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Nurses' Knowledge, Skills, Attitudes, and Barriers to Evidence-based Practice in Sudan: A Cross-Sectional Study

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Abstract:

Introduction: Evidence-based Practice (EBP) is crucial to improving patient outcomes and providing high-quality healthcare. This study aimed to investigate nurses' knowledge, skills, attitudes, and barriers to EBP in Sudanese hospitals.

Methods: This cross-sectional study was conducted in four Sudanese hospitals, with a total of 373 nurses recruited *via* convenience sampling. Data were collected using the Nursing Evidence-Based Practice Survey and analyzed using SPSS (version 28).

Results: Of the 373 nurses who participated in this study, 265 (71.0%) were female, 26.8% were between 20 and 30 years old, 54.4% held a bachelor's degree, 53.1% worked in a government hospital, 28.7% had from 1 to 5 years of clinical experience, 35.1% worked in an emergency department, and 83.6% lacked EBP training. Most nurses had poor knowledge skills (53.9%) and attitudes (57.9%) regarding EBP.

Discussion: Male nurses had a higher perception of the unit culture (M = 210.42, p = 0.007), nurses between 31 and 40 years old had a significantly higher perception of the organizational culture (M = 230.77, p = 0.001), and those working in the general ward had a higher perception of the organizational culture (M = 212.56, p = 0.009). A significantly positive weak correlation (r = .349, p = 0.000) was observed between knowledge, skills, and attitude.

Conclusion: The findings highlighted nurses' low levels of knowledge, skills, attitude, and barriers to EBP in Sudanese hospitals. Health policymakers and nursing managers can use these insights to design continuous education programs for enhancing KSAs toward EBP in Sudan.

Keywords: Nurses, Knowledge and skills, Attitude, Evidence-based practice, Sudan.

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1. INTRODUCTION

Evidence-based practice (EBP) is an emerging issue for the nursing profession in the 21st century [1]. It is now commonly recognized as crucial in improving patient outcomes and achieving high-quality healthcare [2, 3]. EBP is of concern to government regulators, healthcare funders, and patients, as it is the gold standard of care [4]. It is a problem-solving method for providing healthcare that combines scientific research, clinical skills, values, and patient preferences [5]. The application of EBP in clinical nursing practice, teaching, and scientific research is highly prioritized by healthcare facilities worldwide [6, 7]. Studies have shown that implementing EBP results in improved health outcomes, teamwork among healthcare workers, job satisfaction, and safe and high-quality healthcare [8]. In nursing, EBP empowers nurses to make the best clinical judgments and create individualized care plans that result in effective patient care [9]. The World Health Organization (WHO) is also calling on health systems to support nursing services through EBP, which is essential to improving community health [10]. Nurses are vital in translating evidence into clinical practice [11], implementing continuous changes to implement EBP effectively, and improving care quality. They must possess a positive attitude, sufficient knowledge, and the ability to utilize relevant research [12, 13]. Improving nursing knowledge and adhering to EBP is vital for filling nurses' research and practice gaps [14]. In addition, EBP application can be improved by identifying obstacles and facilitators [15].

Existing literature finds that nurses perceive EBP positively and consider it crucial to their work [16]. However, there are multiple barriers to its implementation, such as poor information systems, resistance to changing practices in individual cultures, and a lack of related research, time, and resources [17, 18]. Nurses and nursing students also encounter a variety of barriers to EBP implementation [19]. A study among nurses and midwives in Amhara Region Public Hospitals in Ethiopia revealed that perceived barriers to implementing EBP included limited knowledge, inadequate skills to apply research findings, poor time management, lack of motivation, insufficient resources, and lack of training [20]. Another study reported that nurses' limited knowledge, skills, and time were significant barriers [21]. Studies in Poland, Saudi Arabia, and Oman reported that nurses had limited knowledge but a positive attitude toward EBP [22, 23]. However, others showed that despite nurses' strong knowledge, practices, and positive attitudes toward EBP, several barriers to its implementation exist [24]. A study in Iran noted that nurses have high knowledge and skills related to EBP [25]. Similarly, a study in Taiwan found that senior nurses have higher knowledge, practice, and implementation levels than junior nurses [26].

EBP is advancing quickly and has succeeded in contemporary nursing in developing countries [27]. Despite the advantages of implementing EBP in developing countries, including better health, safety, and cost outcomes, the healthcare practices of most low- and middle-income countries have faced challenges in their implementation [28]. In Sudan specifically, little is known about the implementation of EBP among its nurses. Therefore, we must bridge this knowledge gap. This study aimed to investigate nurses' knowledge, skills, attitudes, and barriers to EBP in Sudanese hospitals. The findings of this study may help healthcare policymakers and administrators adopt appropriate interventions to improve nurses' knowledge, attitude, training, and resources for implementing EBP in Sudanese hospitals.

