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Factors related to the knowledge and skills of evidence-based practice among hospital nurses: A cross-sectional study

Hideaki Furuki*, Nao Sonoda, Akiko Morimoto

Graduate School of Nursing, Osaka Metropolitan University, Osaka, Japan

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Corresponding Author:
Hideaki Furuki, Graduate School of Nursing, Osaka Metropolitan University, Osaka, Japan.
E-mail: s21262g@omu.ac.jp

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ABSTRACT

Background & Aim: This study aimed to clarify the aspects related to the knowledge and skills of evidence-based practice (EBP) among hospital nurses by incorporating potential factors into a single model.
Methods & Materials: This cross-sectional study was conducted among nurses at six hospitals in Japan, selected for convenience. All nurses (n=2,672) who met the eligibility criteria were invited to participate, and data were collected using a structured, self-administered paper-based questionnaire. Knowledge and skills of EBP were measured using the Japanese version of the EBP Questionnaire. Personal factors, such as educational level, participation in EBP education, and experiences conducting research, as well as work-environment factors, including access to a literature database, were measured. Multiple regression analyses were used to evaluate these relationships.
Results: Seven hundred eighteen nurses (26.9%) were included in the final analysis. Having a master's degree ($\beta = 0.153$, $p< 0.001$), received education on all five evidence-based practice steps ($\beta= 0.354$, $p< 0.001$) and any of the steps ($\beta= 0.172$, $p< 0.001$), and experiences conducting research twice ($\beta= 0.201$, $p< 0.001$) or more and once ($\beta= 0.094$, $p= 0.017$) were associated with higher knowledge and skills of EBP. Gender, clinical experience, position, certification, database use, and organizational attitude showed no association.
Conclusion: Effectively enhancing the knowledge and skills of hospital nurses in EBP requires education on all five steps of EBP and experience in conducting research. Furthermore, consideration could be given to strengthening EBP education and research in bachelor's programs to potentially improve evidence-based practice knowledge and skills among more nurses.

Introduction

Evidence-based practice (EBP) is defined as a problem-solving approach for the delivery of healthcare that integrates the best evidence from research and patient care data with clinician expertise, patient preferences, and values (1). EBP is essential to improve the quality of nursing practice, and its promotion has become an urgent issue worldwide (2). However, the promotion of EBP in nursing practice is limited by a lack of knowledge and skills of EBP (3, 4, 5), and a recently published systematic review has also shown that it remains low (6). Therefore, there is a worldwide need for initiatives to improve the knowledge and skills of EBP among nurses.

Understanding essential factors related to the knowledge and skills of EBP among nurses would be helpful in determining priority interventions to improve the knowledge and skills of EBP. We, therefore, recently conducted a comprehensive review of the factors related to the knowledge and skills of EBP among nurses (7). Our review revealed that educational level, participation in EBP education, and experience conducting research were the primary personal factors associated with the knowledge and skills of EBP (7). Additionally, resources and organizational support for EBP were the main work-environment factors related to the knowledge and skills of EBP (7). On the other hand, this review also revealed important issues in previous studies. To accurately evaluate the relationship between each factor and the knowledge and skills of EBP, potential factors

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must be incorporated into a single model (8). However, to our knowledge, no study has evaluated the relationships between each factor and the knowledge and skills of EBP after incorporating these potential factors into a single model. For instance, it has been reported that the relationship between having a bachelor's degree and knowledge and skills of EBP was inconsistent (9, 10, 11, 12). In addition, education is considered an essential factor in improving knowledge and skills, and it is considered to include the five steps of EBP in education: step 1: ask, step 2: acquire, step 3: appraise, step 4: apply, and step 5: assess (13). However, EBP education was evaluated solely on their participation or non-participation in educational activities (7), and the extent of the impact of receiving education about all five steps of EBP on knowledge and skills has not been clarified.

Because of the importance of accurately assessing factors related to knowledge and skills of EBP and linking them to priority interventions, we aimed to clarify factors pertaining to the knowledge and skills of EBP among hospital nurses by incorporating potential factors into a single model.

