Relationship between Nursing Informatics Competency and Innovativeness among Qualified Nurses

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Received April 15, 2019, accepted June 1, 2019.
doi: 10.47104/ebnrojs3.v1i3.87

ABSTRACT

Context: Nursing informatics is an important quality resource for patient care, which promotes, enhances, and increases the organization's growth and influences the innovativeness level of the individuals.
Aim: This study aimed to assess the relationship between nursing informatics competency and innovativeness among qualified nurses.
Methods: Descriptive correlational cross-sectional study design used to conduct this study on all units (57 units) at Benha University Hospital**,** Egypt**.** A Convenience sample of all available (223) qualified nurses working at Banha University Hospital Nursing informatics competency assessment Questionnaire and individual innovativeness (II) questionnaire.
Results: 28% of the participants rated themselves as experts in the nursing informatics competency. At the same time**,** 40% and 22% were early adopters and innovators regarding the total individual innovativeness level. There was a positive, highly statistically significant correlation between the overall score of informatics competency and individual innovativeness for qualified nurses (r= 0.263, p-value = 0.000). A highly statistically significant relationship was also detected between the demographic variables in the study and both informatics competency and individual innovativeness for qualified nurses.
Conclusion: A positive, highly statistically significant correlation is evidenced between the overall score of informatics competency and individual innovativeness for qualified nurses**.** To prepare nursing students to meet the ever-changing technical needs of patients, computer and information skills should be integrated into the nursing curriculum. Also, nursing education programs should utilize educational methods that encourage innovativeness among their students.

Keywords: Nursing informatics competency, innovativeness, and qualified nurses

1. Introduction

Developments in information technology have resulted in fundamental changes in healthcare processes focused on using computers and the introduction of electronic communication *(Terkes, Celik, & Bektas, 2019).* Health services are one of the primary fields where innovation occurs, for many reasons, for example, evolving population structure, growing chronic diseases, and patronizing societal expectations. Innovation is considered a solution to persistent problems in a complex health care environment *(Huber, Bair, & Joseph, 2019).* Besides, innovation is essential in developing and maintaining quality in nursing care and for the nurses to be open to novelty to recognize and respond to the patient's needs *(Turan, Durgun, & Astu, 2019).*

Moreover, healthcare sectors include many technological tools that require nurses to understand informatics competency to manage data and information of patients in a complex health care environment. Therefore, nursing informatics competency has become a fundamental requirement for nurses to fulfill their professional roles safer, more effective, and more efficient *(Abd El-Fattah, 2018).* Thus, there is growing concern regarding the competency level of nursing informatics and how technological skills can affect healthcare providers' innovativeness.

Nursing informatics (NI) is an important quality tool for patient care, which in turn facilitates, improves, and increases organizational development as well as influences the value and cost of health care and ultimately improves information management and communication between health care providers *(El-Sayed, Hussein, & Othman, 2017).* As the most substantial proportion of health care providers, nurses should be able to demonstrate competence and feel confident in using computers and information technology. Accordingly, there has been a great concern in several countries to ensure that nurses entering practice settings can use technology in meaningful and productive ways to benefit patients and professionals *(Kassam, Nagle, & Strudwick, 2017).*

Nursing informatics is defined as using information and technology to reinforce all parts of nursing practice to increase patient safety and improve patient outcomes *(Liston, 2019).* It is described as integrating basic computer skills, information literacy, and information management, which are vital and essential components of modern nursing practice *(Nwozichi, Marcial, Farotimi, Escabarte, & Madu, 2019).* Computer Literacy Skills is a skill set, including the psychomotor skills needed to use computer tools and knowledge of underlying hardware and software functionality. Informatics Literacy Skills is a nurse's ability

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to recognize the need for information and retrieve, evaluate, and use this information appropriately for patient care. At the same time, Information Management Skills are a skill set, including applying data to support clinical decisions, documenting and ensuring data integrity, maintaining confidentiality, and practicing information security. Information management skills encompass the knowledge to articulate the value of information systems in improving patient safety, quality, and outcome *(Schleyer, Burch, & Schoessler, 2011).*