2. MATERIALS AND METHODS

2.1. Study Design and Period

We conducted this descriptive, cross-sectional study design in four government hospitals and reported the results according to STROBE guidelines [29, 30].

2.2. Study Setting

This study was conducted at four government hospitals in Sudan from February 24 to April 18, 2020, to obtain a representative sample of nurses. Initially, data were collected at the Kosti Teaching Hospital in Kosti City. This facility provides medical services to patients from the city and surrounding villages within the state's boundaries [31]. The other three government hospitals, namely, Sudan Heart Center, Bahari Teaching Hospital, and Khartoum Teaching Hospital, were in Khartoum State, the federal capital of Sudan [32].

2.3. Sample Size and Method

We used a standard formula to determine the sample size for this study [33]. The formula assumes $n = P(1-P)Z^2/d^2$, where n = the sample size, P = the expected prevalence or proportion (with 50% assumed for an unknown population), $Z = 1.96$ for a 95% confidence level, and d = indicates the acceptable margin of error (0.05 for 5%). The study was conducted with 80% power.

According to the formula, the ideal sample size was 385 participants. We initially distributed 390 questionnaires of the EBP survey. We eliminated 17 incomplete ones and received responses from 373 nurses using a convenience technique, yielding a response rate of 95.6%.

2.4. Subjects of Study and Inclusion and Exclusion Criteria

The researchers invited registered nurses from private and governmental hospitals who met the inclusion criteria to participate voluntarily in the study. Those excluded were nursing students, non-nursing staff, or nurses who refused to participate and did not complete the questionnaire.

2.5. Data Collection Instrument

We adopted the validated Nursing Evidence-Based Practice Survey (NEBPS) tool with permission [34, 35]. The NEBPS is a self-administered survey that includes 25 items, categorized into five factors: nurses' knowledge and skills (7 items), attitude (2 items), time (2 items), unit

culture (5 items), and organizational culture (9 items). It is based on a five-point Likert-type scale ranging from 1 (*strongly disagree*), 2 (*disagree*), 3 (*uncertain*), 4 (*agree*), and 5 (*strongly agree*). The overall mean scores of the nurses' knowledge, skills, and attitude (KSA) were computed. A median cut-off point (interquartile range) was used to divide them into two categories: scores below the median were considered poor (<50%). In contrast, scores equal to or above the median score were considered good (≥50%) [36-38]. In terms of unit and organizational culture, higher scores signified a high level of support and a strong culture conducive to EMP implementation. Regarding the time factor, a high score indicated that there was enough time to implement EBP in Sudan. In the current study, the subscale reliability was measured using Cronbach's alpha, yielding the following values: 0.593 for knowledge/skills, 0.04 for attitude, 0.082 for time, 0.609 for organizational culture, and 0.526 for unit culture. The overall Cronbach's alpha of internal consistency in five concepts was μ = 0.84, which indicated the high reliability of the tool [34, 35].

2.6. Ethical Clearance of the Study

The author obtained ethical clearance prior to data collection. The authors likewise received consent from each nurse after explaining the aims of the study. They informed the nurses of their right to accept, refuse, or withdraw from the study. All nurses' responses were anonymous, kept strictly confidential, and used only for research. The authors did not identify any of the nurses' personality traits.

2.7. Data Analysis

We coded the quantitative data from this study and analyzed it using the Statistical Package for Social Sciences (SPSS, version 28), including descriptive and inferential statistics. We used descriptive statistics to present the frequencies, percentages, means, and standard deviations. The researchers initially tested the normality of the data using the Kolmogorov-Smirnov test before performing inferential statistics, revealing that the data did not follow a normal distribution. Thus, the researchers used nonparametric tests to compare differences and correlations among the study's variables. These include the Mann-Whitney U test to compare the significant mean difference between the two independent groups, the Kruskal-Wallis test to compare the significant mean difference between more than two independent groups, and the Spearman correlation coefficient to measure the correlation (r). All results were analyzed at the significance level of $p < 0.05$.

3. RESULTS

3.1. Demographic Characteristics

We initially distributed 390 questionnaires for the EBP survey. We eliminated 17 incomplete ones and received complete responses from 373 nurses, resulting in a 95.6% response rate. The results revealed that most of the nurses were female (265, 71.0%), belonged to the 20–30-year age group (100, 26.8%), had a bachelor's degree (203, 54.4%), and were working in a government hospital (53.1%). Furthermore, the majority had clinical experience (107, 28.7%), had 1 to 5 years of experience working in an emergency department (131, 35.1%), and had never received EBP training. Table **1** presents the demographic characteristics.

