

Title:

Evaluation of Evidence-based Practice learning among undergraduate nursing students: relationship between self-reported and objective assessment

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Highlights

- Exists a moderate and positive correlation between the EBP-COQ self-reported questionnaire and an objective test for measuring the EBP competency of nursing students.
- The EBP-COQ can be used when the intention is to evaluate the change observed in the learning of the undergraduate nursing students after an EBP training course
- The development of self-reported questionnaires also should include a study of its correlation with objective tests

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ABSTRACT

Background: Self-reported scales and objective measurement tools are used to assess Evidence-based Practice (EBP) learning. An agreement between these measures has not been widely investigated among nursing students.

Objective: The aim of the present study was to examine the relationship between EBP competency in undergraduate nursing students, **defined as the capability to choose and use an integrated combination of EBP knowledge, skills and attitudes**, evaluated with the self-reported EBP-COQ questionnaire and the final test score of an EBP course included in a Nursing Degree Program.

Design: **A cross-sectional study was carried out.**

Settings: **University of Murcia (Spain), Nursing Degree, academic year 2019/2020.**

Participants: **The study population was comprised by 210 4th-year undergraduate nursing students enrolled in the Clinical Practice and Evidence-based Nursing course. All the students were invited to participate.**

Methods: A validated EBP-COQ questionnaire (1 "lowest score" to 5 "highest score") and an objective test (score from 0 to 10) were used to assess EBP competency. The SPSS 26.0 program was used to perform descriptive, bivariate and multivariate analyses.

Results: 152 students **participated (response rate 72.4%)**, the sample was 81.4% female, and the median age was 20 years old; 76.3% attended more than 75% of the class hours. After the EBP course, the students obtained a high overall EBP competency score (mean=4.21; SD=0.26). The **mean** score on the objective test was 6.86 (SD=1.36). A moderate positive correlation was found between the subjective and objective EBP competency measurements (Pearson's correlation coefficient 0.5; $p < 0.0001$).

Conclusions: Our findings contribute with new and significant evidence of the convergent validity of the EBP-COQ questionnaire, which increases the value of this instrument for evaluating the EBP competency of Nursing Degree students.

Keywords: Evidence-Based Practice; competence assessment; Self-perceived; Objectively measured competence; Correlation; Undergraduate nursing students.

1. Introduction

Evidence-based Practice (EBP) is a systematic approach in which the results from research studies are combined with clinical experience and the preferences of the patients to make clinical decisions within a specific context and the resources available (Dawes et al., 2005). Its application has been attributed to the improvement in clinical, quality of life, and economic outcomes (Melnyk et al., 2014). Also, EBP improves the patient's access to information about the best treatment available and provides opportunities for highly personalized, high-quality, and safe nursing care (Ilic, 2009).

The Sicily statement on EBP points out that "all health care professionals need to understand the principles of EBP, recognize EBP in action, implement evidence-based policies, and have a critical attitude to their own practice and to evidence" (Dawes et al., 2005). Also, international organizations such as the World Health Organization (WHO, 2004) recognize that EBP is a basic competency of nurses and stresses the importance of the training of these health professionals. However, despite being a key factor for the improvement of knowledge, skills and attitudes towards EBP and its application in the clinical practice of future nurses (Melnyk et al., 2012), **we do not know if EBP is widely taught in nursing degrees in Europe, and the limited literature on the subject does not show positive data** (Skela-Savič et al., 2020).