Consistent attention has been given to the global importance of creativity. A value created especially by novelties parallel with technology and is seen in every sense as the key to growth. Innovation is needed because it involves modifying existing approaches or creating new ones *(Huber et al., 2019).* Innovation has a significant role in the health sector, as it directly affects human life and quality of life. However, to exhibit the "innovative" role in the working environment, nurses must have an innovative way of thinking. Previous research indicated a negative relationship between e-health literacy and individual innovativeness mean scores *(Arli, Bakan, & Yildiz, 2019).*

Nevertheless, a lack of focus in the research literature on nurses' innovation behavior in general and in the setting of this study in particular. The previous study was conducted by *Abd El-Fattah (2018)* in a critical care unit at an international private hospital in Egypt. The aimed to measure the relationship between innovation behavior levels and informatics technology guiding education reform (TIGER-based) NI competencies among critical care nurses. The results indicated that more than half of the nurses had a moderate level of innovative behavior. Furthermore, more than 30 percent of the nurses surveyed considered competent in nursing informatics.

Furthermore, a significant positive correlation was evident between innovative behaviors and overall nursing informatics skill levels. However, up to our knowledge, it is the only study conducted in Egypt to study such a relationship. The study was conducted on critical care nurses in a private hospital with different characteristics of nurses in governmental hospitals and other departments. Therefore, testing the relationship between the two variables in a different setting is highly recommended.

2. Significance of the Study

Improving the quality of care and health service delivery is one of the main benefits of integrating technology and innovation solutions into healthcare. Nursing is an integrated discipline that adapts from conventional understanding to socio-cultural, technological, and scientific shifts. So, nurses must demonstrate competence and feel confident in using computers and information technology from the start of education to increase the use of computers in healthcare practice, which in turn enhances their innovation level in providing quality nursing care to their patients *(Terkes et al., 2019).*

The previous studies indicated a relationship between the nursing informatics competency level and patient safety knowledge and attitudes among nursing students. Such results confirmed that learning nursing informatics competencies will emphasize patient safety practices *(Abdrbo, 2015).* Nurses depend on informatics expertise to support the use of health care data and information to generate new knowledge and wisdom in health IT solutions through innovations for the delivery of high-quality nursing care *(Kelley, 2019).* Thus, it is vital to assess the current nursing level of informatics competencies and how it correlates to their innovativeness.

2.1. Theoretical Framework

The study's theoretical framework is based on nursing informatics competencies and Rogers's innovativeness model. Nursing informatics competencies are defined as basic computer skills, information management, and information literacy. *Basic computer skills* are essentially needed for either communication or documentation. These skills encompass an individual's ability to use a computer's basic functionalities. *Information literacy* can interpret relevant and irrelevant information by using critical thinking skills and retrieving, evaluating, and using information. *Information management* can use the information for decision making by collecting, processing, and presenting data and applying the data for decision support *(Staggers, Gassert, & Curran, 2002; Liston, 2019).*

Rogers defines innovation as "an idea, practice, or object that is perceived as new by an individual or other units of adoption" *(Rogers, 2003).* Individual innovativeness is defined as developing, adopting, or implementing an innovation *(Yuan & Woodman, 2010). Rogers (2003)* explained the characteristics of people into five classes. Innovators (risk-takers willing to take the lead and try something new), Early Adopters (tend to be respected group leaders, the individuals essential to adoption by the whole group), Early Majority (the careful, safe, deliberate individuals unwilling to risk time or other resources), Late Majority (those suspect of or resistant to change. Hard to move without significant influence), and Laggards (those who are consistent or even adamant in resisting change. Pressure needed to force change).

3. Aim of the study

This study aimed to assess the relationship between nursing informatics competency and innovativeness among qualified nurses.

3.1. Research Questions

- What is the level of nursing informatics competency among qualified nurses?
- What are qualified nurses' innovation levels?
- Is there a relationship between nursing informatics competency level and the level of innovation among qualified nurses?

