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Artificial Intelligence Technology and its Relation to Decision Making Abilities as perceived by First Line Managers

H.S.Abd Elhamid, E.S.Ahmed, A.M.Abd Elmonem
Nursing Administration Dept.,Faculty of Nursing, Benha University
E-mail: hendsalah.nur@gmail.com

Abstract
Background: Artificial intelligence technology is becoming vital for supporting first-line managers and other healthcare providers in healthcare delivery, and decision-making abilities. **The study aimed** to assess artificial intelligence technology and its relation to decision making abilities as perceived by first line managers. **Study design**: Descriptive correlational design was utilized to conduct this study. **Setting**: The study was conducted in all inpatient units at Benha University Hospital. **Subjects**: Included all available first-line managers 57 who are working at the previously mentioned study settings during the time of data collection. **Tools**: Two tools were used for data collection; (1^{st} tool) Artificial intelligence technology questionnaire, and (2^{nd} tool) Decision-making abilities scale. **The study results showed that**, the majority (80.7% & 84.2%) of first-line managers had high perception level toward artificial intelligence technology, and high decision-making abilities levels, respectively. Also, less than one fifth (15.8%) of them had moderate perception level of artificial intelligence technology, and moderate decision-making abilities levels. **The study concluded that**, there was a highly statistically significant positive correlation between total artificial intelligence technology and total decision-making abilities as perceived by first-line managers. **The study recommended that,** enhancing the readiness of organizations for using artificial intelligence through providing good infrastructure and budgeting, and developing a reward system for first-line managers with effective decision-making to encourage others to do the same.

Keywords: Artificial intelligence technology, Decision making abilities, First line managers, Perceived.

1. Introduction:

In the era of revolutions and globalization, healthcare institutions faced many challenges during the spread of disease due to nursing shortages, increased nurses' workload, and the need for extra bed numbers; so, governments and hospital managers have to think again carefully about the best way to enhance inpatient and outpatient environments to interact with patients, incorporate digital technologies into traditional care like telemedicine and telenursing to form a healthcare system without walls [28].

Moreover, to achieve a competitive advantage in the labor market, there is a need for radical change to digitalize healthcare sectors. From this point, artificial intelligence (AI) has succeeded to grasp the attention of healthcare providers who are currently experiencing a dilemma of whether or not to fully or partially integrate it into their work [22].

First-line managers are key participants in the healthcare structure. They have a pivotal role in influencing both working conditions and quality of care through their leadership. First-line managers operate their units, assign tasks, manage workflow, monitor the quality of work, deal with staff nurses' problems, and keep the middle managers and executive managers informed of problems to be successful at the hospital [8].

First-line managers have an essential role in healthcare delivery that improves health outcomes for patients, reduces healthcare costs, and enriches the patients' experience so, they are considered the consumers of artificial intelligence in healthcare settings. First-line managers must understand the state of AI technologies and the ways that such technologies can be used to improve efficiency, safety, and access to health services, and support the digital transformation of healthcare [16].

Artificial intelligence refers broadly to computing technologies that resemble processes related to human intelligence, such as reasoning, adaptation, learning, sensory understanding, and interaction [6]. The developing use of AI in the sector of healthcare as a technology collection that enables machines to perceive, understand, act, and learn to carry out healthcare administrative and clinical functions, in addition, to being enrolled in research and clinical learning activities [31].

Artificial intelligence rapidly dominates the health service system. Data-driven innovations in healthcare, such as artificial intelligence, are gaining traction in nursing practice with the intent to add value to the delivery of nursing care. It changes the manual health system into an automatic, in which first-line managers conduct tasks to practice the management of patients and nursing resources. Moreover, AI has increased productivity and widespread extensively in daily life is increasing rapidly [29].