2. Background

An updated review of the literature on the effectiveness of EBP training on Nursing Degree students, through the use of different educational methodologies, showed positive results in **EBP domains such as knowledge, skills and attitudes/behaviors** (Patelarou et al., 2020). Most of the questionnaires developed and utilized to measure the EBP competency of nurses and nursing students are self-reported, meaning that the interviewee self-scores their own behaviors or characteristics (Leung et al., 2014; Patelarou et al., 2020). The validity of this type of questionnaire has been questioned, in that the evaluation of EBP competencies and skills should be conducted through the use of objective instruments (Mena-Tudela et al., 2018). **Previous studies have attempted to elucidate the relations of EBP learning in healthcare students and professionals using self-reported measures and objective measures.** A growing number of studies conducted in the medical context (Aguirre-Raya et al., 2016; Lai & Teng, 2011), nursing (Hagedorn Wonder et al., 2017; Wonder & Spurlock, 2020), and diverse health-related disciplines

(Panczyk et al., 2017), highlight the poor correlation between the **objective** evaluation of EBP competencies, and those that are self-reported. Similar results have been observed in studies that compare the EBP competency of medical students through the use of two objective questionnaires (Lai et al., 2012), and those conducted in other disciplines (Zell & Krizan, 2014). The up-to-date studies have been conducted in different contexts, with health care professionals or students with little EBP training, and in some cases with non-validated or not-equivalent instruments in regard to the EBP contents or domains studied.

The EBP-COQ is a self-reported questionnaire created and validated in Spain for the evaluation of the EBP competency of undergraduate nursing students (Ruzafa-Martinez et al., 2013). **Competency in this context should be considered a theoretical construct, defined as the capability to choose and use an integrated combination of knowledge, skills, and attitudes with the intention to perform a task in a certain context (Korthagen, 2004). Its application to the EBP competency concept means gaining knowledge and skills, as well as increasing positives attitudes toward EBP that will promote a change in behavior that will lead to the implementation of EBP in practice (Tilson et al., 2011).**

The EBP-COQ consists of 25 items that assess the three dimensions (attitude, knowledge and skills) that constitute the defined EBP competency concept. A good internal consistency, test-retest reliability, and criterion validity was shown in the original validation study (Ruzafa-Martinez et al., 2013) and the translated versions in Turkish (Yildiz & Güngörmüş, 2016), Polish (Panczyk et al., 2020), Italian (Finotto & Garofalo, 2020) and Chinese (Chen, 2015). Also, it has been adapted to different Spanish-speaking cultural contexts such as Chile and Colombia (Sánchez-García et al., 2019). It has been utilized in diverse international studies (Labrague, McEnroe-Pettite, et al., 2019; Labrague, McEnroe-Pettite, et al., 2019; Mena-Tudela et al., 2018; Ruzafa-Martínez et al., 2016; Tumala & Alshehri, 2019) and **has an** adequate content, construct, and predictive validity (Ruzafa-Martinez et al., 2013). Consequently, it **is therefore necessary** to understand the relationship between the EBP-COQ as a predictor of undergraduate nursing students learning of EBP, in the context of a regular EBP course **included** in a Nursing Bachelor Degree. This could provide new evidences of validity that would define it as a trustworthy instrument, so that educators and trainers will be able to evaluate the EBP competency of nursing students. For this, the aim of the present study was to examine the relationship between EBP competency **of undergraduate nursing students,**

evaluated with the self-reported EBP-COQ questionnaire and the final test score of an EBP course **included** in a Nursing Degree Program.

3. Methods

3.1. Design

A cross-sectional study was conducted on nursing students **enrolled in** the Nursing Degree at the University of Murcia (Spain).

3.2. Sample and Setting

The study population was comprised by the 210 4th-year undergraduate Nursing Students from the University of Murcia (Spain) enrolled in the Clinical Practice and Evidence-based Nursing (CPEBN) course in academic year 2019/2020. The sample size estimation was 114, accepting an alpha risk of 0.05 and a beta risk of 0.2 in a two-sided test, with a correlation coefficient of 0.3. **A drop-out rate of 25% was anticipated. Sampling was not carried out, as all** 210 enrolled students were invited to participate.