4. Subjects & Methods

4.1. Research design

A descriptive correlational cross-sectional study design

was used to describe the variables in this study and examine the relationships among these variables where data was collected at one point in time.

4.2. Research Setting

The study was conducted in all units (57) at Benha University hospital. The total number of beds at this hospital is 880. The hospital comprises three separate buildings, a medical building that includes 478 beds, a surgical building that includes 384 beds, and an Ophthalmology building that includes 18 beds.

4.3. Subjects

A Convenience sample of all available qualified nurses (223) who are working in the study mentioned above setting, at the time of the study, agree to participate after clarification of the purpose of the study and have a minimum of one year of job experience.

4.4. Tools of the study

Data for the present study were collected by using self-reporting questionnaires which include three tools.

4.4.1. A Structured Interview Questionnaire

This questionnaire developed by the researchers based on the review of the related literature for examining demographic details of qualified nurses such as; (sex, age), professional background (education, years of nursing experience, job title), and computer use (previous computer education, and computer users experience).

4.4.2. Nursing Informatics Competency Assessment questionnaire (NICAT)

It is developed by *Rahman (2015)* to assess the level of nursing informatics competency. It is composed of three dimensions. They are computer literacy assessment (which contains ten items, e.g., Recognize the basic components of the computer system such as a mouse, screen, and workstation). The second domain is informatics literacy assessment (which contains 13 items, e.g., use the internet to locate and download items of interest), and informatics management skills assessment (which contains seven items, e.g., protect confidential patient data by logging out, suspending sessions, and password protection). The internal consistency for the NICAT was reported by *El-Sayed et al. (2017)* to be 0.976 , indicating the high reliability of the tool. In this study, Cronbach's alphas were (r= 0.861), indicating the high reliability of the tool.

Scoring system

The questionnaire consists of a five-point self-rated Likert scale ranged from not competent to expert. Not competent scored (1), somewhat competent scored (2), competent scored (3), very competent scored (4), and finally expert scored (5). Total scores of studied nurses regarding competency level classified as a novice (30). Advanced beginner (31-5). Competent (60-89). Proficient (90-119). Expert (120 -150).

4.4.3. Individual Innovativeness (II) Questionnaire

Individual Innovativeness (II) questionnaire developed by *Hurt, Joseph, and Cook (2013)* assesses the level of individual innovation and what innovation category they belong to it. It is composed of 20 items. *Turan et al. (2019); Ozden, Cevik, and Saritas (2019)* reported a scale's reliability Cronbach's as 0.80. In this study, Cronbach's alphas for the overall scale was (r=0.89), indicating the high reliability of the tool.

Scoring system

Items rated on a 5-point Likert scale ranging from strongly disagree = 1 to strongly agree = 5. Twelve statements are positive (1, 2, 3, 5, 8, 9, 11, 12, 14, 16, 18, and 19); eight statements are negative (4, 6, 7, 10, 13, 15, 17, and 20). The Total scores of studied nurses' innovation estimated according to the following formula:

- Step 1: sum the scores for statements 4, 6, 7, 10, 13, 15, 17, and 20.
- Step 2: the sum score for statements 1, 2, 3, 5, 8, 9, 11, 12, 14, 16, 18, and 19
- Step 3: Full the formula: II = 42 + Step 2 total score – Step 1 total score.
- Individuals are categorized in the context of 57 innovations depending on their final scores. Accordingly, Innovators labeled as ratings over 80. Ratings ranging from 69 to 80 graded as early adopters — scores classified as Early Majority between 57 and 68. Scores ranging from 46 to 56 are classified as late majorities. Scores below 46 classified as traditionalists / Laggards.

4.5. Procedures

The operational design for this study included three stages; preparatory phase, pilot study, and fieldwork.

The preparatory phase started from the beginning of December 2018 to the beginning of February 2019. It included reviewing related national and international literature using journals, textbooks, scientific web site, and theoretical understanding of the different aspects of the study subject. Tools translated into Arabic language and back translation to check its accuracy.