Table 1. Demographic characteristics of respondents on NEBPS (N=373).

Variable	N (%)
Gender	-
Male	108 (29.0%)
Female	265 (71.0%)
Age	-
20-30	127 (34.0%)
31-40	100 (26.8%)
41-50	87 (23.3%)
>51	59 (15.8%)
Education level	-
Diploma	127 (34.0%)
Baccalaureate	203 (54.4%)
Master's	43 (11.5%)
Type of employment?	-
Government	198 (53.1%)
Private	175 (46.9%)
Clinical experience	-
Less than 1 year	95 (25.5%)
1 to 5 years	107 (28.7%)
6 to 10 years	89 (23.9%)
> 10 years	82 (22.0%)
Clinical setting	-
OPD	67 (18.0%)
ER	131 (35.1%)
ICU	65 (17.4%)
GW	110 (29.5%)
Have you ever received training course of EBP within your organization?	-
Yes	61 (16.4%)
No	312 (83.6%)

Note: N= number, NEBPS= Nursing Evidence-Based Practice Survey, OPD= Outpatient department, ER= Emergency room, ICU= Intensive care unit, GW= General Ward.

3.2. Assessment of Nurses' KSAs toward EBP

Regarding nurses' knowledge and skills, the results showed that the majority (121, 32.4%) can read nursing research and make a sound judgment about its scientific merit, and 107 (28.7%) can read a nursing research report and generalize its strengths and weaknesses. However, 161 (43.2%) of the respondents strongly disagreed that they can develop an evaluation plan to monitor practice improvements made through evidence-based nursing (Table **2**).

Table 2. Knowledge, skills, and attitude of nurses in implementing EBP (n= 373).

Items	Mean ± SD	Responses n (%)				
		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
Knowledge and skills about EBP	-	-	-	-	-	-
1. I am aware of evidence-based practice in general.	3.23 ± 1.4	60 (16.1%)	68(18.2%)	65 (17.4%)	86 (23.1%)	94 (25.2%)
2. I know where to find evidence (*e.g.*, research findings or evidence-based clinical guidelines) to guide my practice.	3.12± 1.36	61 (16.4%)	70 (18.8%)	78 (20.9%)	91 (24.4%)	73 (19.6%)
3. I can read a nursing research report and generalize its strengths and weaknesses.	3.57± 1.25	31 (8.3%)	45 (12.1%)	84 (22.5%)	106 (28.4%)	107 (28.7%)
4. I can read a nursing research report and make a sound judgment about its scientific merit.	3.50± 1.37	41 (11.0%)	58 (15.5%)	68 (18.2%)	85 (22.8%)	121 (32.4%)
5. I can critique "synthesis" reports or technology assessments (*e.g.*, systematic reviews) for a general understanding of their strengths and weaknesses.]	3.0± 1.30	64 (17.2%)	71 (19.0%)	87 (23.3%)	100 (26.8%)	51(13.7%)
6. I am aware of effective strategies for implementing practice changes.]	3.13± 1.42	74 (19.8%)	54 (14.5%)	76 (20.4%)	89 (23.9%)	80 (21.4%)
7. I can develop an evaluation plan to monitor practice improvements made through the use of evidence-based nursing.	1.94± 1.15	161(43.2%)	146 (39.1%)	18 (4.8%)	24 (6.4%)	24 (6.4%)
The overall knowledge means sore	**3.07± 0.72**	-	-	-	-	-
Attitude toward implementing EBP	-	-	-	-	-	-
1. Physicians are cooperative in implementing evidence-based practices (*e.g.*, evidence-based policies or procedures).	3.00±1.38	68 (18.2%)	81 (21.7%)	80 (21.4%)	72 (19.3%)	72 (19.3%)
2. In general, staff nurses care about evidence-based practice.	3.06±1.35	71 (19.0%)	50 (13.4%)	102 (27.3%)	84 (22.5%)	66 (17.7%)
Overall attitudes mean score	**3.03±0.98**	-	-	-	-	-

Key: SD = Standard deviation; knowledge and skills in implementing NEBPS = Nursing Evidence-Based Practice Survey.