There are many types of AI: Machine learning, deep learning, expert system, fuzzy logic, and natural language processing techniques. Machine learning refers to the use of algorithms to automate modeling that starts with data preparation and data mining to turn raw data into data that are useful for specific use cases, deep learning is a type of machine learning based on artificial neural networks in which multiple layers of processing are used to extract progressively higher-level features from data, The expert system refers to computer systems that imitate the decision-making

process of a human expert, Fuzzy logic is a method of reasoning that makes an estimation based on a set of imprecise data, and natural language processing techniques means that the processing of large human language data to derive meanings and perform various processes such as decision-making [25].

The types of AI are being tested in a wide range of areas within health, for example, medical image analysis, disease epidemic surveillance, pathology classification, and treatment support in healthcare settings. The capabilities of artificial intelligence are significant and compelling, and there is a growing expectation that it will enable a sustainable healthcare system and empower healthcare professionals to contribute to the improvement of patient outcomes, safety, and care [23]. Thus, artificial intelligence is becoming vital for supporting first-line managers and other healthcare providers in healthcare delivery, and decision-making abilities [24].

Every healthcare organization needs to make decisions as part of the managerial process. Some of these decisions are easy to make and need a short decision-making process while others are the hardest choices in the work environment to support organizational growth [34]. Decision-making is a complex process in which first-line managers combine theoretical with practical experience to make a judgment regarding patient care and require thoughtful reasoning so, that the best options for the patient are chosen based on the patient's condition and the priority of the problem [33].

The decision-making process involves observation, information processing, critical thinking, evaluating evidence, applying relevant knowledge, problem-solving skills, and clinical judgment to select the best course of action that optimizes a patient's health and minimizes potential harm. Establishing a positive decision-making environment, generating potential alternatives, evaluating the alternatives, choosing the best alternatives, checking the decision, and communicating & implementing the decision are domains of decision-making abilities among first-line managers [17].

The abilities and skills to make the right and effective decisions are some of the most difficult to learn. It is a lifelong learning process defined by personal traits, errors, and experiences. It is an essential component of first-line managers' ability to make effective decisions is the most important factor affecting the quality of care [12].

Artificial intelligence technology increasingly extends and enriches decision-making through, coordinating data delivery, analyzing data trends, providing forecasts, developing data consistency, quantifying uncertainty, anticipating patient data needs, providing information to the patient in the most appropriate form, and suggesting courses of action. AI decision-making allows the organization to make faster, more accurate, and consistent decisions by capitalizing on datasets with AI that can analyze large datasets without error and helps first-line managers to focus better on work relevant to their tasks [32].

Significance of the study:

Health care organizations must respond rapidly to changing technology, regulation, and customer demands in the rapid transition in healthcare. Artificial intelligence can assist in proactive patient care, decreased future risk, and streamlined work processes. The advancement of artificial intelligence technology to additional adoption and value across healthcare is perpetuated by cost, quality, care outcomes, helps to analyze large amounts of data efficiently and assists instruction [27].

Artificial intelligence technology assists in routine nursing care activities such as patient monitoring vital signs and assisting decision making [21]. Thus, integrating artificial intelligence technology into the nursing workflow facilitates clinical decision making abilities for first line managers to develop more seamless and individualized nursing care plans [7], reduce the time needed for documentation while increasing its accuracy and completeness [15].

From the investigator point of view, as graduated from Benha University and working a head nurse at Benha University Hospital from the last three years, investigator noted that the artificial intelligence technologies enable nurses to perceive, understand, act and learn in order to carry out health care administrative & clinical functions, enroll in research & clinical learning activities. So, investigator praised the necessity of introducing artificial intelligence technology in work as enhance first line managers' decision making abilities, so this study was conducted to assess artificial intelligence technology and its relation to decision making abilities as perceived by first line managers.

2. Aim of the study:

The study aimed to assess the artificial intelligence technology and its relation to decision making abilities as perceived by first line managers.

