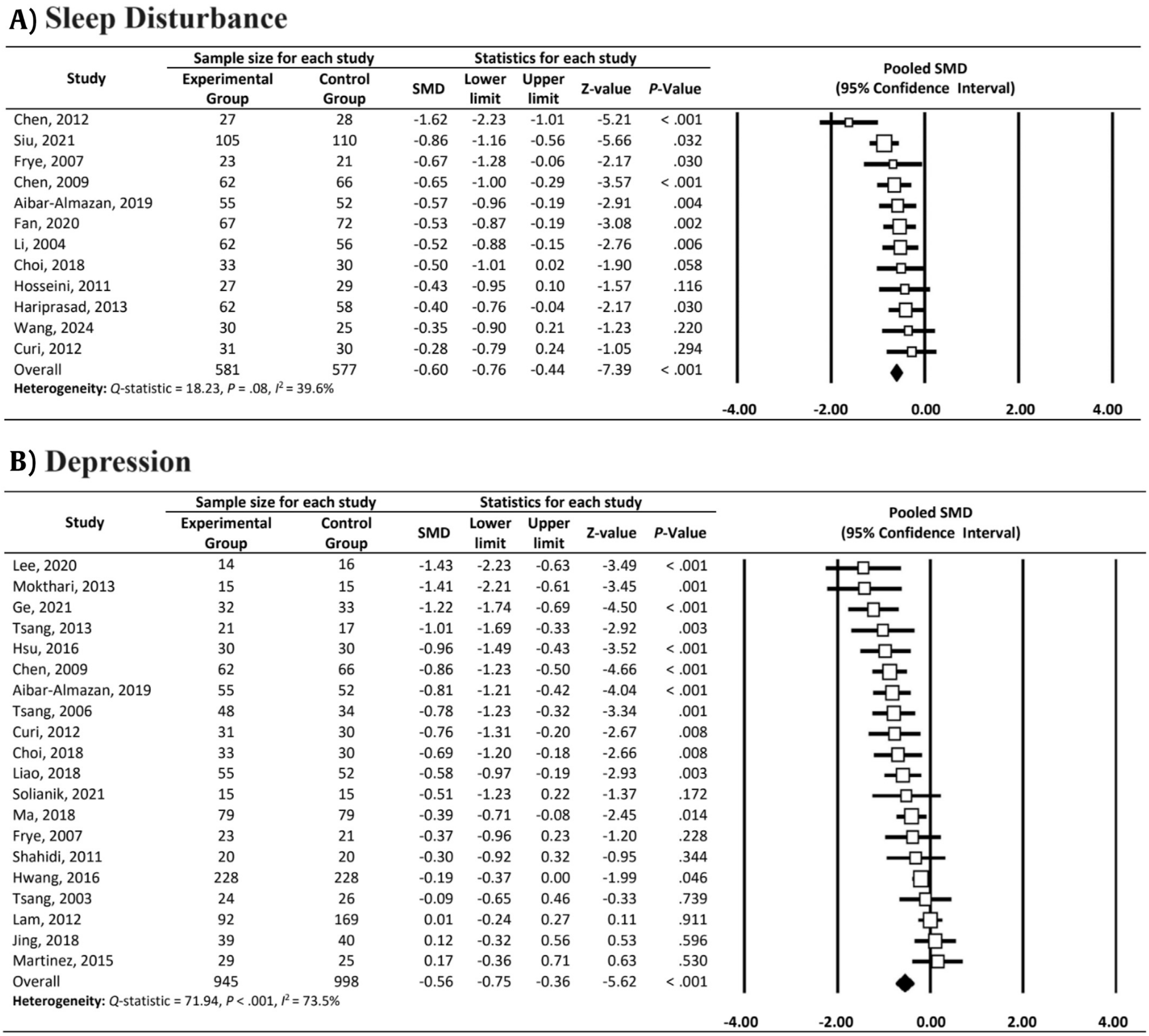


Study	D1	D2	D3	D4	D5
Aibar-Almazan, 2019	+	-	+	X	+
Chen, 2009	+	+	+	-	+
Chen, 2012	+	+	+	+	+
Choi, 2018	-	-	+	-	+
Curi, 2012	+	-	+	+	+
Fan, 2020	+	+	+	+	+
Frye, 2007	-	-	+	-	+
Ge, 2022	-	+	+	-	+
Hariprasad, 2013	+	-	-	-	+
Hosseini, 2011	X	-	+	-	+
Hsu, 2016	-	-	+	+	+
Hwang, 2016	+	-	+	+	+
Jing, 2018	-	-	+	-	+
Lam, 2012	-	-	+	+	+
Lee, 2020	+	-	+	+	+
Li, 2004	+	-	+	+	+
Liao, 2018	-	-	+	+	+
Ma, 2018	+	+	+	-	-
Martinez, 2015	+	-	+	+	+
Mokthari, 2013	X	-	-	+	+
Shahidi, 2011	-	-	X	-	-
Siu, 2021	+	+	+	+	+
Solianki, 2021	+	-	+	+	+
Tsang, 2006	-	-	+	+	+
Tsang, 2003	-	-	+	+	+
Tsang, 2013	-	-	+	+	+
Wang, 2024	+	-	+	+	+

Domains:
D1: Bias arising from the randomization process.
D2: Bias due to deviations from intended intervention.
D3: Bias due to missing outcome data.
D4: Bias in measurement of the outcome.
D5: Bias in selection of the reported result.

Judgement
X High
- Some concerns
\+ Low

Figure 2. Methodological quality of included studies.



A) Sleep Disturbance

Study	Sample size for each study: Experimental Group	Sample size for each study: Control Group	Statistics for each study: SMD	Lower limit	Upper limit	Z-value	*P*-Value
Chen, 2012	27	28	-1.62	-2.23	-1.01	-5.21	< .001
Siu, 2021	105	110	-0.86	-1.16	-0.56	-5.66	.032
Frye, 2007	23	21	-0.67	-1.28	-0.06	-2.17	.030
Chen, 2009	62	66	-0.65	-1.00	-0.29	-3.57	< .001
Aibar-Almazan, 2019	55	52	-0.57	-0.96	-0.19	-2.91	.004
Fan, 2020	67	72	-0.53	-0.87	-0.19	-3.08	.002
Li, 2004	62	56	-0.52	-0.88	-0.15	-2.76	.006
Choi, 2018	33	30	-0.50	-1.01	0.02	-1.90	.058
Hosseini, 2011	27	29	-0.43	-0.95	0.10	-1.57	.116
Hariprasad, 2013	62	58	-0.40	-0.76	-0.04	-2.17	.030
Wang, 2024	30	25	-0.35	-0.90	0.21	-1.23	.220
Curi, 2012	31	30	-0.28	-0.79	0.24	-1.05	.294
Overall	581	577	-0.60	-0.76	-0.44	-7.39	< .001

Heterogeneity: *Q*-statistic = 18.23, *P* = .08, I^2 = 39.6%

B) Depression

Study	Sample size for each study: Experimental Group	Sample size for each study: Control Group	Statistics for each study: SMD	Lower limit	Upper limit	Z-value	*P*-Value
Lee, 2020	14	16	-1.43	-2.23	-0.63	-3.49	< .001
Mokthari, 2013	15	15	-1.41	-2.21	-0.61	-3.45	.001
Ge, 2021	32	33	-1.22	-1.74	-0.69	-4.50	< .001
Tsang, 2013	21	17	-1.01	-1.69	-0.33	-2.92	.003
Hsu, 2016	30	30	-0.96	-1.49	-0.43	-3.52	< .001
Chen, 2009	62	66	-0.86	-1.23	-0.50	-4.66	< .001
Aibar-Almazan, 2019	55	52	-0.81	-1.21	-0.42	-4.04	< .001
Tsang, 2006	48	34	-0.78	-1.23	-0.32	-3.34	.001
Curi, 2012	31	30	-0.76	-1.31	-0.20	-2.67	.008
Choi, 2018	33	30	-0.69	-1.20	-0.18	-2.66	.008
Liao, 2018	55	52	-0.58	-0.97	-0.19	-2.93	.003
Solianik, 2021	15	15	-0.51	-1.23	0.22	-1.37	.172
Ma, 2018	79	79	-0.39	-0.71	-0.08	-2.45	.014
Frye, 2007	23	21	-0.37	-0.96	0.23	-1.20	.228
Shahidi, 2011	20	20	-0.30	-0.92	0.32	-0.95	.344
Hwang, 2016	228	228	-0.19	-0.37	0.00	-1.99	.046
Tsang, 2003	24	26	-0.09	-0.65	0.46	-0.33	.739
Lam, 2012	92	169	0.01	-0.24	0.27	0.11	.911
Jing, 2018	39	40	0.12	-0.32	0.56	0.53	.596
Martinez, 2015	29	25	0.17	-0.36	0.71	0.63	.530
Overall	945	998	-0.56	-0.75	-0.36	-5.62	< .001

Heterogeneity: *Q*-statistic = 71.94, *P* < .001, I^2 = 73.5%

Figure 3. Efficacy of mind-body movement therapy on (A) sleep disturbance and (B) depression.