Methods

Study design and participants

This cross-sectional study was conducted from June to September 2022 at six hospitals in Japan (three university hospitals, two private hospitals, and one public hospital), which were selected for convenience. All registered nurses working at these hospitals who met the eligibility criteria were invited to participate. The inclusion criteria were as follows: 1) currently working as a nurse in a hospital; and 2) directly involved in patient care. The directors of nursing, assistant directors of nursing, and head nurses were excluded from the study. A structured, self-administered, paper-based questionnaire was distributed to participants, and completed questionnaires were returned in sealed envelopes via mail.

The study protocol was prepared in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Osaka Metropolitan University (approval date: June 24, 2022; approval no. 2022–215). Informed consent was obtained from all the participants included in this study.

Data collection

Knowledge and skills of EBP

Knowledge and skills of EBP were measured using the Japanese version of an Evidence-Based Practice Questionnaire (EBPQ-J) (14). This scale is based on an Evidence-Based Practice Questionnaire (EBPQ) developed by Upton and Upton (15). Both the EBPQ and the EBPQ-J have been reported to have high reliability and validity (14). The EBPQ consists of three subscales: EBP implementation, attitudes toward EBP, and knowledge and skills of EBP, while the EBPQ-J consists of four subscales, with knowledge and skills of EBP divided into "knowledge and skills of EBP related to research" and "knowledge and skills of EBP related to practice." We assessed knowledge and skills of EBP using the total scores (range: 9–63) for "knowledge and skills of EBP related to research" (range: 7–49) and "knowledge and skills of EBP related to practice" (range: 2–14) in accordance with the components of the EBPQ. Higher scores indicated more knowledge and skills of EBP. In this study, Cronbach's alpha for the knowledge and skills of EBP was 0.95.

Potential factors related to the knowledge and skills of EBP

In our review (7), educational level, participation in EBP education, experience conducting research, and resources and organizational support for EBP were identified as the primary factors influencing the knowledge and skills of EBP. In addition, age, gender, years of experience as a clinical nurse, position, advanced practice certification, and use of a literature database were also reported as factors related to the knowledge and skills of EBP.

Therefore, the following information was obtained using the self-administered questionnaire as potential factors related to the knowledge and skills of EBP among nurses in this study: age; gender; educational level (diploma, associate degree, bachelor's degree, or master's degree); years of experience as a clinical nurse; position (staff nurse, charge nurse, or assistant head nurse); advanced practice certification ("no," certified nurse, or certified specialist nurse); participation in EBP education (none, no education on all five steps of EBP; partially, received education on any of the five steps of EBP; completely, received education on all five steps of EBP); number of times of experiences conducting research; literature database (yes or no); organizational attitude toward EBP ("Is your workplace a positive attitude toward EBP?" non-positive, neither, moderately positive, or very positive). The five steps of EBP are as follows: Step 1, formulate a clinical question; 2, find best evidence; 3, critically appraise evidence; 4, apply evidence within a practice; 5, evaluate the impact of implementation.

Statistical analyses

First, the normality of the EBP knowledge and skills score was evaluated using the Shapiro–Wilk test and Q–Q plots. While the Shapiro–Wilk test indicated a statistically significant deviation from normality ($p < 0.05$), the Q–Q plot showed that the distribution was approximately normally distributed (Figure 1). Considering this visual evidence and the robustness of parametric tests to mild deviations from normality (16), we applied parametric analyses. Accordingly, differences in the knowledge and skills scores of EBP were analyzed according to personal and work-environment factors using Student's t-test or analysis of variance (ANOVA).