Tools validity: The tools' contents were developed and tested for its content and face validity through a jury of five academic staff in nursing administration from different faculties of nursing in Egypt, namely; Benha faculty of nursing, Ain shams faculty of nursing, El Menoufia faculty of nursing, Tanta faculty of nursing and Helwan faculty of nursing. The validity of the tools aimed to judge its clarity, simplicity, accuracy, comprehensiveness, and relevance. All items were reviewed and accepted by the jury committee.

An official letter requesting permission to conduct the study has been issued from the Dean of faculty of nursing Benha University. It sent to the director of the hospital explaining the aim of the study. Then, the researcher met the hospital administrator, assured complete confidentiality of the obtained information, and the study would not affect the work.

A pilot study was carried out in February 2019 on 10% of study subjects that included (25 qualified nurses) before starting the actual data collection to ascertain the clarity and applicability of the study tools and the feasibility of the research process. It has also served in estimating the time needed for filling the tools. It ranged between 25-30 minutes. The pilot study served to assess the reliability of data collection tools. In the pilot study, participants were included in the study because no modification was done in the study tools.

Fieldwork: Data collection took about one month from March 2019 to April 1, 2019. The researcher met qualified nurses and explained the aim and the nature of the study, and the method of filling the questionnaire. Data collected individually or through group meetings. Researchers distributed the questionnaire sheets to the qualified nurses during work hours scheduled before with the head nurse of each unit according to their workload. It took from 25 to 30 minutes to complete the questionnaire sheet. Data collected three days /week on Sunday, Monday, and Thursday in the morning and afternoon shifts in the researcher's presence to clarify any ambiguity.

Ethical Considerations: Oral informed consent was obtained from the participants. They were informed about their rights to refuse or withdraw from the study with no consequences. They reassured the anonymity of the information collected, and it would be used only for scientific research. No harmful maneuvers were performed or used, and no foreseen hazards were anticipated from conducting the study on participants.

4.6. Data analysis

Statistical analysis was done using IBM SPSS (Statistical Package of Social Sciences) software package version 25. Cleaning of data was done to ensure no missing or abnormal data by running frequencies and descriptive statistics. Data were presented using descriptive statistics like frequencies and percentages for categorical variables, means, and standard deviations for continuous variables (e.g., age). Pearson correlation analysis was used to assess the inter-relationships among quantitative variables. Cronbach's reliability coefficient was used to test the reliability of the questionnaires. Regression analysis was used to describe the statistical relationship between one or more predictor variables (the three dimensions of nursing informatics competency scale) and the response variable (individual innovativeness). The significant level of all statistical analysis was at < 0.05 (P-value).

5. Results

Table 1 shows that the total number of qualified nurses was 223. Concerning their age, more than a third of them (33%) were aged 31-35 years old, and the majority of them (93.7%) were females.

Regarding their years of experience in the current job, more than a third of them (40%) had 5-10 years of experience. Regarding their education, only 9.4 % of the studied sample has a master's degree in nursing. Most of them (58%, 83% respectively) were staff nurses regarding their current job position. They had previous computer education as far as more than one-third of them (36.3%) had from 5-10 years of experience using computers.

Table 2 illustrates that 65% of qualified nurses were experts regarding computer literacy, and 26% of them were competent regarding informatics literacy, while 38% of them were not competent regarding informatics management.

Figure 1 portrays that the highest percentage of qualified nurses (28%) were experts regarding the total level of informatics competency.

Figure 2 clarifies the total level of individual innovations among the qualified nurses, the highest percentage of them (40%) were early adopters, followed by innovators level (22%).

Table 3 shows a positive, highly statistically significant correlation between the overall score of informatics competency and individual innovativeness for qualified nurses.

Table 4 displays a positive, highly statistically significant correlation between age, gender, years of experience, education, previous computer science education, years of experience in uses computers, and both informatics competency and individual innovativeness for qualified nurses.