The total duration of the Nursing Degree in Spain is 4 years, with 2 terms (15 weeks) each year. The first term lasts from September to December, and the second term from February to June. The students are enrolled in the courses of the first and second terms **every year**. The CPEBN course is taught in the first term of the 4th year, and lasts 15 weeks. The nursing students receive training in statistics in their first term of the 1st year and epidemiology in their first term of the 2nd year. **These courses** provide **the** prior knowledge **needed** for the understanding of the content presented in the CPEBN. It involves 40 hours of in-person classes and 110 hours of **independent** work by the student. The objectives of the training program are: to reflect on the variability and decision making in clinical practice; bring the student closer to the EBP concepts, characteristics, advantages, and usefulness; to show the seven steps of EBP; to discuss the barriers found for the implementation of the evidence; to learn how to critically appraise the most frequent research studies, and the interpretation of the primary study results.

The program includes eight laboratory sessions that last **two** and a half hours each, where the students are taught the **fundamentals** of EBP, the phases of application of EBP, the formulation of the clinical question in PICOT format, **which consists in the following elements: Patient, Intervention, Comparison, Outcome, and Time**, and the guidelines related to the search for scientific evidence in bibliographic databases. Also, the students

take part in eight seminars that last two and a half hours each, in which the characteristics and biases from each research study are described, and where they learn critical appraisal skills. The students are free to attend the laboratories and seminars.

3.3. Variables and measurement instruments

The variables included in the study are:

1) Information on the sociodemographic characteristics of the participants: age, sex, academic year where they are enrolled, type of access to the university (high school or vocational training), EBP training, training in research methodology, scientific articles read in the previous month, social networks utilized (Facebook, Twitter, health-related blogs), frequency of use of the social networks and class hours attended during the term.

2) The EBP-COQ questionnaire assesses the self-reported competency level in EBP of nursing students. The instrument has been previously shown to have very good reliability and validity (Ruzafa-Martinez et al., 2013). The EBP-COQ consist of 25 items, and the original validation study showed that the exploratory factor analysis of the 25 items included in the questionnaire yielded a three-dimensional structure that explained 55.55% of the variance of the data: Attitude (13 items), Knowledge (6 items), and EBP skills (6 items). The items are answered using a Likert scale with 5 response options, with the final score ranging from 1 “lowest competency” to 5 “highest competency”. Cronbach's alpha for the total questionnaire was 0.888, and the values for each factor were: 0.940 for attitude toward EBP, 0.800 for EBP knowledge, and 0.756 for EBP skills.

3) Objective measurement of EBP: the evaluation of the EBP learning in the CPEBN course was carried out by two teachers who were members of the research team. They were experts in EBP training and research, with more than ten years of experience. The objective test was comprised by 40 multiple-choice questions, each item having four response options of which one was correct. Half of the questions were theoretical in nature and related to the course content, and the other half evaluated the students' skills on critical appraisal, starting with the reading of a scientific article that the students had read in the four days prior to the test.

3.4. Data Collection

All the data were collected during the month of January, 2020. The EBP-COQ questionnaire and the sociodemographic variables were collected between the 8th to the 14th of January, 2020. Two of the researchers, teachers of the course, invited all the students to participate through an online communication published in the virtual teaching platform from the University of Murcia. A direct link to the questionnaire was shared through Google Forms. Those interested received information about their participation: the voluntary character and the non-academic repercussion if they did not participate. The completion of the questionnaire implied their consent. A week after (January 23rd, 2020) the students took the objective test. It was part of the course evaluation and was performed in the university classrooms, in a specific day for all the students, and under controlled conditions. Thus, all the students had the same amount of time to complete it (1 hour and 40 minutes), and the influence between students was avoided.

3.5. Ethical Considerations

The research study was approved by the Ethics Committee in Research from the University of Murcia (256/18). All the procedures were performed in accordance with the ethical standards of the Helsinki Declaration. The participation in this study was voluntary. The students were informed about the objectives of the study, clarifying that their participation was completely anonymous and that submitting the questionnaire granted their consent for participating in the study. The absolute anonymity and confidentiality of the data provided was guaranteed through the generation of a personal code.