(SMD = −0.52; 95% CI: −0.75 ~ −0.29; *p* < .001), and pilates (SMD = −0.47; 95% CI: −0.78 ~ −0.16; *p* < .001) (Table 2).

Efficacy of mind-body exercise on depression

Twenty studies involving 1943 older adults examined the effects of MBE on depression measured by the Hospital Anxiety and Depression Scale (HADS), Depression State, Geriatric Depression Scale (GDS), Center for Epidemiologic Studies Depression Scale (CES-D), Cornell Depression Score, Patient Health Questionnaire (PHQ), and General Health Questionnaire (GHQ-12). Under the random-effects model, the forest plot demonstrated the pooled SMD was −0.56 (95% CI: −0.75 ~ −0.36; *p* < .001), with high heterogeneity (Q = 71.94; p < .001; I^2 = 73.5%) (Figure 3). Moreover, the certainty of evidence was rated as “low” for depression (Appendix 2). This rating was downgraded due to the inconsistency and publication bias. Overall, these results suggest that MBE statistically significantly had a greater reduction in depression compared with routine care.

Subgroup analysis showed that the pooled effect size did not vary by type of MBE (Q = 4.80; p = .187). However, subgroup analysis also showed that four types of MBE modalities had a statistically significant effect on reducing depression. Interventions delivered through pilates had the highest effect size (SMD = −0.88; 95% CI: −1.18 ~ −0.58; *p* < .001), followed by yoga (SMD = −0.71; 95% CI: −0.98 ~ −0.45; *p* < .001), qigong (SMD = −0.36; 95% CI: −0.58 ~ −0.13; *p* = .002), and tai chi (SMD = −0.31; 95% CI: −0.43 ~ −0.19; *p* < .001) (Table 2).

Table 2 *Subgroup Analyses of Different Types of Mind-body Movement Therapy.*

Outcome	Subgroup	Statistics for each subgroup					
		k	SMD	Lower limit	Upper limit	Z-value	p
Sleep quality	Qigong	2	−0.79	−1.08	−0.49	−5.23	<.001
	Tai Chi	5	−0.64	−0.83	−0.45	−6.63	<.001
	Yoga	3	−0.52	−0.75	−0.29	−4.49	<.001
	Pilates	2	−0.47	−0.78	−0.16	−2.96	<.001
Between subgroup	**Heterogeneity:** Q-statistic = 1.72, p = .630						
Depression	Pilates	3	−0.88	−1.18	−0.58	−5.78	<.001
	Yoga	3	−0.71	−0.98	−0.45	−5.23	<.001
	Qigong	6	−0.36	−0.58	−0.13	−3.15	.002
	Tai Chi	8	−0.31	−0.43	−0.19	−5.21	<.001
Between subgroup	**Heterogeneity:** Q-statistic = 4.80, p = .187						

Note: k = number of analyzed studies; SMD = standardized mean difference.

Publication bias

Upon analyzing the funnel plot visually and corroborating with Egger's test, there was no evidence of publication bias in relation to the sleep disturbance observed ($p = .358$) (Appendix 3). Conversely, an asymmetrical pattern was observed in the funnel plot for the depression outcome alongside a potential small-study effect ($p = .010$), which indicates there is a possibility that a smaller study with negative results is more likely to be published. To address this, the trim and fill method was applied, revealing that the addition of three hypothetically missing studies would result in a point estimate of −0.46 (95% CI: −0.65 ~ −0.26). Despite the indications of initial bias, the intervention demonstrates a robust effect, maintaining its statistical significance after adjusting for these hypothetical missing studies.

Sensitivity analysis

Based on the leave-one-study method, the SMD was not altered or influenced by any of the included studies after removing the studies that were given the most weight.

Discussion

The present review systematically evaluated the efficacy of MBE in reducing sleep disturbance and depression among older adults. Our meta-analysis demonstrated that MBEs significantly reduced both sleep disturbances and depression symptoms. Participants in the included studies varied widely in age and health status, encompassing young-old to old-old individuals and those with conditions ranging from good health to frailty and chronic illness. This diversity underscores the broad applicability and safety of MBEs for older adults. The interventions typically lasted 30–60 minutes per session, conducted thrice weekly and over a period of 12–48 weeks. This regimen aligns with existing exercise recommendations by WHO for older adults, which advocate for muscle-strengthening activities at least twice weekly [69]. These findings support the viability of MBEs as alternative physical exercises that may promote physical and mental health in older individuals with diverse health issues [70,71].

The present review found that different types of MBE, such as qigong, taichi, pilates, and yoga, appear to reduce sleep disturbance among older adults, which aligns with findings from past trials [27,32,33]. These modalities are a kind of physical exercise that emphasizes physical and mental aspects, such as stretching and strength exercises, as well as focusing on breathing [27,32]. Hence, performing this activity will make older adults physically active in the daytime and reduce the duration of daytime sleep, which may increase sleeping time at night. Physical activities like qigong, tai-chi, and yoga induce the release of BDNF [21–23,25], which are natural mood regulators and good for neuronal growth and adaptation that support a positive emotional state conducive to improved sleep [72,73]. This finding is important because many older adults have sleep disturbances globally [74]. Therefore, health professionals may consider applying MBE to treat sleep disturbance among older adults in the first line before the pharmacological approach.

This review also revealed that older adults who performed any kind of MBE showed a potential reduction in depression symptoms, which corresponds to the findings from previous studies [30,34,60]. MBE, comprised of qigong, taichi, pilates, and yoga, are considered low-impact exercises that emphasize physical and mental aspects performed in slow movements and focus on breathing or integrate between body movements and breathing techniques that lead older adults to relax, reduce stress, keep inner calm, and reduce distractions [75]. Also, these kinds of physical activity stimulate the regulation of neurotransmitters in the hippocampus, such as 5-HT [24], that can influence mood (antidepressant effect) and aid in sleep-wake cycle regulation [73]. This finding is noteworthy because the WHO stated that depression was the most prevalent mental health problem among adults aged 60 years or over [76]. Therefore, MBEs are recommended as preventive and rehabilitative approaches to reduce depression symptoms in older adults.

Our results from subgroup analysis demonstrated that various forms of MBEs, including pilates, yoga, qigong, and tai-chi, are effective in reducing symptoms of sleep disturbance and depression, with no significant differences in efficacy among these practices. This suggests that the therapeutic benefits of MBEs are consistent across different modalities, making them a versatile option for managing these conditions. However, the present study cannot rule out considerable heterogeneity in the effects of MBE on depression due to the unequal distribution of subgroups [46]. Despite this heterogeneity, the reliability of our findings is supported by a sensitivity analysis, which indicates that our conclusions are robust, even when adjusting for the study, which was given the most weight. This robustness reassures the applicability of MBEs in clinical settings, although further research is necessary. Future studies should investigate the sources of heterogeneity in these results to better understand the varying impacts across different subgroups.