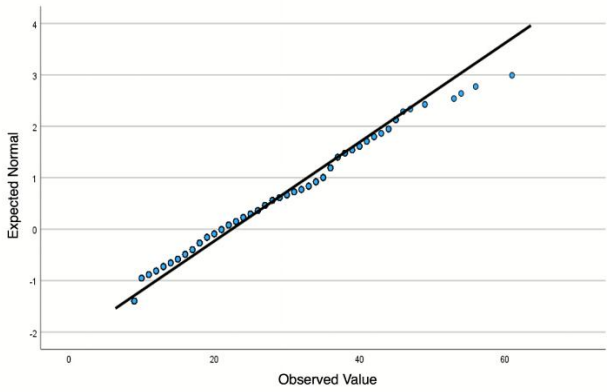

Figure 1. Normal Q–Q plot of knowledge and skills score of EBP

Next, multiple regression analyses were used to estimate the standardized coefficients (β), unstandardized coefficients (B), 95% confidence intervals (CI), p-values, and Cohen's f^2 for each factor associated with the EBP knowledge and skills score. After creating dummy variables for categorical variables, gender, educational level, years of experience as clinical nurses, position, advanced practice certification, participation in EBP education, and number of times of experiences conducting research as personal factors, as well as a literature database and organizational attitude toward EBP as work-environment factors, these were included in the model. In addition, the same analysis was conducted using "knowledge and skills of EBP related to research" and "knowledge and skills of EBP related to practice" as outcomes, according to the construct of the EBPQ-J (14). To assess multicollinearity among independent variables included in all regression models, variance inflation factors (VIFs) were calculated. All VIFs were 3.0 or less, indicating that multicollinearity was not a concern in any of the analyses. All data were analyzed using the SPSS statistical software version 26 (IBM SPSS Japan, Tokyo, Japan). All

reported p-values were two-tailed, and values < 0.05 were considered statistically significant.

Results

Participant characteristics

We included 2,672 nurses, of whom 766 (28.7%) agreed to participate in a mail survey. After excluding those with missing data, 718 nurses (26.9%) were included in the final analysis. Table 1 shows the characteristics thereof. The mean age (standard deviation) was 36.0 (10.0), and more than 90% were female. Of all the participants, 40.1% had a bachelor's degree, 4.0% had a master's degree, and over half had more than 10 years of clinical experience. Most participants were employed at hospitals with access to a literature database, and more than 60% indicated that their organizational attitudes toward EBP were positive.

Differences in knowledge and skills score of EBP by personal and work-environmental factors

Table 2 shows the differences in EBP knowledge and skill scores of EBP by personal and work-environment factors. Educational level ($p<0.001$), advanced practice certification ($p<0.001$), participation in EBP education ($p<0.001$), number of research experiences ($p<0.001$), literature database ($p= 0.017$), and organizational attitude toward EBP ($p= 0.003$) differed significantly among the groups. However, age, gender, years of experience as a clinical nurse, and position did not differ significantly between the groups.

Table 1. Participants' characteristics (n=718)

Factors	n (%)
Personal factors	
Age (years)	Mean (SD): 36.0 (10.0)
Gender	
Women	663 (92.3)
Men	55 (7.7)
Educational level	
Diploma or associate degree	400 (55.7)
Bachelor's degree	287 (40.0)
Master's degree	31 (4.3)
Years of experience as a clinical nurse	
≤3	159 (22.1)
4–9	160 (22.3)
≥10	399 (55.6)
Position	
Staff nurse	653 (90.9)
Charge nurse or assistant head nurse	65 (9.1)
Advanced practice certification	
No	692 (96.4)
Certified nurse or certified specialist nurse	26 (3.6)
Participation in EBP education[a]	
None	236 (32.9)
Partially	420 (58.5)
Completely	62 (8.6)
Number of times of experiences conducting research	
0	322 (44.9)
1	146 (20.3)
≥2	250 (34.8)
Work-environment factors	
Literature database	
No	29 (4.0)
Yes	689 (96.0)
Organizational attitude toward EBP	
Non-positive	82 (11.4)
Neither	186 (25.9)
Moderate positive	281 (39.2)
Very positive	169 (23.5)

Age is shown as mean (standard deviation). Dichotomous data and categorical data are shown as n (%). [a]Participation in EBP education: None; no education received on all five steps of EBP, partially; received education on any of the five steps of EBP, completely; received education on all five steps of EBP.

Table 2. Differences in knowledge and skills score of EBP by personal and work-environmental factors (n=718)

Factors	Knowledge and skills score of EBP (range: 9–63)	*p*-value
Personal factors		
Age (years)		0.988
20s	22.3 (9.4)	
30s	22.4 (10.2)	
40s	22.5 (11.4)	
≥50	22.7 (11.4)	
Gender		0.121
Women	22.2 (10.3)	
Men	24.5 (10.9)	
Educational level		<0.001
Diploma or associate degree	21.6 (10.3)	
Bachelor's degree	22.3 (9.8)	
Master's degree	33.7 (11.3)	
Years of experience as a clinical nurse		0.527
≤3	21.7 (9.2)	
4–9	22.4 (9.9)	
≥10	22.7 (11.0)	
Position		0.100
Staff nurse	22.2 (10.4)	
Charge nurse or assistant head nurse	24.4 (10.7)	
Advanced practice certification		<0.001
No	22.1 (10.3)	
Certified nurse or certified specialist nurse	30.1 (10.7)	
Participation in EBP education[a]		<0.001
None	18.7 (9.1)	
Partially	22.9 (9.9)	
Completely	33.3 (9.9)	
Number of times of experiences conducting research		<0.001
0	20.1 (9.3)	
1	23.4 (9.7)	
≥2	24.8 (11.5)	
Work-environment factors		
Literature database		0.017
No	17.9 (9.4)	
Yes	22.6 (10.4)	
Organizational attitude toward EBP		0.004
Non-positive	20.4 (8.9)	
Neither	20.9 (10.2)	
Moderate positive	23.0 (10.2)	
Very positive	24.2 (11.2)	