3.6. Data Analysis

The descriptive statistics summarized the characteristics of the sample, the EBP-COQ scores and the objective test. The qualitative variables were expressed as frequencies and percentages. For the quantitative variables, the mean and standard deviation (SD) were calculated. In the case that the distribution was asymmetrical, the median and the interquartile range (P25, P75) were utilized. In the objective test, the mean score of the correct answers obtained was calculated. A randomness correction factor was applied, so that for every 3 wrong questions, a correct one was subtracted. Pearson's r correlation coefficient and the 95% confidence intervals were utilized to evaluate the relationship between the EBP-COQ questionnaire (self-reported questionnaire) and the objective test. A scatterplot was utilized to study the linear relationship between both measurements.

Also, multivariate models (multiple linear regression) were carried out to determine the influence of the EBP-COQ questionnaire and modulator variables (age, sex, type of access to the university, previous training on EBP and research methodology, class attendance, scientific articles read in the **previous** month, social networks utilized) on the final test score **of the course**. **The data** were analyzed with the statistical package SPSS version 26 for Windows and RStudio 4.0.0. In the statistical analysis, a level of significance of 5% ($p \leq 0.05$) was utilized.

4. Results

4.1. Sociodemographic and academic characteristics of the sample

In total, 152 students answered the EBP-COQ questionnaire (self-reported questionnaire), and the final course test (objective test) response rate **was** 72.4%, well above the sample size calculated. Of these, 81.6% were women, and the median age was 20 years old (P25:20, P75:54). Most of the students (79.6%) had accessed the university degree with a Baccalaureate (high school) degree. As for their academic characteristics, 77.6% did not have any other education, and 86.2% did not have any previous training in research methodologies and EBP. On the other hand, concerning the reading of scientific articles in the previous month, it was observed that 67.8% had read more than three articles. As for the social networks utilized for consulting scientific information, the most utilized were health-related blogs (73.7%), followed by Facebook (33.6%), and Twitter (23.7%). Also, 76.3% of the participants attended **more than 75% of the in-person class hours** (Table 1).

4.2. Results of the measurements of the subjective and objective tools

The mean score obtained from a maximum of 10 in the objective test was 6.86 (SD=1.36). The minimum score was 2.57, and the highest 9.67. The mean scores of the variables “overall EBP competency” and the dimensions “attitude”, “skills” and “knowledge” from the EBP-COQ questionnaire are shown in Table 2.

4.3. Correlation between the self-reported EBP-COQ questionnaire and the objective test

The bivariate analysis **showed** a moderate, statistically, and positive significant association between the objective test and the three dimensions from the EBP-COQ

“attitude”, “skills”, and “knowledge” and the “overall EBP competency” (Table 3, Figure 1).

Table 4 shows the models obtained after the multiple regression, for the final objective test score. Model 3, **which included** EBP competency (EBP-COQ questionnaire), type of access to the University (High School), and class attendance >75%, explained 38% ($R^2 = 0.38$) of the variance. In this case, the Durbin-Watson D confirmed the validity of the model ($D = 1.99$). **The model detected an association between all the variables included, with a probability of error <0.0001.**

5. Discussion

The students who participated in the study **shared** the most common characteristics found in Nursing Degree students in Spain, where a greater proportion of women **was** observed with a **mean** age of 20 (Villanueva et al., 2019). In our study, the EBP competency scores were high, as measured with both instruments, being somewhat higher with the EBP-COQ, in agreement with similar studies (Snibsøer et al., 2018). Previous research studies **pointed** out that the use of self-reported tools for **measuring** EBP competency **tended** to over-estimate the results (Lai & Teng, 2011; (Panczyk et al., 2017); (Aguirre-Raya et al., 2016). One of the strategies utilized to control this effect **was** the use of specific reference scales, where the scores from an individual **were** compared with respect to a group of **peers** (Salgado, 2005).