Limitations

This current systematic review and meta-analysis have several limitations to consider. First, only studies published in English were included, which may introduce language bias and limit the generalizability of the findings to non-English published studies. This limitation may impact the reliability and applicability of the findings by providing an incomplete assessment of MBE's global effectiveness. Future research should aim to include studies published in multiple languages to provide a more comprehensive evaluation of MBE's effectiveness. Second, although the present study performed some subgroup analyses to examine the source of heterogeneity, more complex subgroup analyses could not be conducted due to the limited number of included studies. This constraint may have prevented a deeper understanding of the factors contributing to heterogeneity. The inability to perform more complex subgroup analyses may obscure important variations in effectiveness across different populations and settings. Increasing the number of high-quality studies with larger sample sizes would enhance the robustness of the findings and allow for more detailed subgroup analyses [77]. Third, despite the trim and fill analysis indicating that the missing studies do not substantially influence the effect of MBE on depression, these findings should still be interpreted cautiously. The potential publication bias and the small sample sizes of some studies may limit the robustness and generalizability of the findings. Last, small sample sizes may lead to less precise estimates of effect sizes and reduce confidence in the conclusions drawn from the meta-analysis. Future researchers should consider exploring the long-term effects of MBE and its impact on different subpopulations, such as those with varying levels of baseline health and different cultural backgrounds.

Conclusions

The pooled evidence from 27 studies concluded that MBE positively affects sleep disturbance and depression among older adults. The present review also revealed that each form of MBE (pilates, yoga, qigong, and tai-chi) significantly reduces sleep disturbance and depression among older adults. Healthcare professionals may consider prescribing older adults MBE in the first line before moving to a pharmacological approach. As a low-impact form of exercise, MBE is recommended for older adults to be performed around 30 to 60 minutes, three times weekly, for 12 to 48 weeks. This nonpharmacological approach is suitable and may serve as an additional option for healthcare institutions to recommend physical activity to assist older adults in enhancing their physical and psychological health. Additionally, to expand the evidence of MBE, high-quality trials with well-designed randomization that are undeviated from the intended protocol are definitely needed for future research. More studies also enable researchers to compare and rank the efficacy of each modality on health outcomes among older adults.

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Registration

This review was prospectively registered under the registration number CRD42023476741.

Data availability statement

Data sharing does not apply to this article as no new data were created in this study.

Conflicts of interest

No conflicts of interest to declare.

Acknowledgments

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.anr.2024.08.002.

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Review Article

Self-efficacy-based Interventions for Patients With Obstructive Sleep Apnea: A Systematic Review

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SUMMARY

Purpose: This study aimed to systematically review self-efficacy-based interventions for patients with obstructive sleep apnea (OSA) and identify the relationship between the number of used techniques for prompting self-efficacy and the main outcome variables.
Methods: This systematic review was conducted in accordance with the PRISMA guidelines. Experimental studies on the use of self-efficacy-based interventions for patients with OSA were analyzed. Five databases, EMBASE, CINAHL, PubMed, SCOPUS, and Web of Science, were systematically searched for articles published until December 2023. Interventions were classified based on the behavior change technique (BCT) taxonomy and the theoretical sources of self-efficacy to conduct a narrative synthesis.
Results: Of the 6,968 articles evaluated, 11 were included for analysis (1,304 participants). The results showed that the most frequently employed BCTs in the analyzed studies were “instruction on how to perform a behavior,” “exposure,” and “social support.” Regarding the number of techniques, an average of 6.0 BCTs (range, 4–8) and 3.2 theoretical sources (range, 2–4) were utilized in studies that showed significant improvements in self-efficacy (5 studies), whereas an average of 4.8 BCTs (range, 2–5) and 2.8 theoretical sources (2–3) were used in studies that indicated null results related to self-efficacy (6 studies).
Conclusion: This review underscores the potential of self-efficacy-based interventions in the management of OSA and provides a solid theoretical foundation for designing effective interventions. Additionally, the results indicate that utilizing a greater diversity of BCTs and theoretical sources may contribute to the effectiveness of self-efficacy interventions. Therefore, clinicians should consider incorporating various behavior change techniques and four sources of prompting self-efficacy from self-efficacy theory into interventions to enhance self-efficacy, and consequently, treatment adherence in patients with OSA.

Introduction

The American Academy of Sleep Medicine defines obstructive sleep apnea (OSA) as a hidden health crisis [1]. OSA is prevalent in 6%–17% of the general adult population [2], and several recent studies have indicated a high prevalence of comorbidities among patients with OSA [3–6]. The main symptoms of OSA are snoring, daytime sleepiness, fatigue, and mood changes [7]. Persistent OSA is associated with various complications, such as stroke, type 2 diabetes, hypertension, ventricular fibrillation, coronary artery disease, heart failure, and death [8–11].

The symptoms of OSA can be treated or managed using surgical and non-surgical interventions. In general, non-surgical interventions, including positive airway pressure (PAP) therapy, oral device therapy, dietary adjustments, exercise therapy, and myofunctional therapy, when considering prior to surgical interventions. Although non-surgical interventions are preferred as the first-line therapy for OSA, they have some limitations. For example, PAP therapy may be hindered by challenges such as difficulty with treatment adherence. Lifestyle modifications or exercise therapy require long-term management because their effects only become apparent after a relatively long period [12,13]. Particularly, in one study conducted over 20-year period, the overall CPAP non-adherence rate was 34.1% [14]. Even in myofunctional therapy, which is effectively used as a non-surgical intervention, the non-compliance rate is approximately 30% during a 3-month intervention period [15].

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OSA is considered a chronic disease similar to hypertension and diabetes and requires continuous management through a multidisciplinary approach [16]. Interventions for patients with chronic diseases have an average adherence rate of only 50%, indicating that poor treatment adherence is a serious challenge in the management of chronic diseases [17]. The World Health Organization (WHO) stated that increasing adherence to healthcare interventions for chronic diseases could more significantly impact health improvement than administration of a specific treatment [18]. Additionally, Anekwe et al. [19] contended that managing any chronic condition requires certain skills, and self-efficacy is a crucial component of such skills.

For effective self-management of diseases, it is essential for patients to possess adequate self-efficacy and hold the conviction that they are capable of controlling their illness [20–23]. Previous studies of various diseases have shown that higher self-efficacy is associated with better treatment adherence and improved health outcomes [24–28]. Furthermore, previous studies on OSA patients have shown that higher self-efficacy is associated with greater adherence to PAP therapy [29,30]. Increasing evidence shows that self-efficacy is a key factor in predicting and explaining the successful initiation and maintenance of behavioral changes [31].

Self-efficacy, which has been used to improve the effectiveness of interventions in various studies, can be developed by utilizing four theoretical sources: mastery experience, vicarious experience, verbal persuasion, and somatic and affective states [32]. According to Bandura et al. [33], these sources interact complementarily to enhance self-efficacy. In a previous study [34], combining the four theoretical sources of self-efficacy proved to be more effective than implementing them separately in motivational interventions for online lessons. However, in a systematic review confirming the effectiveness of interventions on breastfeeding self-efficacy [35], only 2 out of the 21 studies analyzed utilized all four theoretical sources. If interventions do not incorporate all four theoretical sources of self-efficacy, their effectiveness is likely to be diminished. Therefore, self-efficacy-based interventions should be thoroughly developed to reflect all four sources of self-efficacy enhancement before implementation.

Classifying and evaluating the components of interventions using only definitions and examples of theoretical sources of self-efficacy does not effectively identify the active and effective components of the intervention, leading to uncertainty and confusion [36]. The behavior change technique (BCT) taxonomy, a method developed to overcome these limitations, was utilized in a recent study to reliably characterize interventions with respect to BCTs [36]. However, the current BCT taxonomy is a methodological tool for specifying the contents of interventions and is not linked to behavior change theories. Therefore, in this study, we analyzed the interventions using a review [31] that connected BCTs to the four theoretical sources of self-efficacy.