Research questions

1. What are the first line managers' levels of perception about artificial intelligence technology?
2. What are the decision making abilities levels as reported by first line managers?
3. Is there a relation between artificial intelligence technology and decision making abilities as perceived by first line managers?

3. Subjects and method:

I. Technical design:

The technical design included a description of the study design, setting, subjects and tools of data collection.

Study design

A descriptive correlational design was utilized to conduct this study.

Study setting

The current study was conducted in all inpatient units at Benha University Hospital. **Study subjects**

All available first-line managers 57 who are working at the previously mentioned study setting during the time of data collection.

Tools of Data Collection: Data was collected by using two tools:

I-**Artificial intelligence technology questionnaire:**

It was included two parts:

Part (1): Personal characteristics of first-line managers include; age, gender, marital status, educational qualification, years of experience in nursing work, previous work in private hospitals working with artificial intelligence technology, and study setting.

Part (2): Artificial intelligence technology questionnaire was developed by the investigator after reviewing the related literature **(Oh, *et al.*, 2019; Abdullah& Fakiehan, 2020; Schepman & Rodway, 2020)** to assess artificial intelligence technology as perceived by first-line managers. It consisted of 42 items grouped under six dimensions; perception toward AI technology [11], advantages of using AI technology [8], Economic expectation of using AI technology in the work [2], performance expectancy with using AI technology in the work [8], barriers to AI technology application in nursing care [5], and attitudes toward using AI technology [8].

Scoring system:

Responses of first-line managers were rated on a three point Likert Scale ranged from (1-3) as; (3) Agree, (2) Neutral, and (1) Disagree. Finally the scores of each dimension summed up and converted to percent scores. Range of scores from 42-126 and cutoff point was done at 60 % = 76 points. Accordingly, levels of artificial intelligence technology as perceived by first line managers were categorized as the following;

High perceived level if the percent ≥ 75% that equals ≥ 94 points. Moderate perceived level if the percent from 60 % - < 75% that equals from 76 - > 94 points and low perceived level if the percent < 60% that equals < 76 points.

II- Decision making abilities scale:

It was developed by **(Abd Elghaffar, 2018)** based on **(Jinkinis, 1988)** and modified by investigator to assess decision-making abilities among first-line managers. It consisted of 42 items grouped under six main domains; establishing a positive decision making environment (8), generating potential alternatives (7), evaluating the alternatives (6), choice the best alternatives (8), check decision (8), and communication and implementation (5).

Scoring system:

First line managers' responses were rated on a three point Likert Scale ranged from (1-3) as; (3) Always, (2) Sometimes, and (1) Never. Finally the scores of each dimension summed up and converted to percent scores. Range of scores from 42-126 and cutoff point was done at 60 % = 76 points. So, the levels of decision making abilities among first line managers were categorized as the following;

High perceived level if the percent ≥ 75 % that equals ≥ 94 points. Moderate perceived level ranged from 60 % - < 75% that equals to 76 - < 94 points and low perceived level if the percent < 60 % that equals <76 points.

II. Administrative design:

An official permission was issued from the Dean of the Faculty of Nursing Benha University to the Director of Benha University Hospital and then an official approval was obtained from the Director of Benha University Hospital to allow the investigator to collect data; this approval was given after the aim of the study was clarified.

III. Operational design:

This phase started from the beginning of March to end of May 2022 covering three months, it included; reviewing the national and international related literature using Journals, Periodicals and internet of the various aspects concerning the topic of the study to construct study tools and translate the tools into Arabic to check its accuracy.

Validity of the tools:

The tools were tested by five Experts from different Nursing Faculties in the field of Nursing Administration; (one Assistant Professor from Benha University, two Assistant Professors from Tanta University, one Assistant Professors from Menoufia University, and one Assistant Professors from Ain Shams University). The validity of the tools aimed to judge its clarity, comprehensiveness, relevance, and accuracy.