The results from our study show a moderate and positive correlation between the three dimensions (attitude, knowledge, and skills), and the overall EBP competency measured with the EBP-COQ questionnaire and the objective test, showing results that **were** higher than the studies conducted up to date (Hagedorn Wonder et al., 2017); (Wonder & Spurlock, n.d.); (N M Lai et al., 2012); (Snibsøer et al., 2018). **Furthermore**, the EBP students' self-reported competency using the EBP-COQ questionnaire, background in high school, and time dedicated to the classes, **were** significant variables in the students learning, accounting for 38% of the variance in the final EBP course test score.

There **was** no consensus with respect to the optimum correlation between the subjective and objective measurements, and **a** perfect correlation is difficult to observe when aspects related to human behavior or cognitive processes are studied. Achieving a

greater correlation between both types of evaluations could be very complicated, without it nullifying the validity of the self-reported instrument. There are diverse factors that have an influence on this. Thus, we find factors related with the individual, and the context of application of the test and the instrument.

Among the factors related with the individual, previous studies have shown a certain number of inexactness in the self-evaluation ability of individuals, especially in high-complexity tasks (Blanch-Hartigan, 2011; N M Lai et al., 2012; Zell & Krizan, 2014), such in the case of EBP. Nevertheless, the exactness of the self-evaluation of an individual is greater the more familiar one is with the subject matter in question (Oude Rengerink et al., 2011). In this case, the participants had previously taken the EBP course, performing tasks throughout the trimester, and had prepared themselves for the objective test. In previous studies in which a subjective measurement was compared to an objective one, higher correlations were found in those in which the participants had received EBP training (Pearson's coefficient between 0.24 and 0.29) (Lai et al., 2012; Snibsøer et al., 2018), as compared with correlations obtained in studies where the participants did not have specific EBP training (Pearson's coefficient between 0.017 and 0.13) (Hagedorn Wonder et al., 2017; Wonder & Spurlock, n.d.). Also, the individual's personality, along with other cognitive strategies, could be relevant in the exactness of the self-evaluation (Katowa-Mukwato & Banda, 2016). The judgement of our skills is very often based on the same cognitive strategies we utilize to judge others, and when they are applied to ourselves, we could make mistakes when trying to identify our own strengths and weaknesses (Eva & Regehr, 2005). In this way, the results of the participants with a greater ability to self-criticize will be more accurate with respect to those who have a lesser ability to self-criticize (Ehrlinger et al., 2008).

As for the context in which the test was conducted, the moment in time when the self-evaluation is performed is important (Zell & Krizan, 2014). The result of the self-evaluation could be influenced by the efforts made to obtain the knowledge, and not as much as by the real EBP competency (Oettingen & Mayer, 2002). In other research studies, greater correlations were observed between the real performance and the self-evaluation, when judgements were obtained from the post-performance as related to the pre-performance (Eva & Regehr, 2005). The objective results would serve as feedback for substantiating the greater or lesser self-competency. On the other hand, the motivation of the participants when completing the questionnaire could also be an influencing factor. (Shaneyfelt et al., 2006). As motivation theories point out, when demotivated, students

lack intentionality and a sense of personal causation, and could have thoughts associated to their own lack of capacity to perform a task (Ryan & Deci, 2002).

Among the factors related with the instruments, it is crucial that they are validated and that they evaluate equivalent concepts. Thus, they should include the main contents and dimensions of the construct to be evaluated (Lai et al., 2012), as in the present study. Perhaps the scarce correlation between the instruments that measure EBP competency is not exclusively due to the type of questionnaire utilized (objective or subjective), but in that they do not exactly measure the same construct. This could explain the lack of high correlations between objective instruments that measure EBP competency as well (Lai et al., 2012).