To our best knowledge, no literature review has interpreted the strategies and effects of self-efficacy-based interventions in patients with OSA. Therefore, this systematic review primarily aimed to analyze and synthesize the strategies used in self-efficacy-based interventions for patients with OSA. The secondary aim was to identify the relationship between the number of used theoretical sources/BCTs and the main outcome variables.

Methods

Study design

This systematic review was conducted following the methodology outlined in the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocol (PRISMA) guidelines. The protocol was registered with The International Prospective Register of Systematic Reviews (PROSPERO; registration no: CRD42022291882).

Search strategy

Five databases, namely, the Excerpta Medica Database (EMBASE), Cumulative Index to Nursing and Allied Health Literature (CINAHL), PubMed, SCOPUS, and Web of Science, were systematically searched for articles published between the dates of inception of the databases and December 2023. The terms “self-efficacy,” “OSA,” and “intervention” were combined for the database searches (Supplementary data 1). Additional articles were identified through the references of the extracted articles.

Eligibility criteria

Types of studies

Experimental studies, including randomized controlled trials, non-randomized controlled trials, and pre- and post-test studies, were considered eligible for inclusion.

Types of participants

Patients of any age who were diagnosed with OSA were included.

Types of interventions

Self-efficacy-based interventions for patients with OSA including interventions based on any of the following aspects were included: positive airway pressure (PAP), dietary adjustments, exercising, oral device therapy, self-management, and medication. To be included, the interventions must have been developed using self-efficacy as the conceptual framework with detailed descriptions.

Types of outcome measures

Included studies must measure self-efficacy as an outcome variable. Additionally, studies that assessed intervention adherence, sleepiness, fatigue, sleep quality, sleep quantity, behavioral change, and other OSA-related symptoms as secondary outcome variables were included.

Exclusion criteria

The exclusion criteria were as follows: lack of access to the full text of articles; ongoing study, protocol study, review study, and grey literature; self-efficacy was not measured before and after the intervention; and studies that primarily aimed evaluating feasibility or acceptability.

Study selection

A two-step selection process was performed after removing duplicate articles from the extracted articles. First, the titles and abstracts of the extracted articles were independently screened for eligibility by two researchers, and duplicates were removed. Thereafter, the full texts of the remaining articles were independently reviewed for eligibility by two researchers. Discussion or arbitration was arranged when the two researchers disagreed with the inclusion of a study.

Data extraction

The lead researcher extracted data from the selected articles and compiled them into an electronic spreadsheet that was reviewed by another researcher for accuracy. Any differences in interpretation were resolved through discussion. The extracted items were author name, publication year, country, study design, participant characteristics, description of intervention, techniques for prompting self-efficacy, and outcome measures. Self-efficacy data were extracted and classified based on how the self-efficacy results were reported, either as a total score or as one of the domains of the self-efficacy measurement instrument.

Summary measures and analysis

Outcomes of included studies were presented according to the primary outcome and the efficacy of the interventions (positive or null results). Data on the mean differences and *P* values of statistical significance for each outcome were extracted and analyzed. The included studies varied in intervention types, durations, and delivery methods. Additionally, the eligibility criteria had no restrictions on control groups. Therefore, performing a meta-analysis to quantify and analyze the results was deemed likely to produce an inappropriate summary and thus was not conducted.

Techniques for prompting self-efficacy

Techniques for prompting self-efficacy utilized within the interventions were analyzed through a review [31] that linked sources of self-efficacy with the BCT taxonomy [36]. The BCT taxonomy includes 93 hierarchical techniques, grouped into 16 categories, and is the standard for the documentation of methods aimed at eliciting changes in health behavior. Techniques utilized in the interventions that were described using the definitions outlined in the BCT taxonomy were objectively coded by the lead researcher and checked by the senior researcher to ensure consistency (see definitions and examples of the “General description of technique” and “BCTs” in Supplementary data 2).

Assessment of methodological quality

The Quality Assessment Tool for Quantitative Studies (QATQS) described by the Effective Public Healthcare Panacea Project (EPHPP) [37] was used to evaluate the qualities of the studies reported in the selected articles (Supplementary data 3). The quality appraisal tool included six domains: selection bias, research design, confounders in studies, blinding issues, methods of data collection, and withdrawals/dropouts of participants. Each domain was assigned 1, 2, or 3 points to indicate weak, moderate, or strong quality, respectively. The assessment included two additional areas: intervention integrity and appropriate analysis, but they were not included in the overall score. Intervention integrity examined if participants received the intended duration and intensity, and appropriate analysis evaluated statistical methods and analysis by intervention status. Assessing these factors helped interpret study results accurately.

The overall rating for the study was determined by assessing the six component ratings. Studies with no weak ratings and at least four strong ratings were considered ‘strong’. Those with less than four strong ratings and one weak rating are considered ‘moderate’. Finally, those with two or more weak ratings are considered ‘weak’. Strong and moderate studies were included in a review [37].

Results

Study selection

A total of 6,968 articles were identified in the initial database search. After removing 666 duplicates, the titles and abstracts of the remaining 6,302 articles were screened. Thereafter, 6,263 articles were excluded, and the full texts of the remaining 39 articles were reviewed. Among the 39 articles, 11 (1,304 participants) [38–48] were selected for analysis. The specific reasons for the exclusion of ineligible articles are shown in Figure 1.

Quality assessment results

As shown in Supplementary data 2, eight studies [38,39,42–45,47,48] yielded a strong global rating. The global rating of three studies [40,41,46] was moderate, and no study was rated as weak.

Characteristics of the included studies

Table 1 provides an overview of the 11 included studies, which were conducted between 2007 and 2023 in the United States of America [39,41,44,46], Australia [38,40,42,48], China [43,45], and South Korea [47]. Of these studies, nine were randomized controlled trials, whereas one was a quasi-experimental (pre-post design) study. Regarding participant characteristics, the total number of participants included in the studies ranged from 31 to 250, with the majority of them being male (61.7–100.0%). The mean ages of the participants ranged from 46.8 years to 57.7 years. The mean apnea-hypopnea index (AHI) varied from 16.6 events/hour to 57.5 events/hour. Overall, 10 of the 11 studies were focused on PAP interventions [38–46,48]; therefore, most of the studies included the assessment of intervention adherence to determine the effect of the intervention. Outcome indicators, such as sleepiness and fatigue, sleep quality, depression, and anxiety, were also examined. The measurement timepoints varied from twice to six times. The duration of the studies also varied, ranging from 28 days to 12 months.

Description of self-efficacy-based interventions

Theoretical frameworks were used to describe the design of the interventions in all the studies. The social cognitive theory was employed in nine studies [38,39,41,42,44–48], the health belief model was utilized in one study [40], and the health action process approach theory was applied in one study [43]. Most interventions included programs that incorporated motivational enhancement or social cognitive concepts to enhance intervention adherence. The duration and intensity of the interventions varied. The duration of the interventions ranged from 1 day to 12 months, whereas the number of sessions ranged from 1 to 15. Interventions were administered through face-to-face interactions (either in group or individually) [38,40–48] or via phone calls [39] to improve self-efficacy. Most intervention providers were nurses [40,41,43,45–47]; other providers included CPAP therapists and sleep-unit staff members [38], psychologists [42,48], and educated peer buddies [44]. Automated phone calls [39] were also used (Table 1).