3.3. Perceived Factors of Organizational Culture in Implementing EBP

The results revealed that most nurses (113, 30.3%) strongly agreed that advanced practice nurses (*e.g.*, clinical nurse specialists, nurse educators) serve as mentors in EBP. Additionally, 101 (27.1%) nurses agreed to participate in data collection for quality improvement projects. However, 158 participants (42.4%) disagreed that their organization gave them the opportunity to participate in data collection for EBP projects. Furthermore, 97 (26.0%) nurses strongly disagreed with the organization's provision of opportunities for data collection for research (Table **3**). Given these findings, the health administrator urgently needs to conduct education interventions to raise nurses' awareness of EBP and engage them in conducting research and collecting data for EBP projects.

Table 3. Perceived factors related to implementing EBP among nurses (n = 373).

Items	Mean ± SD	Responses n (%)				
		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
Organizational culture related to implementing EBP	-	-	-	-	-	-
1. I am aware of nursing research related to my clinical area because of discussions with colleagues.	3.18±1.43	66(17.7%)	65(17.4%)	70 (18.8%)	81 (21.7%)	91 (24.4%)
2. I have convenient access to nursing research journals.	3.08±1.34	62 (16.6%)	64 (17.2%)	99 (26.5%)	79 (21.2%)	69 (18.5%)
3. Advanced practice nurses (*e.g.*, clinical nurse specialists, nurse educators, *etc.*) act as mentors for evidence-based practice.	3.31±1.47	63 (16.9%)	57 (15.3%)	66 (17.7%)	74 (19.8%)	113 (30.3%)
4. Nurse Managers I work with promote and implement evidence-based practices in the clinical setting.	3.09±1.36	60 (16.1%)	78 (20.9%)	72 (19.3%)	94 (25.2%)	69 (18.5%)
5. I understand the process for implementing evidence into practice in my organization.]	3.20±1.39	63 (16.9%)	62(16.6%)	67(18.0%)	98 (26.3%)	83 (22.3%)
6. I am aware of evidence-based practice projects implemented in my organization.]	3.00±1.44	86 (23.1%)	57(15.3%)	70 (18.8%)	90 (24.1%)	70 (18.8%)
7. I participate in the collection of data for research studies (*i.e.*, conduct of research, not evidence-based practice projects).]	2.88±1.47	97 (26.0%)	67(18.0%)	61 (16.4%)	81(21.7%)	67(18.0%)
8. I participate in the collection of data for quality improvement projects.	2.95±1.37	83 (22.3%)	56(15.0%)	81 (21.7%)	101(27.1%)	52(13.9%)
9. I participate in the collection of data for evidence-based practice projects.	1.95±1.103	149 (39.9%)	158(42.4%)	20 (5.4%)	26 (7.0%)	20 (5.4%)
The overall mean sore	**2.92±0.68**	-	-	-	-	-

Key: SD = Standard deviation; perceived knowledge and skills in implementing NEBPS= Nursing Evidence-Based Practice Survey.

Table 4. Perceived factors of unit culture and time in implementing EBP among nurses (n = 373).

Unit Culture Related to Implementing EBP	Mean ± SD	Responses n (%)				
		Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
1. Evidence-based nursing practice is important to me.	3.09± 1.49	76 (20.4%)	73 (19.6%)	61 (16.4%)	67(18.0%)	96 (25.7%)
2. A journal club to discuss nursing research findings would be helpful.	3.18±0 .44	77 (20.6%)	48 (12.9%)	56 (15.0%)	113 (30.3%)	79 (21.2%)
3. I seek out evidence-based solutions to patient care problems.	3.06±1.45	68(18.2%)	86 (23.1%)	67 (18.0%)	61(16.4%)	91 (24.4%)
4. Someone to assist with a literature search and obtain articles would increase the use of evidence-based practices.	3.11±1.38	66 (17.7%)	59 (15.8%)	94 (25.2%)	75 (20.1%)	79 (21.2%)
5. A bulletin board in my unit to share research articles would be helpful.	3.18± 1.42	61 (16.4%)	74 (19.8%)	65 (17.4%)	83 (22.3%)	90 (24.1%)
Total mean of unit culture	**3.13± 0.84**	-	-	-	-	-
Time: related to implementing EBP	-	-	-	-	-	-
1. Nurses have enough time to implement evidence-based practice findings.	2.94±1.43	84 (22.5%)	71 (19.0%)	66 (17.7%)	86 (23.1%)	66 (17.7%)
2. I could find one hour per week on the job for evidence-based practice activities if I made it a priority.	2.92±1.47	94 (25.2%)	62 (16.6%)	72 (19.3%)	69 (18.5%)	76 (20.4%)
The overall mean sore	**2.93±1.05**	-	-	-	-	-

Key: SD = Standard deviation; perceived knowledge and skills in implementing NEBPS = Nursing Evidence-Based Practice Survey.