Continuous data analyzed with a t-test or ANOVA and shown as mean (standard deviation).

[a]Participation in EBP education: None; no receive education on all five steps of EBP, partially; received education on any of the five steps of EBP, completely; received education on all five steps of EBP.

Factors related to the knowledge and skills of EBP among hospital nurses

Table 3 presents standardized coefficients, unstandardized coefficients, 95% confidence intervals (CIs), p-values, and Cohen's f^2 for personal and work-environment factors related to the knowledge and skills score of EBP. Factors related to the knowledge and skills of EBP among hospital nurses were educational level, participation in EBP education, and a number of times of experience conducting research. Specifically, nurses with a master's degree were positively associated with knowledge and skills of EBP compared to those with a diploma or associate degree (β= 0.153, p< 0.001). Nurses who received education on all five steps of EBP (β= 0.354, p< 0.001) and any of the five steps of EBP (β= 0.172, p< 0.001) were positively associated with knowledge and skills of EBP compared to those without education on all five steps of EBP. Nurses with two or more experiences conducting research (β= 0.201, p< 0.001) and one experience (β= 0.094, p= 0.017) were positively associated with knowledge and skills

of EBP compared to those without experience conducting research. Conversely, gender, years of experience as a clinical nurse, position, advanced practice certification, literature database, and organizational attitude toward EBP were not associated with knowledge and skills of EBP. The regression model was statistically significant, $F(15, 702)= 13.016$, $p< .001$, with an adjusted R^2 of 0.201. An additional analysis, using "knowledge and skills of EBP related to research" and "knowledge and skills of EBP related to practice" as outcomes, showed nearly identical results (Tables 4-1 and 4-2).

Table 3. Personal and work-environment factors related to the knowledge and skills of EBP among hospital nurses (n=718)

Factors	Reference	*β*	B	95% CI	*p*-value	Cohen's f^2
Personal factors						
Gender						0.003
Men	vs. women	0.049	1.920	(-0.664 to 4.503)	0.145	
Educational level						0.028
Bachelor's degree	vs. diploma or associate degree	-0.002	-0.045	(-1.658 to 1.568)	0.956	
Master's degree	vs. diploma or associate degree	0.153	7.813	(4.229 to 11.398)	<0.001	
Years of experience as a clinical nurse						0.002
4–9	vs. ≤3	-0.022	-0.551	(-2.657 to 1.554)	0.607	
≥10	vs. ≤3	-0.057	-1.196	(-3.352 to 0.959)	0.276	
Position						<0.001
Charge nurse and assistant head nurse	vs. staff nurse	0.020	0.725	(-1.826 to 3.277)	0.577	
Advanced practice certification						0.004
Certified nurse or certified specialist nurse	vs. no	0.060	3.314	(-0.523 to 7.150)	0.090	
Participation in EBP education[a]						0.124
Partially	vs. none	0.172	3.617	(1.957 to 5.277)	<0.001	
Completely	vs. none	0.354	13.087	(10.329 to 15.844)	<0.001	
Number of times of experience conducting research						0.027
1	vs. 0	0.094	2.419	(0.442 to 4.396)	0.017	
≥2	vs. 0	0.201	4.379	(2.403 to 6.355)	<0.001	
Work-environment factors						
Literature database						0.001
Yes	vs. no	0.028	1.481	(-2.087 to 5.050)	0.415	
Organizational attitude toward EBP						0.005
Neither	vs. non-positive	0.005	0.117	(-2.321 to 2.555)	0.925	
Moderate positive	vs. non-positive	0.058	1.242	(-1.086 to 3.569)	0.295	
Very positive	vs. non-positive	0.067	1.635	(-0.895 to 4.166)	0.205	