Table 5 ascertains that computer literacy was positively and significantly associated with individual innovativeness as when the computer literacy increases by one unit, then the individual innovativeness will increase by 0.81 unit. The model R^2 value was 0.49, indicating that computer literacy explains 49% of the variability/variance in individual innovativeness level.

The table also indicated a significant positive impact on informatics literacy on individual innovativeness as when informatics literacy increases by one unit, then the individual innovativeness will increase by 0.51 unit. The model R^2 value was 0.31, indicating that informatics literacy explains 31% of the variability/variance in individual innovativeness level.

There is a significant positive impact for informatics management on individual innovativeness when the informatics management increases by one unit. Then the individual innovativeness will increase by 0.6 units. The model R^2 value was 0.21, indicating that computer literacy explains 21% of the variability/variance in individual innovativeness level.

Table (1): Frequency and percentage distribution of studied qualified nurses according to their characteristics (N =223).

Personnel characteristics	No	%
Age in years		
< 25	15	7
25 - 30	52	23
31 - 35	74	33
36 - 40	44	20
≥ 41	38	17
Mean±SD	33.4±7.15	
Gender		
Male	14	6.3
Female	209	93.7
Years of experience		
<5	12	5
5 - 10	89	40
11-15	77	35
16-20	30	13
≥ 21	15	7
Mean ±SD	11.5±9.23	
Education		
BSN Degree	202	90.6
Master's degree in nursing	21	9.4
Current Job position		
Head nurse	65	29
Head nurse assistance	29	13
Staff nurse	129	58
Have previous computer education		
Yes	185	83
No	38	17
The years of experience in uses computer		
<5	33	14.8
5 - 10	81	36.3
11-15	53	23.8
16-20	35	15.7
≥ 21	21	9.4
Mean±SD	9.25 ±8.75	

Table (2): Frequency and percentage distribution of qualified nurses' regarding informatics competency dimensions (n=223).

Informatics Competency Dimensions	Competent Not		Somewhat Competent		Competent		Very Competent		Expert	
	No	%	No	%	No	%	No	%	No	%
Computer literacy (10) items	17	8	9	4	27	12	25	11	145	65
Informatics literacy (13) items	55	25	49	22	59	26	30	13	30	14
Informatics Management (7) items	87	38	70	32	33	15	25	11	8	4
Total	53	23	43	19	40	18	27	12	61	28

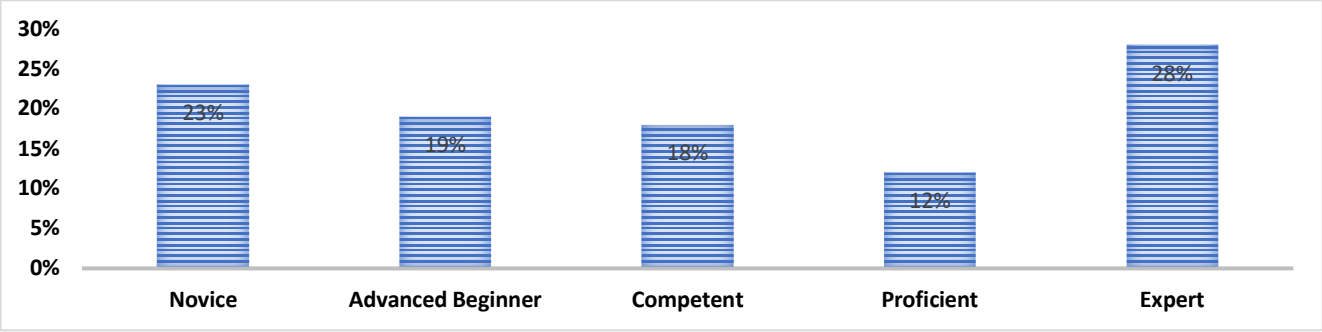

Figure (1): Percentage distribution of the qualified nurses regarding the total level of informatics competency.