Lastly, it should point out that the use of objective instruments also has certain inconveniences. For conducting an objective test, prior knowledge is a fundamental prerequisite. Thus, if the intention is to evaluate the change observed in the learning of the students after an EBP training course, an objective test as the sole measurement tool would not be useful, as previous theoretical knowledge is necessary. However, subjective tests, and more specifically, the EBP-COQ questionnaire, have already demonstrated their usefulness in this type of study (Mena-Tudela et al., 2018; Patelarou et al., 2020; Ruzafa-Martínez et al., 2016). Also, an objective instrument cannot evaluate aspects such as attitudes, a fundamental component of the “Competency” construct (Ruzafa-Martinez et al., 2013; Sánchez-García et al., 2019). Therefore, the issue raised should not be choosing an objective or a subjective instrument to evaluate the EBP competency, but it should be choosing the adequate instrument according to the context in which it will be utilized, the objectives to be reached, the profile of the subjects, and the means available.

In future research studies, it would be interesting to conduct comparative studies that analyze the correlation between objective and subjective instruments for measuring EBP competency, with the participation of students with different levels of competency and which evaluate the relationship with other explanatory variables related with self-perception.

5.1.Limitations

The main limitation of the study is that it dealt with a homogeneous sample of students from the same center, which could make difficult the extrapolation of the results. On the other hand, and despite the voluntary nature of the study, a social desirability bias could

exist, as the students could have thought that the answers to the questionnaire would be taken into account for the evaluation of the course. Lastly, the lack of published data on this issue limited the discussion of our findings.

6. Conclusions

The Nursing Degree students in this study have a high level of EBP competency in terms of knowledge, skills, and attitudes. The moderate positive correlation between the self-reported and the objective evaluation scores **indicates** that the EBP-COQ is a valid instrument for measuring the EBP competency of nursing students. It is recommended that the development of self-reported questionnaires also include a study of its correlation with objective tests as another **piece of evidence** of the validity of these instruments.

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Figure 1. Scatterplot of the relationship between the dimensions and the overall score of the EBP-COQ questionnaire and the objective test