Pilot study:

A pilot study was conducted at August, 2022 to test the sequence of items feasibility, practicability and applicability of the tools, clarity of the language and to estimate the time needed for filling each tool. It was done on 10% of the total subjects that is means it done on 6 first-line managers. There was no change occurred of the pilot study so, this sample was included in the main study subjects.

Reliability of the tools:

Reliability of tools tested by using Cronbach's Alpha coefficient test to measure the internal consistency for the tools: Artificial intelligence technology questionnaire was 0.91, and decision-making abilities scale was 0.88 that reflect accepted internal consistency and high degree of reliability.

Field work:

Data collection took about two months from September, 2022 to the end of October, 2022 after getting necessary permissions. The investigator met first-line managers during available work time while not interfere with their duties and explained the aim, the nature of the study, and the method of filling questionnaire. This was done individually. The number of collected questionnaire from firs-line managers per week ranged from 3-4 sheets. Time needed to fill two questionnaire; artificial intelligence technology and decision making abilities ranged from 30-35 minutes. Data collected two days / week in Sunday and Wednesday from 10 am to 12 pm and the investigator investigates each sheet after completing by first line managers.

Ethical considerations:

Before conducting the study, the respondent rights was protected by ensuring voluntary participation, so the informed consent was obtained from each participant

after explaining the aim of the study, its potential benefits, methods for filling data collection tools and expected outcomes. The respondent rights to withdraw from the study at any time were assured. Confidentiality of data obtained was protected by allocation code number to the questionnaire sheets. Subjects were informed that the content of the tools used for the study purpose only.

IV. Statistical analysis:

All data were collected, coded, tabulated, and subjected to statistical analysis. Statistical analysis was performed by Statistical Package for Social Sciences (SPSS version 26.0); also, Microsoft Office Excel is used for data handling and graphical presentation. Descriptive statistics were applied in the form of mean and standard deviation for quantitative variables and frequency and percentages for qualitative variables. In addition, Pearson correlation coefficient (r) were used to estimate the closed association between two quantitative variables. Statistical significance was considered at p-value ≤0.05 and highly statistical significance was considered at p-value ≤0.001.

4. Result

Table (1): Illustrates that more than half (59.6%) of the first-line managers were in the age group ranged from 30 to less than 35 years with a mean age of 31.28±3.20 years. As far as, their gender and marital status, more than two-thirds (68.4% & 71.9%) of them were female and married, respectively. As regards their educational qualification and years of experience, the majority (87.7% &84.2%) of them had a Bachelor of Nursing Science, and their experience ranged from 10 to less than 15 years respectively, with a mean of experience 11.16±3.11 years. Also, more than half (56.1%) of first-line managers had the previous working in private hospitals working with artificial intelligence technology.

Figure (1): Shows that slightly less than three-fifths (59.6%) of the first-line managers were working at the medical building. Also, slightly less than two-fifths (36.9%) of them were working at the surgical building. While the lowest percentage (3.5%) of the first-line managers were working at the ophthalmology building.

Figure (2): Indicates that, the majority (80.7%) of the first-line managers had a high perception level of artificial intelligence technology, while less than one-fifth (15.8%) of them had a moderate perception level, and the lowest percentage (3.5%) of them had a low perception level of artificial intelligence technology.

Table (2): Clarifies that the total mean score for all dimensions of artificial intelligence (AI) technology among first-line managers was 98.29±7.94.

Figure (3): Indicates that, the majority (84.2%) of first-line managers had a high level of decision-making abilities. While less than one-fifth (15.8%) of them had a moderate level of decision-making abilities.

Table (3): Clarifies that the total mean score for all decision-making abilities domains among first-line managers was 100.58±4.55.

Table (4): Shows that; there was a highly statistically significant positive correlation between total artificial intelligence technology and total decision-making abilities among first-line managers.