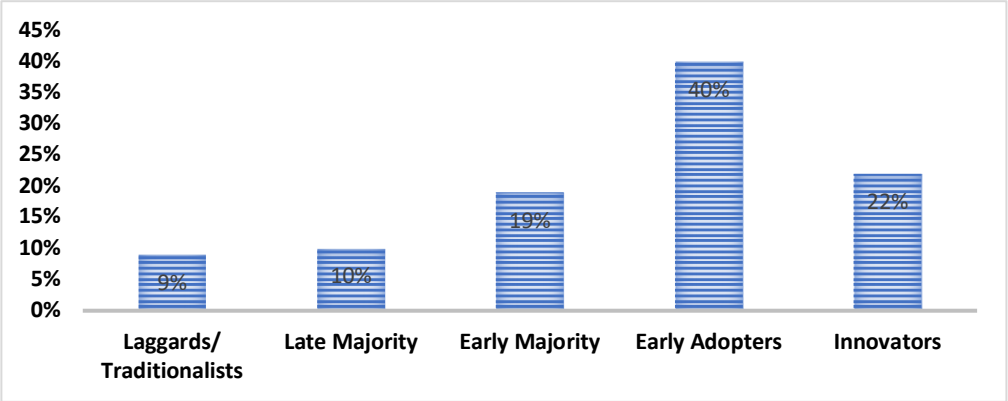

Figure (2): Total score of individual innovativeness among qualified nurses.

Table (3): Correlation between qualified studied nurses' total informatics competency score and their innovativeness scores.

Variables	Informatics Competency	
	r	p-value
Individual Innovativeness	0.263	0.000

Table (4): Correlation between personal characteristics, informatics competency level, and individual innovativeness level among the qualified nurses (223).

Personal characteristics	Individual Innovativeness		Informatics Competency	
	r	p-value	r	p-value
Age	0.125	0.000	0.253	0.000
Gender	0.625	0.000	0.216	0.000
Years of experience of the current job	0.436	0.000	0.314	0.000
Education	0.521	0.000	0.291	0.000
previous computer science education	0.178	0.000	0.347	0.000
The years of experience in uses computer	0.298	0.000	0.429	0.000

Table 5: Summary of computer literacy, informatics literacy, and informatics management, and individual innovativeness regression model.

Predictive variable	R	R^2	Individual Innovativeness			
			Coefficients	Std. Error	t	Sig
(Constant)	0.20	0.04	63.903	1.937	32.997	0.000
Computer literacy	0.70	0.49	0.81	0.015	5.575	0.000
Informatics literacy	0.56	0.31	0.51	0.029	1.757	0.000
Informatics Management	0.46	0.21	0.6	0.098	0.611	0.000

6. Discussion

The advent of the new century has created groundbreaking health care challenges. Great value is placed on technology to deliver innovative bedside treatments and analyze large amounts of data related to quality outcomes *(Godsey, 2015).* Thus, there is growing concern regarding the competency level of nursing informatics and how technological skills can affect healthcare providers' innovativeness. Thus, this study aimed to assess the relationship between nursing informatics competency and innovativeness among qualified nurses.

Regarding the level of nursing informatics competency among the qualified nurses, the highest percent (more than one-fourth) of qualified nurses have an expert level in nursing informatics competency. This finding may be due to that the majority of the participants already have previous computer education. The nursing curriculum for bachelor nursing education includes a computer science that helped qualified nurses enhance their competency level.

This result agreed with *El-Sayed et al. (2017)*, who conducted a study to assess the correlation between nurses' attitude toward evidence-based practice and nursing informatics competency among oncology center qualified nurses, Mansura University, Egypt. The findings indicated that the highest percentage of qualified nurses in the study sample have competency levels varied from proficient to expert level. This finding signified a high competency level in nursing informatics among the studied subjects.

The finding disagreed with a previous study conducted by *Liston (2019),* who assess the level of advanced informatics competencies among nurses working at Sutter Maternity and Surgery hospital. The results indicated a low level of informatics competency and disagreed with *Fargaly and Abd El-Wahab (2016),* who conducted a study to assess nurses' readiness to use electronic information

systems at a selected hospital in Giza Governorate in Egypt. The findings indicated that the majority of nurses are found at unacceptable computer skills levels. However, most nurses in such a study had a technical diploma in nursing who may have different characteristics and education courses than qualified nurses (nurses who graduated from nursing faculties) in this study.