Dummy variables coded 0 for women/1 for men (gender); 0 for diploma or associate degree/1 for bachelor's degree/2 for master's degree (educational level); 0 for "≤3"/1 for "4–9"/2 for "≥10" (years of experience as a clinical nurse); 0 for staff nurse/1 for charge nurse and assistant head nurse (position); 0 for "no"/1 for certified nurse or certified specialist nurse (advanced practice certification); 0 for "none"/1 for "partially"/2 for "completely" (participation in EBP education); 0 for "0"/1 for "1"/2 for "≥2" (number of experience conducting research); 0 for "no"/1 for "yes" (literature database); and 0 for non-positive/1 for neither /2 for moderate positive /3 for very positive (organizational attitude toward EBP).

Model summary: $F (15, 702) = 13.016$, $p < 0.001$; Adjusted $R^2 = 0.201$

Cohen's f^2 was calculated for each predictor to indicate practical significance.

[a]Participation in EBP education: None; no education received on all five steps of EBP, partially; received education on any of the five steps of EBP, completely; received education on all five steps of EBP. *β*, standardized coefficients; B, unstandardized coefficients; CI, confidence interval.

Table 4–1. Personal and work-environmental factors related to the knowledge and skills of EBP related to research among hospital nurses (n=718)

Factors	Reference	*β*	B	95% CI	*p*-value	Cohen's f²
Personal factors						
Gender						0.005
Men	vs. women	0.065	1.961	(-0.035 to 3.958)	0.054	
Educational level						0.038
Bachelor's degree	vs. diploma or associate degree	-0.002	-0.036	(-1.282 to 1.210)	0.955	
Master's degree	vs. diploma or associate degree	0.180	7.135	(4.365 to 9.905)	<0.001	
Years of experience as a clinical nurse						0.002
4–9	vs. ≤3	-0.019	-0.372	(-1.999 to 1.255)	0.654	
≥10	vs. ≤3	-0.066	-1.067	(-2.733 to 0.598)	0.209	
Position						0.001
Charge nurse and assistant head nurse	vs. staff nurse	0.023	0.647	(-1.324 to 2.619)	0.519	
Advanced practice certification						0.005
Certified nurse or certified specialist nurse	vs. no	0.062	2.688	(-0.277 to 5.653)	0.076	
Participation in EBP education[a]						0.118
Partially	vs. none	0.130	2.123	(0.84 to 3.406)	0.001	
Completely	vs. none	0.342	9.831	(7.700 to 11.961)	<0.001	
Number of times of experiences conducting research						0.028
1	vs. 0	0.094	1.887	(0.360 to 3.415)	0.016	
≥2	vs. 0	0.205	3.463	(1.937 to 4.990)	<0.001	
Work-environment factors						
Literature database						0.001
Yes	vs. no	0.024	1.001	(-1.757 to 3.759)	0.476	
Organizational attitude toward EBP						0.005
Neither	vs. non-positive	0.009	0.167	(-1.717 to 2.052)	0.862	
Moderate positive	vs. non-positive	0.064	1.056	(-0.743 to 2.855)	0.249	
Very positive	vs. non-positive	0.069	1.315	(-0.641 to 3.270)	0.187	

Dummy variables coded 0 for women/1 for men (sex); 0 for diploma or associate degree/1 for bachelor's degree/ 2 for master's degree (educational level); 0 for "≤3"/1 for "4–9"/2 for "≥10" (years of experience as a clinical nurse); 0 for staff nurse/1 for charge nurse and assistant head nurse (position); 0 for "no"/1 for certified nurse or certified specialist nurse (advanced practice certification); 0 for "none"/1 for "partially"/2 for "completely" (participation in EBP education); 0 for "0"/1 for "1"/2 for "≥2" (number of experience conducting research); 0 for "no"/1 for "yes" (literature database); and 0 for non-positive/1 for neither /2 for moderate positive /3 for very positive (organizational attitude toward EBP).

Model summary: $F(15, 702) = 13.511$, $p < 0.001$; Adjusted $R^2 = 0.207$

Cohen's f^2 was calculated for each predictor to indicate practical significance.

[a]Participation in EBP education: None; no education received on all five steps of EBP, partially; received education on any of the five steps of EBP, completely; received education on all five steps of EBP.