Table 5. Categorization of nurses' KSAs regarding implementation of EBP in Sudan (N = 373).

Variable	n (%)	
	Poor (< 50%)	Good (≥ 50%)
Knowledge and skills	201 (53.9%)	172 (46.1%)
Attitude	216 (57.9%)	157 (42.1%)

Note: KSA = Knowledge, skills and attitude; EBP= Evidence-Based Practice.

3.4. Perceived Factors in Implementing EBP

Regarding unit culture, the result showed that 113 (30.3%) nurses agreed that a journal club to discuss nursing research findings would be beneficial. However, regarding time allocation, 94 (25.2%) nurses strongly disagreed that they could dedicate 1 hour per week on the job to EBP activities, even if they made it a priority (Table **4**). Hospital administrators should allocate time for journal clubs to discuss nursing research and schedule time for research.

3.5. Categorization of Nurses' KSAs regarding EBP Implementation

To determine the level of nurses' KSA regarding EBP implementation, the researchers divided the total mean scores of the KSA into two categories based on median score: scores below the median were considered poor (<50%), while scores equal to or above the median were considered good (≥50%) [36, 37]. The categorization results revealed that most nurses (201, 53.9%) had poor knowledge and skills, while 216 (57.9%) had poor attitudes regarding the implementation of EBP in Sudan (Table **5**).

3.6. Comparing Differences in Nurses' KSAs toward EBP with Demographic Variables

We used the Mann-Whitney U-test to examine differences between two independent groups and the Kruskal-Wallis test for more than two groups to compare demographic characteristics and mean scores of nurses' knowledge, skills, and attitudes (KSA) toward implementing EBP. The results indicated significant differences in the mean score for knowledge and skills based on gender. Male nurses had a higher mean score of knowledge and skills (M = 205.91, p = 0.030) than female nurses in implementing EBP. Significant differences in nurses' educational level were found as well, with respect to mean scores for knowledge and skills. Nurses with a bachelor's degree showed a higher mean score of knowledge and skills toward implementing EBP (M = 199.54, p = 0.010) than those with other education levels. Furthermore, a significant difference in the mean score of knowledge and skills was noted depending on the type of employment. The knowledge and skills of nurses in governmental hospitals toward implementing EBP were significantly higher (M = 203.76, p = 0.001) than those in private hospitals. However, there was no significant difference between nurses' demographic characteristics and their attitude toward implementing EBP, nor in their knowledge and skill levels (p > 0.05) with other demographic variables (Table **6**).

3.7. Differences between Nurses' Demographic Variables and other Factors

We tested the differences between other nurses' demographic variables and perceived factors related to implementing EBP. The findings revealed significant differences between nurses' genders and their perception of unit culture. Male nurses had a higher mean score of perceived unit culture (M = 210.42, p = 0.007) toward

implementing EBP than female nurses. Significant differences between nurses' age and the mean score of organizational culture were likewise observed. Nurses between 31 and 40 years of age had a significantly higher (M = 230.77, p = 0.0001) mean score of perceived organizational culture as a factor in implementing EBP compared to other age groups. Furthermore, there was a significant difference between clinical setting and organizational culture. Nurses who worked in the general ward had a significantly higher mean score of perceived organizational culture in implementing EBP (M = 212.56, p = 0.009) compared with those who worked in other clinical settings in the hospital. However, the findings did not show significant differences between the nurses' other demographic variables and other perceived factors in implementing EBP (p > 0.05) (Table 7).

3.8. Correlation between the KSA of EBP

We investigated the relationship between the study variables, KSA, using Spearman's rho to examine the strength and direction of the correlation between the study domains. The results showed a significant positive weak correlation between knowledge, skills, and attitude (r = 0.349**, p = 0.000) [39], as shown in Table 8.

Table 6. Comparing differences of nurses' knowledge, skills, and attitude towards the implementation of EBP with demographic characteristics (N = 273).