Techniques for prompting self-efficacy

The techniques utilized in the interventions were classified according to four theoretical sources, 15 general descriptions of techniques, and 20 BCTs. Techniques utilized in the interventions that were also administered to participants in the comparison groups are annotated in Table 2. Aloia et al. [41] reported using only three techniques (2 exclusive to the intervention group), whereas Lai et al. [45] reported using 11 BCTs (8 exclusive to the intervention group), which was the highest number of techniques used in a study. The most commonly reported techniques across all studies were “instruction on how to perform a behavior”, “exposure”, and “social support” (reported in eight studies). Among the techniques included exclusively in interventions administered to the

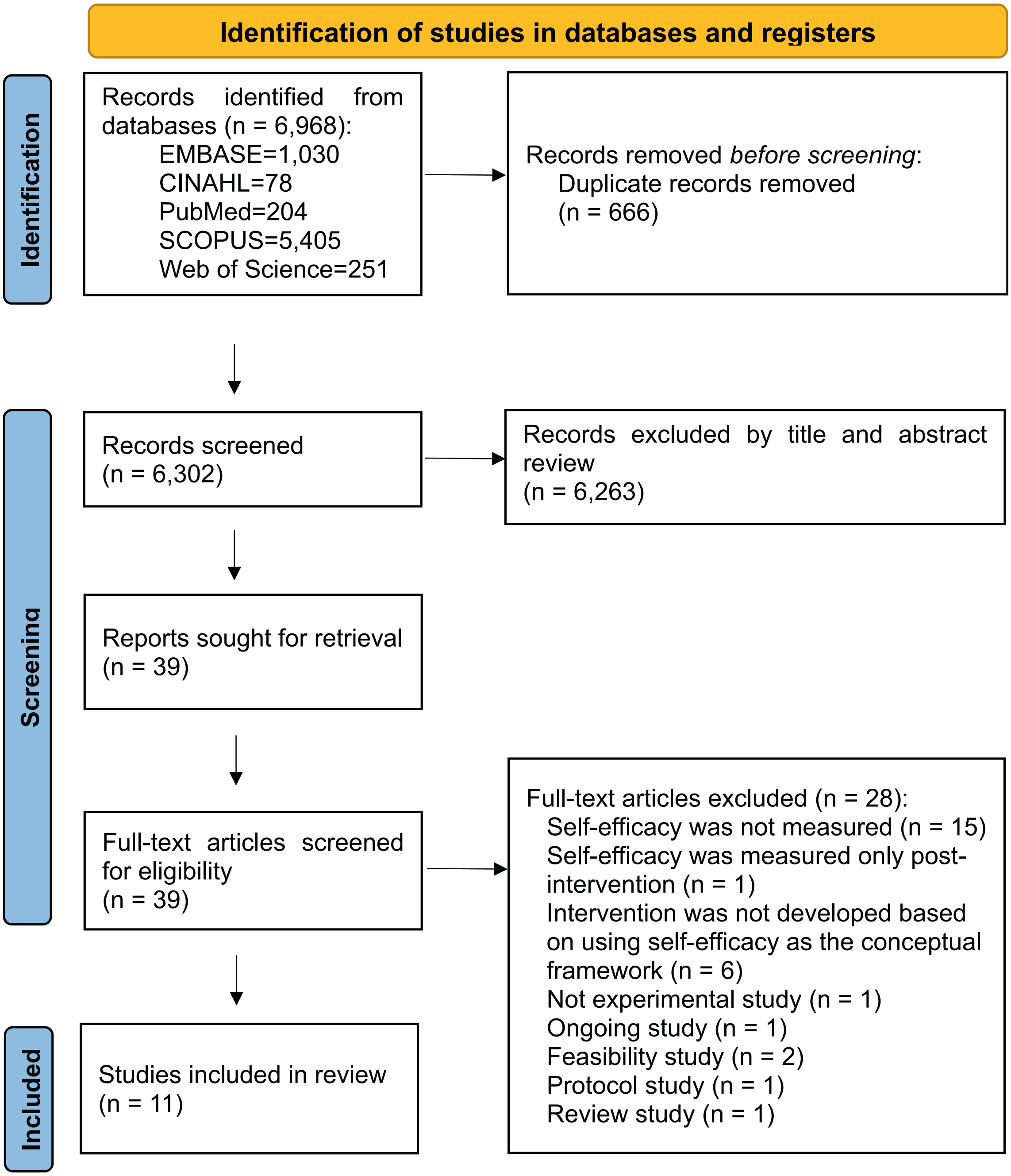

Figure 1. Flow diagram of study selection.

intervention group, “focus on past success”, “demonstration of the behavior”, “vicarious consequences”, “verbal persuasion about capability”, “credible source”, and “problem-solving” were the most frequently reported (in six studies). Of the 20 techniques that linked sources of self-efficacy with BCTs, six were not reported in the studies included in the present systematic review.

Outcomes of included studies

The outcomes of the studies are presented in Table 3. Study results were classified according to whether they had a statistically significant effect or insignificant result, as indicated by the authors. The statistical methods used for analyses in the studies are also presented. Self-efficacy (the primary outcome) was measured by several instruments such as the Social Cognitive Theory (SCT) scale, Self-Efficacy Measure for Sleep Apnea (SEMSA), and Self-Efficacy Scale (SES) (Table 1). Self-efficacy was reported either as a total score [39,47] or as one of the domains of the instrument [38,40–46,48]. Several studies presented varying findings, with some outcomes showing improvement while others were unchanged, complicating the assessment of the comprehensive impact of interventions based on self-efficacy. Results regarding the impact of self-efficacy-based interventions on a single outcome varied across studies. For instance, of the 11 studies that measured self-efficacy, significant improvement was reported in 5 studies [38,39,43,45,47], whereas a insignificant result was reported in the others [40–42,44,46,48].

Except for one study [47], the included studies reported adherence with the use of PAP device. Subcategories of intervention adherence included mean nightly PAP usage and the proportion of

Table 1 *Characteristics of the Included Studies.*

Author, year and country	Design	Aim of the study	Total number of participants (male)	Mean age (IG/CG)	AHI (IG/CG)	Outcome indicators (Instrument)	Measurement timepoints	Intervention descriptions		
								Theoretical framework	Duration (Intensity)	Delivery (Provider)
Richards et al. 2007 [38] Australia	RCT	To improve adherence to CPAP therapy using cognitive behavioral treatment intervention	100 (96)	56.1/56.2	27.6/25.3	Self-efficacy (SCT scale) Intervention adherence (CPAP)	BL 7 days 28 days	SCT	1 month (2 times)	Face-to-face[a] (CPAP therapist, Sleep-unit staff member)
Sparrow et al. 2010 [39] USA	RCT	To investigate the effectiveness of telephone-linked communications intervention to improve adherence to CPAP	250 (205)	56.0/54.0	36.0/40.5	Self-efficacy (SCT scale) Intervention adherence (CPAP)	BL 6 months 12 months	SCT	12 months (15 times)	Automated phone-call
Olsen et al. 2012 [40] Australia	RCT	To assess the effectiveness of motivational interview nurse therapy intervention to improve acceptance and adherence to CPAP therapy	100 (69)	55.1/57.7	36.2/32.4	Self-efficacy (SEMSA) Intervention adherence (CPAP) Sleepiness (ESS) Quality of life (FOSQ)	BL 1 month 2 months 3 months 12 months	HBM	1 month (3 times)	Face-to-face[b] (Nurse)
Aloia et al. 2013 [41] USA	RCT	To test motivational enhancement therapy intervention in improving adherence to PAP	227 (140)	51.4/47.0/52.4	45.7/46.1/48.2	Self-efficacy (SCT scale) Intervention adherence (CPAP) Decisional balance (Decisional balance scale)	BL 1 month 2 months 3 months 6 months 12 months	SCT	3 weeks (3 times)	Face-to-face[b] (Nurse)
Bartlett et al. 2013 [42] Australia	RCT	To examine whether social cognitive therapy intervention increases CPAP use	206 (140)	46.8/49.3	30.4/39.9	Self-efficacy (SCT scale) Intervention adherence (CPAP) Sleepiness and fatigue (ESS) Quality of life (FOSQ) Sleep quality (PSQI) Fatigue (FSS) Depression (DASS-D) Anxiety (DASS-A) Stress (DASS-S)	BL 1 month 6 months	SCT	1 day (1 time)	Face-to-face[a] (Psychologists)
Deng et al. 2013 [43] China	RCT	To evaluate the effectiveness of stage-matched care intervention of adherence to CPAP inpatients with OSA	110 (88)	48.0/50.4	57.5/54.0	Self-efficacy (SEMSA) Intervention adherence (CPAP) Sleepiness (ESS) Sleep quality (PSQI)	BL 1 month 3 months	HAPA	3 months (4 times)	Face-to-face[b] (Nurse)
Parthasarathy et al. 2013 [44] USA	RCT	To evaluate patient ratings of the acceptability of a peer buddy system intervention (PBS), promote CPAP therapy adherence and obtain preliminary data on the effectiveness of PBS	39 (39)	53/50	36.7/37.5	Self-efficacy (SEMSA) Intervention adherence (CPAP) Sleepiness (ESS) Quality of life (FOSQ) Activation (PAM) Psychomotor (PVT)	BL 90 days	SCT	3 months (10 times)	Face-to-face[b] (Educated peer buddies)
Lai et al. 2014 [45] China	RCT	To examine the efficacy of a brief motivational enhancement education program in improving adherence to CPAP	100 (83)	53/51	30.7/28.2	Self-efficacy (SEMSA) Intervention adherence (CPAP) Sleepiness (ESS) Quality of life (FOSQ, Calgary Sleep Apnea Quality of Life Index, Short Form-36 Health Survey Questionnaire)	BL 1 month 3 months	SCT	3 days (3 times)	Face-to-face[b] (Nurse)
Sawyer et al. 2019 [46] USA	RCT	To examine the feasibility and acceptability of a social cognitive intervention to promote PAP adherence	60 (42)	52.5/50.1	33.9/38.0	Self-efficacy (SEMSA) Intervention adherence (CPAP)	Pre-diagnosis Post-diagnosis Post-titration Day 2 PAP Day 7-10 PAP	SCT	8 days (7 times)	Face-to-face[a,b] (Nurse)