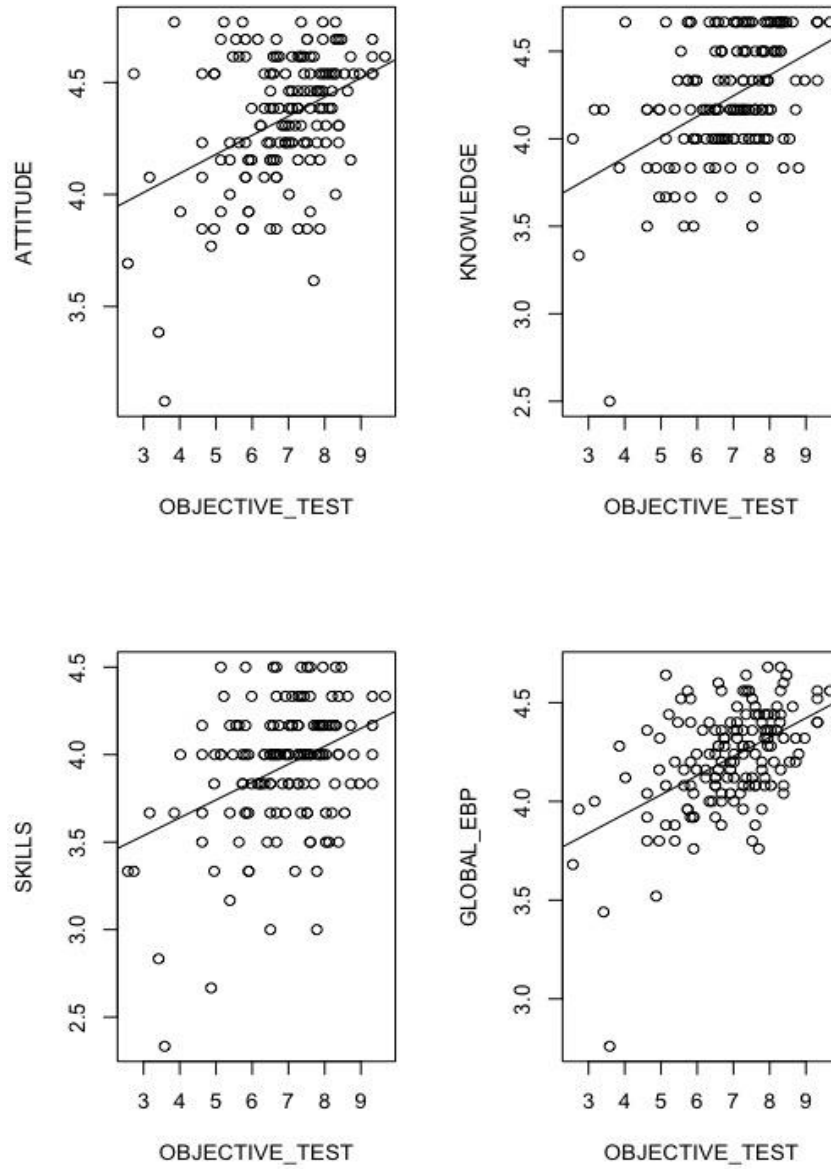


Table 1. Sociodemographic and academic characteristics of the participants (n=152)

Variables	N	%
Sex		
Female	124	81.6
Male	28	18.4
Age		
(median, P ₂₅ -P ₇₅)	20 (20-54)	
Class attendance		
<24%	4	2.7
25-49%	8	5.3
50-74%	22	14.7
>75%	116	77.3
Access to the degree		
Baccalaureate	121	79.6
Professional Training	22	14.5
Other	13	5.9
Other education		
None	131	74.0
University	5	2.8
Professional Training	37	20.9
Associate degree	1	0.6
Masters	1	0.7
Previous training on research methodology		
None	131	86.2
<40 hours	14	9.2
40-150 hours	7	4.6
Previous EBP training		
None	131	86.2
<40h	18	11.8
40-150h	3	2.0
Articles read in the last month		
None	3	2.0
1-3	46	30.3
<3	103	67.8
Social network consultation		
Never	25	16.4
Occasionally	42	27.6
Monthly	13	8.6
Weekly	58	38.2
Daily	14	9.2
Networks consulted		
Facebook	51	33.6
Twitter	36	23.7
Health-related blogs	112	73.7

Table 2. Overall EBP competency, attitude, skills and knowledge utilizing the EBP-COQ questionnaire(n=152)

EBP-COQ	M	SD
Attitude	4.34	0.29
Skills	3.93	0.36
Knowledge	4.23	0.35
Overall competency	4.21	0.26

M: mean; SD: Standard deviation.Range 1-5

Table 3. Results of the correlation between the dimensions and the overall score of the EBP-COQ questionnaire and the objective result

	Pearson's coefficient	95% confidence interval	p value
EBP-COQ	Objective questionnaire		
Attitude	0.401	0.26-0.52	0.000**
Knowledge	0.453	0.31-0.57	0.000**
Skills	0.384	0.24-0.51	0.000**
Overall EBP competency	0.500	0.37-0.61	0.000**

** The correlation is significant at 0.01 (two-way)

* The correlation is significant at 0.05 (two-way)

Table 4. Stepwise multiple linear regression model

Model	R	R ²	corrected R ²	Std. Error Estimation	Change Statistics			Durbin-Watson
					Change in R ²	Change in F	Sig. of change in F	
1	.50	.25	.24	1.18	.25	49.9	.000	
2	.59	.35	.34	1.10	.10	22.8	.000	1.99
3	.62	.38	.37	1.08	.035	8.4	.000	

Model 3	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity	
	B	Std. Error	Beta			Tol	VIF
(Constant)	-4.36	1.41		-3.07	.002		
EBP Competency (EBP-COQ)	2.33	0.34	.45	6.84	.000	.96	1.03
Access University (High School)	1.13	.22	.33	5.11	.000	.99	1.00
Class attendance >75%	.62	.21	.19	2.90	.004	.96	1.04

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