Variable	N	K-S-Mean± SD (3.070 ± 0.72) Mean Rank	*p*-value	A- Mean± SD (3.03±0.98) Mean Rank	*p*-value
Gender	-	-	-	-	-
Male	108	205.91	**0.030***	201.70	0.089
Female	265	179.29		181.01	
Age	-	-	-	-	-
20-30	127	175.05	0.053	187.12	0.149
31-40	100	208.52		205.80	
41-50	87	192.72		175.77	
>51	59	167.82		171.45	
Education level	-	-	-	-	-
Diploma	127	180.57	**0.010***	186.17	0.908
Baccalaureate	203	199.54		188.76	
Master's	43	146.81		181.13	
Type of employing?	-	-	-	-	-
Government	198	203.76	**0.001****	189.37	0.648
Private	175	168.04		184.32	
Clinical experience	-	-	-	-	-
Less than 1 year	95	167.81	0.185	186.08	0.859
1 to 5 years	107	186.44		189.17	
6 to 10 years	89	198.75		192.69	
> 10 years	82	197.21		179.05	
Clinical setting	-	-	-	-	-
OPD	67	161.88	0.055	158.72	0.098
ER	131	186.35		196.39	
ICU	65	180.73		184.72	
GW	110	206.78		158.72	
Have you ever had training on EBP?	-	-	-	-	-
Yes	61	177.39	0.445	192.34	0.669
No	312	188.88		185.96	

Note: N = number, EBp = Evidence-Based Practice, OPD = Outpatient department, ER = Emergency room, ICU = Intensive care unit, GW = General Ward. K-S-Mean = knowledge and skills mean score; SD = Standard deviation; A-Mean = attitude mean score; Mann–Whitney U and Kruskal-Wallis Test were nonparametric tests employed to compare mean differences with demographic characteristics of nurses in implementing EBP since the data was not normally distributed; * p-values ≤ 0.05; ** p-values ≤ 0.001.

Table 7. Differences between nurses' demographic variables and factors of implementing EBP (n = 373).

Variable	N	Organization Mean± SD (2.92± 0.68) Mean Rank	*p*-value	Unit Culture Mean± SD (3.13 ± 0.84) Mean Rank	*p*-value	Time Mean± SD (2.93 ± 1.05) Mean Rank	*p*-value
Gender	-	-	0.265	-	0.007**	-	0.712
Male	108	196.72	-	210.42	-	190.19	-
Female	265	183.04		177.45		185.70	
Age	-	-	0.000**	-	0.350	-	0.346
20-30	127	165.60	-	178.61	-	185.54	-
31-40	100	230.77		202.70		177.55	
41-50	87	189.48		180.07		204.32	
>51	59	155.21		188.68		180.64	
Education level	-	-	0.382	-	0.066	-	0.487
Diploma	127	177.72	-	196.92	-	195.77	-
Baccalaureate	203	194.00		188.01		181.31	
Master's	43	181.35		152.93		187.98	
Type of employing	-	-	0.110	-	0.073	-	0.926
Government	198	195.36	-	196.36	-	186.52	-
Private	175	177.54		176.41		187.55	
Clinical experience	-	-	0.094	-	0.231	-	0.127
Less than 1 year	95	206.39	-	192.39	-	186.69	-
1 to 5 years	107	171.06		173.04		177.14	
6 to 10 years	89	193.93		203.22		177.31	
> 10 years	82	177.81		181.37		210.73	
Clinical setting	-	-	**0.009****	-	0.439	-	0.409
OPD	67	175.53	-	178.41	-	185.75	-
ER	131	167.73		184.32		198.56	-
ICU	65	194.40		178.22		172.93	-
GW	110	212.56		200.61		182.31	-
Have you ever had training on EBP?	-	-	0.719	-	0.828	-	0.519
Yes	312	187.88	-	186.46	-	185.43	-
No	61	182.48		189.74		195.05	-

Note: N = number, EB*p* = Evidence-Based Practice, OPD = Outpatient department, ER = Emergency room, ICU = Intensive care unit, GW = General Ward. K-S-Mean = knowledge and skills mean score; SD = Standard deviation; A-Mean = attitude mean score; Mann–Whitney U and Kruskal-Wallis Test were nonparametric tests employed to compare mean differences with demographic characteristics of nurses in implementing EBP since the data were not normally distributed; * *p*-values ≤ 0.05; ** *p*-values ≤ 0.001.

Table 8. Correlation between knowledge-skills and attitude (N=373).

Variable	Correlation Coefficient (rho)
Knowledge, skills, and Attitude	0.349**

Note: Spearman's rho test used; **. Correlation is significant at the 0.01 level (2-tailed).

4. DISCUSSION

Nurses are one of the most critical professional groups in healthcare, and they are expected to apply research findings to their practice to enhance patient outcomes [40]. In recent years, EBP has been recognized as crucial in improving patient outcomes and providing high-quality healthcare [2, 3]. However, implementing EBP in nursing continues to be a challenge [41]. To the best of our knowledge, this is the first study to investigate the levels of nurses' KSAs and the perceived factors influencing the implementation of EBP in Sudan. The study revealed that most nurses have low knowledge and skills in implementing EBP. This result aligns with a study conducted in Egypt, which found that nurses lack sufficient EBP knowledge [42]. However, unlike another study among nurses, the current results showed that nurses have a high level of KSA and a moderate level of practice in EBP [43]. The results of low knowledge and skills toward implementing EBP among nurses in our study could be attributed to the lack of continuous EBP education

programs for nurses. Thus, to enhance nurses' knowledge and skills in implementing EBP, nursing managers and health policymakers should provide ongoing educational programs. Educators should also integrate EBP into the nursing curriculum to improve nursing students' competencies in implementing EBP in their future clinical practice.