β, standardized coefficients; B, unstandardized coefficients; CI, confidence interval.

Table 4–2. Personal and work-environmental factors related to the knowledge and skills of EBP related to practice among hospital nurses (n=718)

Factors	Reference	*β*	B	95% CI	*p*-value	Cohen's f²
Personal factors						
Gender						<0.001
Men	vs. women	-0.004	-0.042	(-0.867 to 0.783)	0.921	
Educational level						0.002
Bachelor's degree	vs. diploma or associate degree	-0.001	-0.009	(-0.524 to 0.506)	0.973	
Master's degree	vs. diploma or associate degree	0.044	0.678	(-0.466 to 1.823)	0.245	
Years of experience as a clinical nurse						<0.001
4–9	vs. ≤3	-0.024	-0.179	(-0.851 to 0.493)	0.601	
≥10	vs. ≤3	-0.020	-0.129	(-0.817 to 0.559)	0.713	
Position						<0.001
Charge nurse and assistant head nurse	vs. staff nurse	0.007	0.078	(-0.737 to 0.893)	0.851	
Advanced practice certification						0.001
Certified nurse or certified specialist nurse	vs. no	0.037	0.626	(-0.599 to 1.851)	0.316	
Participation in EBP education[a]						0.085
Partially	vs. none	0.234	1.494	(0.964 to 2.024)	<0.001	
Completely	vs. none	0.291	3.256	(2.376 to 4.137)	<0.001	
Number of times of experiences conducting research						0.012
1	vs. 0	0.068	0.532	(-0.099 to 1.163)	0.098	
≥2	vs. 0	0.139	0.915	(0.284 to 1.546)	0.005	
Work-environment factors						
Literature database						0.001
Yes	vs. no	0.030	0.480	(-0.660 to 1.620)	0.408	
Organizational attitude toward EBP						0.002
Neither	vs. non-positive	-0.007	-0.050	(-0.829 to 0.728)	0.899	
Moderate positive	vs. non-positive	0.029	0.185	(-0.558 to 0.929)	0.625	
Very positive	vs. non-positive	0.043	0.321	(-0.487 to 1.129)	0.436	

Dummy variables coded 0 for women/1 for men (sex); 0 for diploma or associate degree/1 for bachelor's degree/ 2 for master's degree (educational level); 0 for "≤3"/1 for "4–9"/2 for "≥10" (years of experience as a clinical nurse); 0 for staff nurse/1 for charge nurse and assistant head nurse (position); 0 for "no"/1 for certified nurse or certified specialist nurse (advanced practice certification); 0 for "none"/1 for "partially"/2 for "completely" (participation in EBP education); 0 for "0"/1 for "1"/2 for "≥2" (number of experience conducting research); 0 for "no"/1 for "yes" (literature database); and 0 for non-positive/1 for neither /2 for moderate positive /3 for very positive (organizational attitude toward EBP).

Model summary: $F(15, 702) = 6.814$, $p < 0.001$; Adjusted $R^2 = 0.108$

Cohen's f² was calculated for each predictor to indicate practical significance.

[a]Participation in EBP education: None; no education received on all five steps of EBP, partially; received education on any of the five steps of EBP, completely; received education on all five steps of EBP.

β, standardized coefficients; B, unstandardized coefficients; CI, confidence interval.

Table 5. Personal and work-environmental factors related to the knowledge and skills of EBP among hospital nurses, excluding master's degree holders (n=689)