Table (1) Distribution of the first-line managers regarding their personal characteristics (n=57)

Personal Characteristics		N.	%
Age (years)	25: <30	16	28.1
	30: <35	34	**59.6**
	≥ 35	7	12.3
	M±SD	**31.28±3.20** years	
Gender	Female	39	**68.4**
	Male	18	31.6
Marital status	Married	41	**71.9**
	Unmarried	16	28.1
Educational qualification	Bachelor of Nursing Science	50	**87.7**
	Others post graduate studies	7	12.3
Years of experience in nursing work	5: <10	7	12.3
	10: <15	48	**84.2**
	≥ 15	2	3.5
	M±SD	**11.16±3.11** years	
Previous working in private hospitals working with artificial intelligence technology	No	25	43.9
	Yes	32	**56.1**

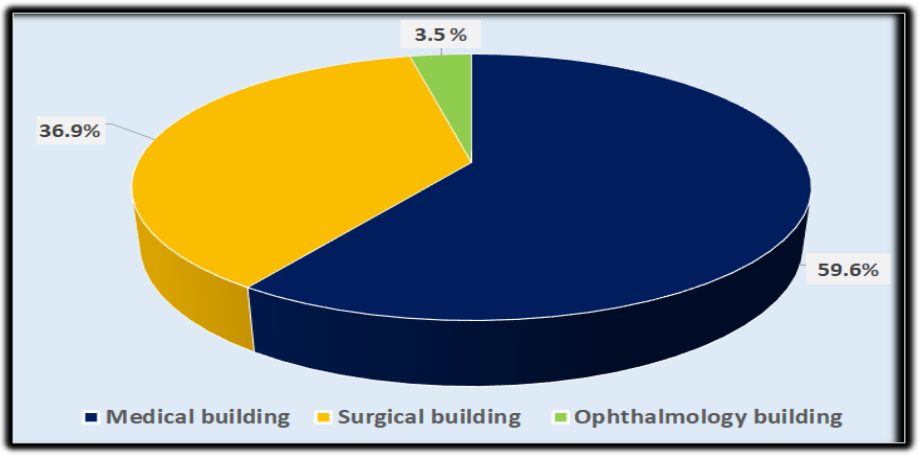

Fig. (1) Distribution of the first-line managers according to the study setting

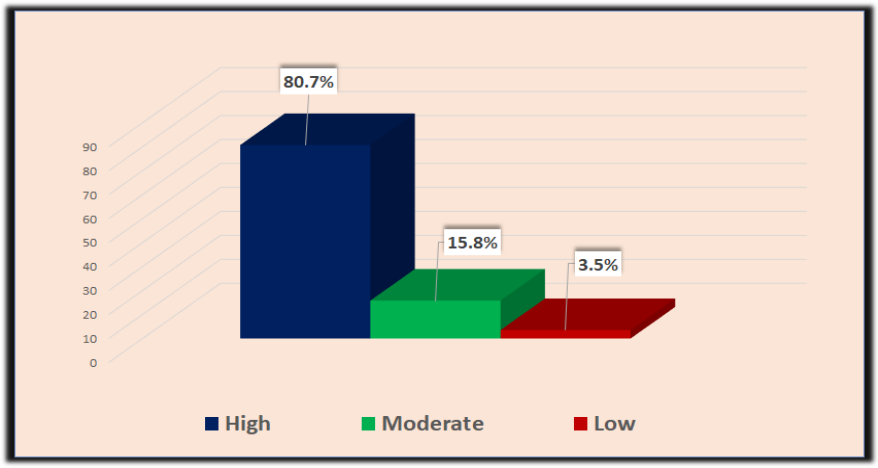

Fig. (2) Perception levels of artificial intelligence technology among first-line managers

Table (2) Total mean and standard deviation of artificial intelligence (AI) technology dimensions as perceived by the first-line managers (n=57)

Total artificial intelligence technology (AI) dimensions	Maximum score	Mean ± SD
	126	98.29±7.94