Regarding the attitude of nurses toward implementing EBP, the results revealed that Sudanese nurses have a low level of attitude toward implementing EBP. However, this finding differs from other studies in different countries where nurses have positive and high levels of attitude toward implementing EBP [44-46]. This low attitude among nurses in our study may be related to their limited knowledge of EBP. Thus, nurses must possess solid knowledge and skills and maintain a firm belief in the critical role that EBP plays in clinical settings to ensure the timely transfer of research findings to clinical practice [47]. Additionally, in the present study, a majority of nurses reported disagreement regarding the opportunities their organization provided for them to participate in data collection for EBP projects. This outcome is consistent with other studies in Kenya, which found that a lack of organizational support, limited knowledge, time constraints, and lack of autonomy among nurses were barriers to implementing EBP [48]. Therefore, the study findings reinforce the need for nurse managers and health policymakers to implement continuous education and training programs for Sudanese nurses to improve their competency and resource allocation for data collection for EBP. Huang and his colleagues also emphasized the significance of enhancing research education for nurses, fostering a research-friendly environment, proactively providing protected time, and instituting a framework that enables them to access, read, discuss, assess, and apply research articles in hospital or medical institutional settings [49].

We used non-parametric tests (*e.g.*, Mann-Whitney U-test and Kruskal-Wallis test) to compare the scores of nurses' knowledge, skills, and attitudes (KSA) toward using EBP with demographic variables because the data in this study did not follow a normal distribution. The results showed significant differences between respondents' gender and knowledge and skills. In implementing EBP, male nurses had higher knowledge and skills than female nurses. This finding contradicts a Malawian study that found no significant differences in nurses' knowledge of using EBP based on their gender [50]. This considerable difference in our study results could indicate that male and female nurses in Sudan have different knowledge and skills levels for implementing EBP. Therefore, future EBP educational interventions should take gender variation in knowledge into account when implementing EBP. The analysis showed significant differences in knowledge and skills mean scores for implementing EBP based on nurses' educational level. Nurses with a bachelor's degree had higher mean scores toward implementing EBP than those with other qualifications. The results of this study are consistent with research that indicates a positive correlation between professional attributes such as age and educational attainment and EBP competency, which consists of four components: knowledge, skills, attitude, and EBP application. Nurses with a higher education level and younger nurses appear to be more proficient in EBP [51]. The results of this study may indicate that recent graduates continue to retain information from their schooling, which is critical for implementing future educational programs to ensure knowledge retention stability. The mean score on knowledge and skills also differed significantly depending on the type of employment. The knowledge and skills of nurses employed in governmental hospitals were substantially higher for implementation than those in private hospitals. These findings may be attributed to the easier access of nurses in government hospitals to research databases. They can use resources more effectively and attend training interventions more frequently than nurses in private hospitals, where EBP may be more challenging to implement. The other five primary organizational obstacles to EBP are workplace culture, workload, lack of authority or autonomy to affect change, lack of support from management and other workers, and lack of resources [52].

Regarding organizational and unit culture, we examined the differences between organizational culture and nurses' demographic variables. The results revealed a significant difference between age and organizational culture. Nurses between 31 and 40 years of age had a significantly higher mean score of perceived organizational culture as a factor in implementing EBP than other age groups. Those who worked in the general ward had a significantly higher mean score of perceived organizational culture in implementing EBP compared with those who worked in other clinical settings in the hospital. Furthermore, there were significant differences between nurses' genders and unit cultures. Male nurses had a higher mean score of perceived unit culture toward implementing EBP than female nurses. This result generally indicates that culture can significantly influence the success of EBP implementation within its context. Therefore, integrating EBP into the vision and goals of the organization is essential to its implementation success [52].