Factors	Reference	*β*	B	95% CI	*p*-value	Cohen's f²
Personal factors						
Gender						0.004
Men	vs. women	0.060	2.332	(-0.357 to 5.020)	0.089	
Educational level						<0.001
Bachelor's degree	vs. diploma or associate degree	-0.005	-0.110	(-1.715 to 1.496)	0.893	
Years of experience as a clinical nurse						0.002
4–9	vs. ≤3	-0.030	-0.721	(-2.851 to 1.409)	0.506	
≥10	vs. ≤3	-0.063	-1.284	(-3.473 to 0.906)	0.250	
Position						0.001
Charge nurse and assistant head nurse	vs. staff nurse	0.030	1.042	(-1.563 to 3.647)	0.433	
Advanced practice certification						0.004
Certified nurse or certified specialist nurse	vs. no	0.057	3.412	(-0.859 to 7.683)	0.117	
Participation in EBP education[a]						0.131
Partially	vs. none	0.174	3.543	(1.885 to 5.201)	<0.001	
Completely	vs. none	0.368	13.335	(10.543 to 16.128)	<0.001	
Number of times of experience conducting research						0.027
1	vs. 0	0.109	2.747	(0.746 to 4.747)	0.007	
≥2	vs. 0	0.199	4.234	(2.235 to 6.233)	<0.001	
Work-environment factors						
Literature database						0.001
Yes	vs. no	0.029	1.471	(-2.073 to 5.014)	0.415	
Organizational attitude toward EBP						0.004
Neither	vs. non-positive	0.006	0.137	(-2.316 to 2.590)	0.913	
Moderate positive	vs. non-positive	0.063	1.310	(-1.037 to 3.656)	0.273	
Very positive	vs. non-positive	0.048	1.135	(-1.420 to 3.691)	0.383	

Dummy variables coded 0 for women/1 for men (sex); 0 for diploma or associate degree/1 for bachelor's degree/ 2 for master's degree (educational level); 0 for "≤3"/1 for "4–9"/2 for "≥10" (years of experience as a clinical nurse); 0 for staff nurse/1 for charge nurse and assistant head nurse (position); 0 for "no"/1 for certified nurse or certified specialist nurse (advanced practice certification); 0 for "none"/1 for "partially"/2 for "completely" (participation in EBP education); 0 for "0"/1 for "1"/2 for "≥2" (number of experience conducting research); 0 for "no"/1 for "yes" (literature database); and 0 for non-positive/1 for neither /2 for moderate positive /3 for very positive (organizational attitude toward EBP).
Model summary: $F(14, 672) = 10.373$, $p < 0.001$; Adjusted $R^2 = 0.161$
Cohen's f² was calculated for each predictor to indicate practical significance.
[a]Participation in EBP education: None; no education received on all five steps of EBP, partially; received education on any of the five steps of EBP, completely; received education on all five steps of EBP.
β, standardized coefficients; B, unstandardized coefficients; CI, confidence interval

Table 6. Differences in participation in EBP education between the non-positive, neither, and positive groups of organizational attitudes toward EBP (n=718)

	Organizational attitude toward EBP				*p*-value
	Non-positive (n=82)	Neither (n=186)	Moderate positive (n=281)	Very positive (n=169)	
Participation in EBP education[a]					<0.001
None	41 (50.0)	72 (38.7)	83 (29.5)	40 (27.3)	
Partially	39 (47.6)	104 (55.9)	175 (62.3)	102 (60.4)	
Completely	2 (2.4)	10 (5.4)	23 (8.2)	27 (16.0)	

Participation in EBP education was analyzed with Chi-squared tests and shown as n (%).
[a]Participation in EBP education: None; no education received on all five steps of EBP, partially; received education on any of the five steps of EBP, completely; received education on all five steps of EBP.

Discussion

After incorporating potential factors related to knowledge and skills of EBP into a single model, educational level (master's degree), participation in EBP education (completely or partially), and the number of times of experience conducting research (two or more times or one time) were significantly positively associated with knowledge and skills of EBP among hospital nurses in this study. However, gender, years of experience as a clinical nurse, position, advanced practice certification, literature database, and organizational attitude toward EBP were not associated with knowledge and skills of EBP. To our knowledge, no studies have

comprehensively examined the relationships between multiple factors and EBP knowledge and skills among hospital nurses. Our results provide useful insights for future initiatives aimed at improving EBP competencies among nurses.

Having a master's degree was positively associated with hospital nurses' knowledge and skills of EBP. Since master's programs typically involve research, this is likely due to acquiring knowledge and skills of EBP, such as formulating clinical questions, finding the best evidence, and critically appraising the evidence while conducting research (17). In contrast, having a bachelor's degree was not associated with EBP knowledge or skills among hospital nurses. This finding suggests that EBP education may not be adequately provided in undergraduate education. In fact, a large-scale fact-finding survey conducted in six European countries found that only 30% of bachelor's degree programs offered stand-alone EBP courses (18). While the master's program is important for learning EBP and conducting research, consideration could be given to strengthening EBP education and research in bachelor's programs to potentially support EBP knowledge and skill improvements among more nurses.