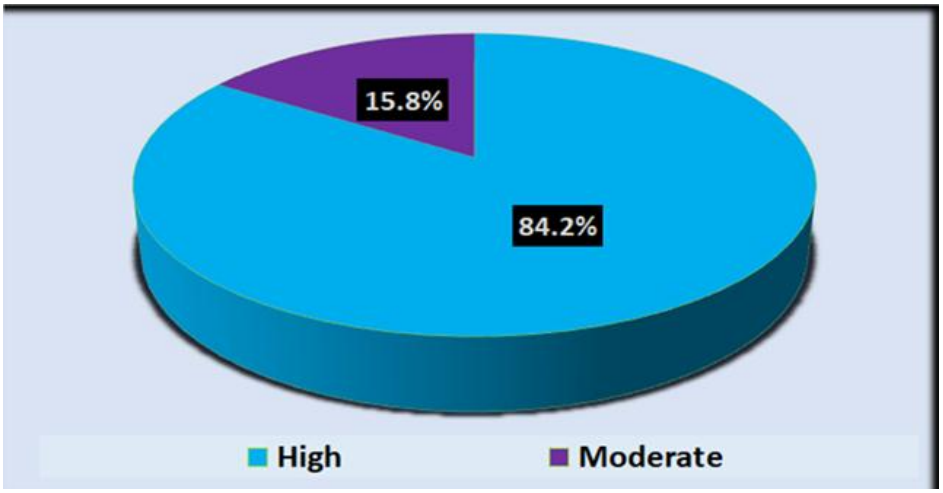

Fig. (3) Levels of decision-making abilities among first-line managers

Table (3) Total mean and standard deviation of decision-making abilities domains among first-line managers (n=57)

Total decision-making abilities domains	Maximum score	Mean ± SD
	126	100.58±4.55

Table (4) Correlation between the total artificial intelligence technology perception and total decision-making abilities among first-line managers (n=57)

Variables	Decision-making abilities	
	r	P value
perception of the artificial intelligence technology	0.784	0.000**

**** Highly statistical significance (p<0.001)**

5. Discussion

Artificial intelligence in healthcare organizations is used to support decision-making, management of diseases, patient engagement, and organizational enhancements. So, it is a central part of any management role, a core element in problem-solving and important in a range of other activities [13]. Technology perceptions and attitudes are significant factors that may hinder the uptake and success of its implementation [5].

The current study was conducted to assess artificial intelligence technology and its relation to decision-making abilities as perceived by first-line managers that can be achieved through the following objectives; assessing the first-line managers levels of perception about artificial intelligence technology, identifying the decision-making abilities levels among first-line managers, and determining the relation between artificial intelligence technology and decision-making abilities as perceived by first-line managers.

The findings of the present study illustrated that slightly less than three-fifths of the first-line managers were in the age group ranged from 30 to less than 35 years with a mean age of 31.28±3.20 years. As far as, their gender and marital status, more than two-thirds of them were female and married. As regards their educational qualification and years of experience, the majority of them had a Bachelor of Nursing Science, and their experience ranged from 10 to less than 15 years, with a mean of experience 11.16±3.11 years. Also, more than half of first-line managers had the previous working in private hospitals working with artificial intelligence technology.

The findings of the present study indicated that the majority of the first-line managers had a high perception level of artificial intelligence technology, while less than one-fifth of them had a moderate perception level, and the lowest percentage of them had a low perception level of artificial intelligence technology. From the investigator's point of view, this result may be related to the ability of artificial intelligence in transforming the level of health care through AI programs that help in predicting, diagnosing, diseases treatment, improvement of care and reducing workload.

This result agreed with [19] who conducted a study in Iran about “Nursing managers’ attitudes towards using artificial intelligence systems in nursing decisions” and reported that the majority of nursing managers had a high level of awareness toward applications of artificial intelligence technology. While, this result was disagreement with [20] who conducted a study in Korean about "Physician confidence in artificial intelligence: An online mobile survey" and reported that the lowest percentage of respondents answered that they had good familiarity with AI**.** While, this result inconsistent with [2] who conducted a study in Riyadh about “Health care employees' perceptions of the use of artificial intelligence applications: Survey study” and reported that the overall respondents' perception toward AI was moderate.