The theoretical framework by Melnyk and Fineout-Overholt (1999) aims to guide critical systems and players toward the practical and long-term application of EBP. It consists of three main parts: assessing the organizational culture of an institution concerning EBP, identifying the leading promoters and impediments to the application of EBP, and integrating mentors in the field of EBP within the organization. These mentors can devise plans to start, enhance, assess, and continue applying EBP by fostering positive attitudes and skill-building [53]. According to the Institute of Medicine's 2020 target of 90% evidence-based clinical decisions, nurse leaders and educators must foster supportive cultures and provide opportunities for EBP learning [54]. Therefore, we advocate for nursing managers and health authorities to enhance organizational

and unit culture among nurses. This can be achieved by allocating resources, creating a positive work atmosphere, conducting education programs, and motivating nurses to engage actively in EBP research projects and implementation. These initiatives, in turn, will enhance their cultural awareness and skills in implementing EBP.

We tested the correlation between knowledge, skills, and attitudes towards implementing EBP. The correlation results showed a significantly weak positive relationship between knowledge, skills, and attitude. This correlation aligns with previous studies that demonstrated a relationship between attitudes and knowledge in the application of EBP [55, 56]. The explanation for this result could be that nurses who enhance their knowledge and skills demonstrate enhanced positive attitudes and increased motivation to implement EBP in nursing settings [57]. Therefore, nursing managers and health policymakers should adopt continuous education programs to improve nurses' knowledge, skills, and attitudes (KSAs) toward implementing EBP.

4.1. Study Implications

First, health policymakers and hospital administrators can use the study findings to allocate resources and prepare an attractive environment for implementing EBP in Sudan. Second, nursing managers should conduct an education program for nurses to enhance their knowledge, skills, and attitudes (KSAs) toward implementing EBP. Third, health policymakers and nursing managers should encourage nurses to conduct research and translate their findings into practice, thereby improving the quality of care and patient outcomes. Fourth, nursing researchers should conduct further studies using random sampling methods to investigate other factors behind suboptimal levels of KSA toward implementing EBP in Sudan. Finally, nursing educators should incorporate EBP into the nursing curriculum before graduation. This will make it easier for graduates to implement EBP after graduation.

4.2. Strengths and Limitations

The strength of this study lies in revealing the low level of nurses' KSAs and the role of organizational and unit culture in implementing EBP in Sudan. These findings can serve as a foundation for future research and assist nursing managers and health policymakers in adopting continuous education programs and allocating resources to nurses, thereby enhancing their competency in implementing EBP in Sudan. However, this study does have some limitations. First, we employed convenience sampling and a self-administered instrument for data collection, which yielded a Cronbach's alpha value of very low significance for the subscale analysis. We recommend further development of the tool in future studies to avoid bias. Second, qualitative data were lacking, and a cross-sectional design was applied. Third, the study's data did not follow a normal distribution. Fourth, we utilized non-parametric analysis to present the data. As a result, the researchers could not generalize these findings to all Sudanese nurses regarding EBP implementation. Therefore, it is essential to conduct further research on nurses, incorporating data from other hospitals in Sudan and using a randomized sampling method, to identify additional factors contributing to the suboptimal implementation of EBP in Sudan.

CONCLUSION

This study highlighted that nurses have low levels of knowledge, skills, and attitudes (KSAs) regarding the implementation of EBP. There were significant differences in nurses' gender, education level, work area, and barriers related to organizational and unit culture regarding EBP implementation. Therefore, considering these significant differences in the findings, health policymakers and nursing managers should allocate resources and provide continuous education programs for nurses to improve their KSAs and the implementation of EBP in Sudan. These efforts will help enhance the quality of nursing care and patient outcomes. Further studies are suggested to explore additional barriers to the implementation of EBP in Sudan.

AUTHORS' CONTRIBUTIONS

The authors confirm their contributions to the study as follows: M.A. and M.A.: Conceptualization and study design were carried out by; M.A. and E.R.: Data collection was performed by; I.I. and M.M.: Data analysis was conducted by; A.M.: Study supervision was provided by; A.S.: Manuscript writing was done by; Z.A.: Critical revisions for important intellectual content were made by. All authors have read and agreed to the published version of the manuscript.

LIST OF ABBREVIATIONS

KSA	=	Knowledge, Skills, and Attitude
EBP	=	Evidence-Based Practice
SPSS	=	Statistical Package for Social Sciences

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The author obtained ethical clearance from the Faculty of Nursing Science at the University of El Imam El Mahdi, Sudan (Ref. No./FNS/2020/02).

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

The authors obtained consent from each nurse after explaining the study's aim and informing them of their right to accept, freely refuse, or withdraw at any time. All nurses' responses would be anonymous, kept strictly confidential, and used only for research. The authors did not identify any personality traits of the nurses.

STANDARDS OF REPORTING

STROBE guidelines were followed

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the article will be available from the corresponding author [M.A] upon reasonable request.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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