Kim et al. 2020 [47] South Korea	Pre-post	To determine the impact of a myofunctional therapy support program during myofunctional therapy	31 (23)	53.9/49.2	19.5/16.6	Self-efficacy (SES) Sleepiness (ESS) Sleep quality (PSQI) AHI, SaO_2 (PSG) Dry mouth (NRS) Snoring (NRS)	BL 12 weeks	SCT	12 weeks (12 times)	Face-to-face[a,b] (Nurse)
Tolson et al. 2024 [48] Australia	RCT	To assess the utility of a tailored intervention program to improve CPAP use and self-efficacy in patients with OSA	81 (50)	52.9/51.4	35/32	Self-efficacy (SEMSA) Intervention adherence (CPAP)	BL Post-titration 1 month 4 months	SCT	4 weeks (5 times)	Face-to-face[a,b] (Psychologist)

Note. AHI = apnea-hypopnea index; BL = baseline; CG = comparison group; CPAP = continuous positive air pressure; DASS = Depression Anxiety Stress Scales; ESS = Epworth Sleepiness Scale; FOSQ = Functional Outcomes of Sleep Questionnaire; FSS = Fatigue Severity Scale; HAPA = health action process approach; HBM = health behavior model; IG = intervention group; NRS = numeric rating scale; OSA = obstructive sleep apnea; PAM = patient activation measure; PAP = positive air pressure; PSG = polysomnography; PSQI = Pittsburgh Sleep Quality Index; PVT = psychomotor vigilance task; RCT = randomized controlled trial; SCT = social cognitive theory; SEMSA = self-efficacy measure for sleep apnea; SES = Self-Efficacy Scale.

[a] Group setting.

[b] Individually.

participants who used the PAP device for more than 4 or 6 hours. There were no discrepancies in the results of subcategories related to intervention adherence in a single study. Regarding the results on intervention adherence across the ten studies, five indicated a positive effect [38,39,43–45], four showed no effect [41,42,46,48], and one showed both positive and null results [40], depending on the timing of measurement.

The number of techniques and theoretical sources used only in the intervention group and the effects of the intervention on self-efficacy and intervention adherence are shown in Table 4. Of the five studies in which the participants showed significantly improved self-efficacy [38,39,43,45,47], four studies measured intervention adherence, which was significantly improved [38,39,43,45]. The average number of used BCTs and the theoretical sources were compared among studies that showed positive effects and those that showed null results related to self-efficacy. The number of used BCTs and theoretical sources in each study can be found in Table 2. The average number of BCTs used in studies that indicated a positive effect of the interventions on self-efficacy was 6.0, whereas the average number of BCTs used in studies that indicated no effect was 4.8. The average number of theoretical sources used in studies that showed a positive effect was 3.2, whereas the average number of theoretical sources used in studies that showed no effect was 2.8.

Discussion

This systematic review analyzed 11 studies on self-efficacy-based interventions for improving OSA. The theoretical elements and self-efficacy techniques employed in these studies were examined as well. The most frequently used theoretical source in self-efficacy-based interventions for OSA patients was found to be “mastery experience.” To achieve this, common BCTs included “instructions on how to perform a behavior,” “exposure,” and “focusing on past success.” Only half of the studies were effective in enhancing self-efficacy, and these studies also showed improvements in intervention adherence. Additionally, the review highlighted that effective studies in self-efficacy utilized a higher average number of BCTs and theoretical sources.

Overall, 10 of the 11 studies included in this review focused on improving adherence to PAP interventions. PAP is often the initial treatment for OSA [49], and its success heavily depends on adherence, which is significantly influenced by self-efficacy [50,51]. Patients with high self-efficacy may exhibit greater adherence, as they experience a stronger association between adherence and improvement in positive effects and a reduction in sleepiness and fatigue the following day [52]. Treatment adherence leads to better conditions on the following day, and such positive feedback can reinforce ongoing adherence. Therefore, understanding the role of self-efficacy is vital for developing interventions to increase adherence. For measuring self-efficacy, 10 out of the 11 studies used a situation-specific self-efficacy tool (SCT scale or SEMSA), while one study used a general self-efficacy tool (SES). Bandura posits that self-efficacy only has predictive power when it is evaluated against specific tasks in a specific context [53]. Therefore, when applying and evaluating self-efficacy in interventions, using specific self-efficacy tools for specific skills or knowledge areas along with a general self-efficacy tool can provide a more accurate prediction and improvement opportunities for an individual's abilities in relation to the particular situation or activity.

Theoretical frameworks closely related to self-efficacy were utilized in all 11 studies included in this review. The most frequently mentioned theoretical framework in the studies included in this review was the SCT. The SCT posits that self-efficacy is a central construct that influences behavior directly and

Table 2 *Theoretical Sources of Self-efficacy and Behavior Change Techniques (BCTs) Utilized in the Intervention Arms of the Included Studies.*

Techniques used to induce self-efficacy			[a]Study											
Theoretical source	General description of technique	BCTs	1	2	3	4	5	6	7	8	9	10	11	Total
Mastery experience	Create direct opportunities for performance	Instruction on how to perform a behavior	[b]✓		[b]✓		[b]✓	[b]✓	[b]✓	[b]✓	✓		[b]✓	8
		Exposure	[b]✓		[b]✓		[b]✓	[b]✓	[b]✓	[b]✓	✓		[b]✓	8
		Behavioral practice/rehearsal												0
	Graded mastery experiences	Graded tasks												0
	Mental imagery	Mental rehearsal of successful performance												0
	Preparation for setbacks	Reattribution												0
	Self-monitoring of behavior and behavioral outcome	Self-monitoring of behavior		✓				✓				[b]✓		3
		Self-monitoring of outcome of behavior			✓									1
	Reflection on past successes to obtain orientation	Focus on past success		✓		✓		✓		✓	✓	✓		6
	Learning orientation	Non-codable												0
Vicarious experience	Life/symbolic modeling	Demonstration of the behavior	✓				✓		✓	✓		✓	✓	6
		Vicarious consequences	✓				✓		✓	✓		✓	✓	6
	Self-modeling	Non-codable												0
Verbal persuasion	Encouragement or verbal placebo from professional or significant other	Verbal persuasion about capability	✓				✓		✓	✓		✓	✓	6
		Credible source	✓				✓		✓	✓		✓	✓	6
		Social support	[b]✓			[b]✓	[b]✓	✓	✓	✓	[b]✓		✓	8
	Instruction or motivational self-talk	Self-talk			✓									1
Somatic and affective states	Psychoeducation	Information about antecedents												0
		Information about emotional consequences	✓							✓				2
	Biofeedback	Biofeedback		✓								✓		2
	Identification/acquisition of coping skills	Problem-solving		✓	✓	✓		✓			✓		✓	6
		Reduce negative emotions	✓				✓	✓		✓		✓		5
	Opportunities to test coping skills	Exposure	[b]✓		[b]✓		[b]✓	[b]✓	[b]✓	[b]✓	✓		[b]✓	8
		Behavioral practice/rehearsal												0
Number of BCTs used (only employed in intervention group)			10(6)	4(4)	6(3)	3(2)	9(5)	8(5)	8(5)	11(8)	6(5)	8(7)	9(6)	
Number of theoretical sources used (only employed intervention group)			4(3)	2(2)	3(3)	3(2)	4(3)	3(3)	4(2)	4(4)	3(2)	4(4)	4(3)	