Receiving education on all five steps of EBP had the largest standardized coefficient on knowledge and skills of EBP in this study. The same results were obtained in an additional analysis that excluded master's degree holders to eliminate the influence of educational level (Table 5). These findings support the argument that it is important to provide education on the five steps of EBP (13). However, a systematic review has reported that most previous studies only provided education on steps 1–3 of EBP (19). This study also showed that the proportion of nurses who had received education on all five steps of EBP was only 8.6%. Therefore, it would be crucial to provide education on all five steps of EBP to effectively improve hospital nurses' knowledge and skills of EBP.

Experience in conducting research is positively associated with knowledge and skills of EBP among hospital nurses. Moreover, two or more experiences in conducting research were more positively associated with knowledge and skills of EBP than one experience. Hence, it would be crucial to have multiple experiences in conducting research. However, research by hospital nurses is not being undertaken and is insufficient due to various barriers such as insufficient time, inadequate research knowledge, lack of research training opportunities, low priority of research, and organizational culture that does not support research (7, 20). Therefore, it would be crucial for nursing administrators and educators to address the above barriers and offer more opportunities for experiences conducting research, especially multiple experiences.

Work-environment factors, such as the literature database and organizational attitude toward EBP, were not significantly related to the knowledge and skills of EBP among hospital nurses in a multivariable analysis model. This suggests that personal factors have a more substantial influence on the knowledge and skills of EBP among nurses than work-environment factors. Additional analysis showed that the more positive organizational attitudes toward EBP, the higher the proportion of nurses who had participated in EBP education (Table 6). Therefore, a positive organizational attitude toward EBP is essential, although not sufficient, and it is necessary to provide EBP education for nurses to improve their knowledge and skills of EBP.

In addition, the EBP competency-associated factors differed between research- and practice-related EBP knowledge and skills. Both experiences, conducting research and participation in EBP education, were significantly competency-associated in both domains. In contrast, having a master's degree was associated only with research- and not with practice-related competencies. These discoveries might reflect the current focus of many master's programs on research training, as previously discussed (17). Consideration could be given to enhancing

the practical, clinically oriented EBP education elements at the graduate level to support a more balanced EBP competency development.

This study has several limitations. First, the cross-sectional design could not prove causality. Therefore, prospective studies are required to confirm these findings. Second, because the response rate was 28.7%, we cannot exclude the possibility of selection bias, where individuals with a greater interest in EBP were more likely to be selected. Third, because no instrument was available in Japanese, our study assessed organizational attitudes toward EBP using a self-designed questionnaire. Fourth, this study was conducted in Japan, a high-income country. Based on several studies conducted in high-income countries, educational level, participation in EBP education, and experiences conducting research are all reported factors associated with knowledge and skills of EBP (9, 10, 11, 12, 21, 22, 23). In contrast, studies from low- and middle-income countries described associations with educational level and experiences conducting research, but not with participation in EBP education (24, 25). To enhance the generalizability of the hereby-presented results, future research studies should comprise similar analyses in low- and middle-income countries to assess reproducibility in different settings. Finally, the number of participants in certain subgroups, e.g., those holding a master's degree (n = 31, 4.3 %), certified nurses (n = 26, 3.6 %), and those who were educated on all five EBP steps (n = 62, 8.6 %), remained relatively small. Therefore, findings related to these groups should be interpreted with caution, as the observed associations in these groups might be somewhat unstable.

Conclusion

After incorporating potential factors related to knowledge and skills of EBP into a single model, educational level (master's degree), participation in EBP education (completely or partially), and the number of times of experiences conducting research (two or more times or one time) were significantly positively associated with knowledge and skills of EBP among hospital nurses in this study. However, gender, years of experience as a clinical nurse, position, advanced practice certification, literature database, and organizational attitude toward EBP were not associated with knowledge and skills of EBP. To effectively improve hospital nurses' knowledge and skills of EBP, we believe that firstly, it would be essential to provide education on all five steps of EBP. Secondly, we believe that it would be crucial to have experience in conducting research, especially multiple experiences. Thirdly, while the master's program is an important program for learning EBP and conducting research, consideration could be given to strengthening EBP education and research in bachelor's programs to potentially support EBP knowledge and skill improvements among more nurses.

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Conflict of Interest

The authors declare that they have no competing financial interests or personal relationships that may have influenced the work reported in this study.

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