The findings of the present study indicated that the majority of first-line managers had a high level of decision-making abilities. While less than one-fifth of them had a moderate level of decision-making abilities. From the investigator's point of view, this result might be due to first line managers had highly knowledge, experience, trained, self-confidence and situation awareness. As they have higher level of autonomy and higher level of formal empowerment.

This result agreed with **[18]** who conducted a study in Benha about "Assessment of decision making ability among head nurses and its influence on their job satisfaction at Benha University Hospital" and reported that the majority of head nurses had high level of decision making ability. Also, this result was consistent with **[20]** who conducted a study in Kingdom about "Factors influencing nurses' decision-making process: An integrative literature review" and reported that the decision makers had high decision making abilities as they had a good kknowledge of the environment, experience, confidence, autonomy, values, and work with physical and psychological situation that improve their decision making abilities.

This result was in the same line with [23] who conducted a study in Menoufia about "Decision making ability: A key for internship student's self-esteem at selected hospitals" and reported that more than half of nursing interns had high level of decision making ability. This result was harmony with [9] who conducted a study in Benha about "Metacognition and mindfulness and its relation to head nurses' decision making abilities" and reported that the majority of head nurses had high level of decision making abilities.

The findings of the present study revealed that there was a highly statistically significant positive correlation between total artificial intelligence technology and total decision-making abilities among first-line managers. From the investigator's point of view, this result might be due to most applications of artificial intelligence contain huge volumes of data to make tasks effectively and help them in intelligent decisions.

This result agreed with [30] who conducted a study in Germany about "The current state of combining human and artificial intelligence for strategic organizational decision making" who reported that AI techniques are increasingly extending and enriching decision support through organizing data delivery, analyzing data trends, providing forecasts, and developing data consistency. This result supported by [4] who conducted a study in Jeddah about "Linking artificial intelligence use to improved decision-making, individual and organizational outcomes" who reported that there was a statistically significant positive correlation between total AI capability and improved decision-making.

Additionally, this result was harmony with [11] who conducted a study in Turkey about " Artificial intelligence and robot nurses: From nurse managers’ perspective: A descriptive cross-sectional study" and reported that artificial intelligence applications used to identify nursing diagnoses reduced the time spent on decision-making.

6. Conclusion

Based on the current study findings, it can be concluded that the majority of first-line managers had high perception level toward artificial intelligence technology, and high decision-making abilities level. While less than one-fifth of them had moderate perception level of artificial intelligence technology and moderate decision-making abilities level. Also, the lowest percentage of first-line managers had a low perception level of artificial intelligence technology. Moreover, there was a highly statistically significant positive correlations between total artificial intelligence technology and total decision-making abilities as perceived by first-line managers.

7. Recommendations

In light of the findings obtained from the present study, the following points are recommended:

For the hospital administration

- Enhancing the readiness of organizations for using artificial intelligence through providing good infrastructure and budgeting.
- Putting pre-established criteria for selecting first-line managers at the hospitals based on the ability to take good decision-making.
- Developing a reward system for first-line managers with effective decision-making to encourage others to do the same.
- Representing first-line managers in hospital committees and participate in decision-making about patients` problems and hospital policies.

For the educational

- Recognizing artificial intelligence technology as an effective tool that helps first-line managers to improve their professional competencies not replace them in the work.

For further study:

- Replication of the study on a large probability sample is highly recommended to achieve generalization results.

- Conduct a study to examine challenges facing first-line managers' involvement in artificial intelligence technology and decision-making process.
- Study the relation between artificial intelligence technology, self-directed learning, and academic achievement among nursing students.

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