[a] Studies are numbered in alphabetical order in this table: 1 = Richards et al. [38]; 2 = Sparrow et al. [39]; 3 = Olsen et al. [40]; 4 = Aloia et al. [41]; 5 = Barlett et al. [42]; 6 = Deng et al. [43]; 7 = Parthasarathy et al. [44]; 8 = Lai et al. [45]; 9 = Sawyer et al. [46]; 10 = Kim et al. [47]; 11 = Tolson et al. [48].

[b] The techniques included in the intervention were also employed in the comparison group.

Table 3 *Outcomes of the Included Studies.*

Type of outcome	Author, Year	Positive effect	Insignificant result
Self-efficacy	Number of studies: n = 11	5/11	6/11
	Richards et al., 2007 [38]	[a]●	
	Sparrow et al., 2010 [39]	[b]●	
	Olsen et al., 2012 [40]		[c]●
	Aloia et al., 2013 [41]		[d]●
	Barlett et al., 2013 [42]		[a]●
	Deng et al., 2013 [43]	[c]●	
	Parthasarathy et al., 2013 [44]		[a]●
	Lai et al., 2014 [45]	[c]●	
	Sawyer et al., 2019 [46]		[c]●
	Kim et al., 2020 [47]	[e]●	
	Tolson et al., 2023 [48]		[c]●
Intervention adherence	†Number of studies: n = 10	6/10	4/10
Mean nightly CPAP usage	Richards et al., 2007 [38]	[a]●	
	Sparrow et al., 2010 [39]	[b]●	
	Olsen et al., 2012 [40]	[a]● *(at 1M, 2M, 3M)*	[a]● *(at 12M)*
	Aloia et al., 2013 [41]		[d]●
	Deng et al., 2013 [43]	[a]●	
	Parthasarathy et al., 2013 [44]	[c]●	
	Lai et al., 2014 [45]	[a]●	
	Sawyer et al., 2019 [46]		[a]●
	Tolson et al., 2023 [48]		[c]●
Proportion of patients who used CPAP (≥4 hours/night)	Richards et al., 2007 [38]	[f]●	
	Barlett et al., 2013 [42]		[f]●
	Deng et al., 2013 [43]	[f]●	
Proportion of patients who used CPAP (≥6 hours/night)	Richards et al., 2007 [38]	[f]●	
	Barlett et al., 2013 [42]		[f]●
Proportion of patients who showed CPAP adherence	Lai et al., 2014 [45]	[f]●	
Usage index	Lai et al., 2014 [45]	[a]●	
Intention to use CPAP	Lai et al., 2014 [45]	[a]●	
Non-adherence (<4 hours/night)	Sawyer et al., 2019 [46]		[a]●
Adherence to exercise therapy	Kim et al., 2020 [47]	[g]●	

Outcome expectations	Number of studies: n = 7	4/8	4/8
	Richards et al., 2007 [38]	[a]●	
	Olsen et al. 2012 [40]		[c]●
	Barlett et al., 2013 [42]		[a]●
	Deng et al., 2013 [43]	[c]●	
	Parthasarathy et al., 2013 [44]		[a]●
	Lai et al., 2014 [45]	[c]●	
	Sawyer et al., 2019 [46]		[c]●
	Tolson et al., 2023 [48]	[c]●	
Sleepiness	Number of studies: n = 6	2/6	4/6
	Olsen et al., 2012 [40]		[c]●
	Barlett et al., 2013 [42]		[a]●
	Deng et al., 2013 [43]	[a]●	
	Parthasarathy et al., 2013 [44]		[a]●
	Lai et al., 2014 [45]		[c]●
	Kim et al., 2020 [47]	[e]●	
Risk perception	Number of studies: n = 6	0/6	5/6
	Olsen et al., 2012 [40]		[c]●
	Deng et al., 2013 [43]		[c]●
	Parthasarathy et al., 2013 [44]		[a]●
	Lai et al., 2014 [45]		[a]●
	Sawyer et al., 2019 [46]		[c]●
	Tolson et al., 2023 [48]		[c]●
Quality of life	Number of studies: n = 3	0/3	3/3
	Olsen et al., 2012 [40]		[c]●
	Barlett et al., 2013 [42]		[a]●
	Lai et al., 2014 [45]		[c]●
Sleep quality	Number of studies: n = 3	1/3	2/3
	Barlett et al., 2013 [42]		[a]●
	Deng et al., 2013 [43]	[a]●	
	Kim et al., 2020 [47]		[e]●

Decisional balance index	Number of studies: n = 3	1/3	2/3
	Sparrow et al., 2010 [39]	[b]●	
	Aloia et al., 2013 [41]		[d]●
	Parthasarathy et al., 2013 [44]		[a]●
Social support	Number of studies: n = 2	1/2	1/2
	Richards et al., 2007 [38]	[a]●	
	Barlett et al., 2013 [42]		[a]●
Fatigue	Number of studies: n = 1	0/1	1/1
	Barlett et al., 2013 [42]		[a]●
Depression	Number of studies: n = 1	0/1	1/1
	Barlett et al., 2013 [42]		[a]●
Anxiety	Number of studies: n = 1	0/1	1/1
	Barlett et al., 2013 [42]		[a]●
Stress	Number of studies: n = 1	0/1	1/1
	Barlett et al., 2013 [42]		[a]●
Apnea-hypopnea index	Number of studies: n = 1	1/1	0/1
	Kim et al., 2020 [47]	[e]●	
Lowest arterial oxygen saturation	Number of studies: n = 1	0/1	1/1
	Kim et al., 2020 [47]		[e]●
Snoring intensity	Number of studies: n = 1	1/1	0/1
	Kim et al., 2020 [47]	[e]●	
Snoring frequency	Number of studies: n = 1	0/1	1/1
	Kim et al., 2020 [47]		[e]●
Activation	Number of studies: n = 1	0/1	1/1
	Parthasarathy et al., 2013 [44]		[a]●
Psychomotor	Number of studies: n = 1	0/1	1/1
	Parthasarathy et al., 2013 [44]		[a]●

Note. Green circles (●) indicate positive effect, red circles (●) indicate insignificant result.
[a] Independent t-test; [b] generalized estimating equation; [c] analysis of variance; [d] linear mixed model; [e] Wilcoxon signed-rank test; [f] chi-squared test; [g] Spearman correlation rho test (with self-efficacy).

[†] Kim et al. was not calculated due to the absence of intergroup comparisons.

CPAP = continuous positive air pressure; M = month.

Table 4 *Number of Behavior Change Techniques (BCTs) and Theoretical Sources of the Included Studies.*

Outcome		Intervention adherence				[a]Average number of used BCTs/theoretical sources
		Positive effect	Partially positive effect	Null result	Unverified	
Self-efficacy	Positive effect	[38,39,43,45]	-	-	[47]	6.0/3.2
	Null result	[44]	[40]	[41,42,46,48]	-	4.8/2.8

Note. BCT = behavior change technique.