Regarding the innovativeness level among the participants, the results indicate that nearly half of the participants rated themselves as early adopters, and about one-fourth rated themselves as innovators. This finding indicates that the qualified nurses in this study are risk-takers who are willing to take the initiative and time to try something new and tend to be respected group leaders. This result agreed with *Coklar (2012),* who examined individual innovativeness levels of educational administrators; the results indicated that most educational administrators considered themselves as early adopters.

This result also agreed with *Ozden et al. (2019),* who conducted a study to determine the effect of online information searching strategies on individual innovativeness in students taking the course of information technology in nursing. The results showed that the individual innovativeness levels of the students were moderate. They were individual innovators in the early majority style. The results also agreed with *Abd El-Fattah (2018),* who found that more than fifty percent of the participants had a moderate level of innovative behavior. The finding disagreed with *Arli et al. (2019),* who conducted a study to examine the relationship between e-health literacy and individual innovation in university students enrolled in health-related departments. According to their innovativeness scale scores, the classification of the participants showed that the highest percent of the participants were laggards, which means that they are consistent or even adamant in resisting change. At the same time, no students are found to be innovators.

Regarding the relationship between the qualified nurses' informatics competency score and their innovativeness scores, the results show a positive, highly statistically significant correlation between the overall nursing informatics competency scores and individual innovativeness scores of the qualified nurses. All the dimensions of nursing informatics competency (computer literacy, informatics literacy, and informatics management) have a highly statistically significant relation with the innovativeness level. However, the computer literacy dimension has the highest effect on qualified nurse's innovativeness level, followed by informatics literacy, as indicated in the regression model.

This result agreed with *Ozden et al. (2019),* who reported a positive correlation between the online information searching strategies and individual innovativeness among the studied sample. The results also agreed with *Abd El-Fattah (2018),* who reported a significant positive relationship between innovation behavior and overall NI competency levels as perceived by the participants. The results also agreed with *Arli et al. (2019)*, who reported a negative relationship between e-health literacy and individual innovativeness.

Regarding the relation between nursing informatics competency and the demographic characteristics of the qualified nurses, the results display a positive highly statistically significant correlation between age, gender, years of experience, education, previous computer science education, the years of experience in uses computer and both informatics competency and individual innovativeness for qualified nurses**.**

This result agreed with *Kinnunen et al. (2019),* who reported that competency to use the electronic health records was associated with the education level among the studied sample and agreed with *Yang et al. (2014),* who study perspectives of nurse managers regarding informatics competencies. The studied nurses reported that education level had a significant impact on informatics competencies. This result also coincides with *Fehr (2014); Hsu, Hou, Chang, and Yen (2009),* who declared that nurses' age and years of experience are essential factors in nursing informatics competency. While disagreed with *Liston (2019),* who reported that age, experience, education level, and gender were not statistically significant in affecting the scores of informatics competency.

7. Conclusion

In light of the main study findings, it can be concluded that: the highest percentage of qualified nurses were experts regarding the total level of informatics competency. Regarding the total level of individual innovativeness, the highest percent of the qualified nurses were early adopters, followed by innovators level. There was a positive, highly statistically significant correlation between the overall score of informatics competency and individual innovativeness among the qualified nurses. There was a positive, highly statistically significant correlation between age, years of experience, education, previous computer education, years of experience in uses computers, and both informatics competency and individual innovativeness for qualified nurses.

8. Recommendations

- Informatics and information competencies must be integrated into the nursing curriculum to equip nursing graduates to meet the ever-changing technological needs of patients.
- Nursing education programs should utilize educational methods that encourage innovativeness among their students.
- Future researches are needed to examine the effect of NI and the innovativeness of nurses on patient and nurse outcomes.

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