[a] Which were provided only in intervention group.

indirectly through its impact on goals, outcome expectations, barriers, and facilitators [54]. For OSA patients undergoing PAP therapy, assessing factors of the SCT 1 month after the start of treatment allows clinicians to develop a better understanding of their impact on intervention adherence [55] and can predict long-term treatment adherence [56]. However, it should be noted that SCT is much broader in scope compared to other health behavior theories. Thus, it has not been comprehensively tested [57]. Therefore, it is important to have a solid understanding of the existing evidence on SCT as it pertains to OSA when applying the theory.

The durations and intensities of the interventions assessed in the studies included in this review varied. Developers of behavioral interventions need to consider patient burden and adherence to ensure that the effective dose is as close as possible to the efficacious dose. However, there is no information regarding guidelines for selecting dose parameter values when designing behavioral interventions [58]. Considering that it typically takes at least 2 months for behavioral changes to become habitual [59], providing continuous feedback or interventions for at least 2 months is necessary for enabling individuals to engage in health behaviors frequently enough to establish habits.

Interventions with these diverse characteristics were analyzed based on their self-efficacy theoretical sources, general descriptions of the technique, and the BCT taxonomy. The number of BCTs used per study included in this review ranged from 3 to 11, with the most frequently used techniques being “instruction on how to perform a behavior,” “exposure,” and “social support.” “Instruction on how to perform a behavior” [60,61] and “social support” [62] are common BCTs. “Instruction on how to perform a behavior” and “exposure” provide instructions for engaging in behaviors necessary for adhering to the intervention protocol, making them essential techniques for achieving the effects of any training. As ten out of the 11 studies included in this review were focused on interventions for PAP use, education and guidance on mask-fitting and machine operation methods had to be provided to both the experimental and control groups. In future trials on self-efficacy interventions, the experimental group should be provided with instructions or exposure experiences different from those of the control group to effectively enhance their experiences of successful behaviors.

“Social support” is also a crucial factor related to behavioral change [63,64]. Particularly, family support can increase treatment adherence in patients with OSA and is considered an initial motivation for starting treatment [65,66]. Ensuring that the patient's family and acquaintances are educated about the disease and treatment can encourage more active participation in the treatment. In the included studies, the frequently used BCTs were similarly distributed across the four theoretical components of self-efficacy. Among the four sources of self-efficacy identified by Bandura, “mastery experience” is the most powerful driver of self-efficacy [67,68]. A review study examining effective BCTs to promote physical activity in adults, reports that prompting behavioral practice and rehearsal [69], which falls under mastery experience, might lead to better intervention outcomes. However, the reviews included in this study did not effectively utilize a variety of BCTs that fall under mastery experience. However, most studies included in this review focused on PAP therapy; this may explain the limited diversity of “mastery experience” used in the studies. As there are various treatment methods (e.g., physical exercise, dietary improvements, and myofunctional therapy) for improving the symptoms of OSA, future interventional studies should be focused on exploring and developing behavioral change strategies suitable for treatment, effectively enhancing self-efficacy and positively influencing treatment adherence. Transparency and accuracy of the coding process are vital when using and analyzing BCTs in research [70]. However, because the studies included in this review did not mention whether BCTs were used or provide the coding numbers or names for the interventions, the confidence in the reliability of the BCTs coded by the reviewers of this review may be diminished. Therefore, future research should explicitly specify the structure of interventions using the BCT taxonomy to aid researchers in developing effective interventions drawing on previous research.

Among the 11 studies included in this review, 5 studies showed a significant improvement in self-efficacy in the groups that received interventions. Of these five studies, four demonstrated a significant improvement in intervention adherence. Differences in intervention adherence between groups were not examined in the remaining study; however, the results statistically confirmed that higher self-efficacy led to improved intervention adherence. These findings align with those of previous research [71–73], underscoring the potential of enhancing self-efficacy to improve treatment adherence and symptom management in OSA. In addition, these results emphasize the importance of exploring methods for enhancing self-efficacy in intervention programs and conducting in-depth investigations of their effectiveness. Self-efficacy can be enhanced by applying specific techniques based on the theoretical sources outlined by Bandura [67]. Notably, a higher average number of theoretical sources were generally employed in the studies that showed significant improvements in self-efficacy than in those that indicated no effects (3.2 vs. 2.8). This finding suggests that utilizing various theoretical sources of self-efficacy may enhance the effectiveness of interventions by addressing multiple facets of self-efficacy.

According to Bandura's theory, individuals develop self-efficacy beliefs through four primary sources [67]. These sources interact complementarily to enhance self-efficacy [33]; therefore, using all four sources is more effective than employing only one [34]. For instance, the value of successful mastery experiences can be amplified through verbal persuasion [74]. In addition, combining mastery experiences with verbal persuasion can increase the significance and concreteness of feedback [75]. However, the four self-efficacy enhancement strategies proposed by Bandura were employed in only a limited number of studies included in this review. Given that there may not be sufficient evidence to support the effectiveness of using a few strategies in interventions, a holistic approach should be adopted in the development of self-efficacy interventions. In addition, it is essential to analyze specific strategies that are particularly effective in enhancing self-efficacy based on previous research.

Given that self-efficacy can vary across different situations and target populations, it is imperative to design and provide tailored interventions that consider these variations. This approach ensures that interventions effectively enhance self-efficacy in diverse contexts and for different individuals. The findings of this review underscore the significance of adopting a comprehensive approach to enhancing self-efficacy using intervention programs. Further, they highlight the need for further research to identify the specific strategies that are most effective in various scenarios. Tailored interventions that account for differences in self-efficacy across contexts and populations are crucial for improving treatment adherence and symptom management in patients with OSA.

The present study investigated the relationship between the diversity of BCTs used to enhance self-efficacy and improvement in self-efficacy outcomes. The findings revealed that a higher average number of BCTs (6.0 vs. 4.8) was employed in studies that showed statistically significant improvements in self-efficacy than in those that did not. These results are consistent with those of previous studies and support the hypothesis that utilizing various BCTs may be effective in enhancing self-efficacy. Interventions that include a variety of BCTs seem to be more effective in maintaining changes in self-efficacy for physical activity than those that include a few BCTs [76]. A systematic review of studies on maintaining changes in physical activity and dietary behavior found that interventions that included more than six BCTs were more successful in maintaining change than in those that did not [77]. Samdal et al. [78] found that the number of BCTs unique to the intervention group predicted the short- and long-term effects of physical activity in adults. These findings have significant implications for researchers and developers of intervention programs for promoting self-efficacy and sustaining changes in health behavior. The use of diverse BCTs to enhance self-efficacy can be a valuable strategy for promoting and maintaining changes in health behavior, offering a strategic approach to health management and behavior improvement.

This study has certain limitations. First, the specific details of the interventions actually used in each study may not have been mentioned in the article. Thus, it is possible that the effectiveness of the strategy is underestimated in comparison to that of the actual strategy used. Second, PAP is the most commonly used primary treatment for OSA, and nine of the reviewed studies are PAP related. Therefore, we could not analyze other strategies used in self-efficacy-based interventions. Third, gray literature such as conference proceedings and government reports were not considered, which may have led to potential selection bias.

Conclusion

This systematic review provided valuable insights into the design and implementation of such interventions by analyzing theoretical sources of self-efficacy techniques employed in various studies. Importantly, the study highlights the effectiveness of self-efficacy-based interventions in improving treatment adherence and health outcomes among patients with OSA. Our findings underscore the importance of utilizing a comprehensive approach that integrates multiple theoretical sources and behavioral change techniques to effectively enhance self-efficacy. Moreover, the positive correlation between the diversity of behavior change techniques and self-efficacy outcomes suggests the potential benefits of incorporating various strategies into intervention programs. Tailored interventions that consider individual differences and contextual factors are crucial for optimizing treatment adherence and symptom management in patients with OSA. These insights contribute to the development of evidence-based strategies for promoting self-efficacy and sustaining positive health behavior changes in clinical practice.

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Availability of data, code, and other materials

The data supporting the review findings are available upon submitting a reasonable request to the corresponding author.

Conflict of interest

The authors have no conflicts of interest to disclose.

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Appendix A. Supplementary data

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