# Green Intellectual Capital and Its Effect on Innovation among Health Care providers

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**Abstract**

**Background:** Today with growing demands for innovation to improve quality of care, contain upward costs, maintain sustainability. "Green Intellectual Capital" (GIC) is a modern advance in corporate sustainability; more effective methods are needed to manage and measure green intellectual capital both within and across healthcare organizations. **Aim** of the study: The study aimed at investigating green intellectual capital and its effect on innovation among health care providers. **Research Design:** A descriptive correlational design was used in this study. **Settings:** This study was carried out at Cardio -Vascular Hospital, which is associated with Ain Shams University Hospitals. **Subject:** Two groups involved in this study, the first group included all staff nurses, their number was (145), and the second group are doctors. Their number was (52). **Tools of data collection:** there are two tools used namely green intellectual capital scale and innovative behavior inventory. **Results:** total green intellectual capital level of health care providers clarified that around one third of them had a high level but slightly increased among doctors (32.40%) than staff nurses (30.10%). While more than half of staff nurses (58.90% ) and doctors had moderate level (58.60%), and the minority of staff nurses and doctors (11 %, 9 %) respectively had low level of green intellectual capital. Additionally, a quarter of staff nurses (25%) had high level of total innovation and less than one fifth (17%) of doctors were had high total innovation level, while more than three quarter doctors had moderate total innovation level (76%), and their level was higher as compared with staff nurses was (60%) and finally minority of doctors and staff nurses had low innovation level (15% , 7 %)respectively .**Conclusion:** a highly statistical significant positive correlation existed between green intellectual capital and innovation among health care providers. **Recommendation:** Implement training program for health care providers that focus on increasing their awareness about green intellectual capital and innovation that foster different and innovative ways of decision making.

**Keywords:** Green Intellectual Capital, Innovation, Health Care providers

## Introduction

Healthcare organizations face multiple challenges, such as fast incremental costs, decrease in nursing numbers, clinician exhaustion, varying hospital rules, hospital quality healthcare differences. Thus, innovation is a crucial requirement for solving hospital problems (**Hara et al ,2022).** Nurses perform more than eighty percent firsthand care and direct care and represent the bulk of global health care professionals; they are most exposed to organizational failures and must create solutions for the many everyday gaps in healthcare delivery. Advancing healthcare innovation may be limited when nurses experience multiple obstacles that affect their innovation engagement **(DeClerck , 2023).**

Today, enhancing organization green image is interesting due to pressure from international entities, community, the government and customers **(Sampene et al., 2022).** As well as the organization gives great significance to intangibles assets that reliance on knowledgeable workers in order to provide sustainable growth and development. Green intellectual capital (GIC) is looked at as an innovative idea that overrides environmental deterioration, and bridge competitive hospital advantages **(Asurakkody & Shin, 2018; Jirakraisiri et al., 2021).**

Health care providers as practitioners are prioritizing environmental concerns. In order to provide a high standard of service, health care organizations will need qualified, well-trained, creative, and experienced doctors, nurses, and administrators. Those professionals working in health care service organization possess unique knowledge, ideas, experiences, and competencies **(Nilsen et al 2020; Salopek-Žiha 2020; Wu et al., 2020)**. Since the hospitals also rely on employees for all their organization functions, building the green intellectual capital of not only managers but also highly skilled providers are important for hospitals and employees **(Yusliza et al.,2020; Haldorai et al.,2022).**

Nurses and doctors, in their daily work, constantly treat information and applied knowledge. They observe, care for, and promote the psychological and physical well-being of the patient. Today, as never before, it seems essential that they should be equipped with tools to help them carry out their work in a more time-efficient and useful manner. Enhancing health workers' personal knowledge would satisfy an essential requirement to promote overall organizational knowledge by favoring innovation in hospital **(Hermes et al 2020; Javaid, 2023).**

Green Intellectual Capital (GIC) is considered as a later development in intellectual capital and organizational sustainability studies (**Benevene et al., 2021).** GIC is described as an intangible organizational factor that consists of a repository of knowledge, supply of ideas and learning which allows the organization to enhance its values and worths **(Ali et al., 2021).** Because competence is a substantive requirement that effectuates outcomes. When personnel take advantage and apply the green knowledge in their experiences they become have wisdom and experiences that eventually can improve organization outcomes **(Khan et al., 2022).**

Green Intellectual Capital (GIC) types or dimensions include three types: "green human capital" defines as feed with skills, information, education and experience in one's ownership which encourage their initiatives and execution in the organization, also it is associated with external environmental assets that continuously embed, gain, and apply by all organizations. "Green structural capital" refers to information about organizations' process and systems that evolve by knowledge fusion to promote sharing of knowledge and finally "green relational capital" it refers to collaboration-based information, in which acquire knowledge returned to relationship with stakeholders that lets them exchange information, hence constructing their internal organizational confidence. Upgrading organization outcomes in speedy altering policies and information require apply whole of these green types knowledge (**Aboelmaged & Hashem,2019; Ahmed et al.,2020; Al Issa et al .,2023).**

By using information, organization can gain competitive advantage, development in technology and information revolution has occurred. GIC indeed makes human resources have the skills and knowledge to create chummy processes and measures that prevent environmental deterioration, as well as is at the forefront of reaching organization sustainability. Additionally, organizations that flooded more in green intellectual capital saw a considerable boost in the degree of innovation **(Shabana, 2023).**

Innovation is defined as "the process of implementing new products, services, and/or solutions that create new value". This concept naturally confirms the knowledge that innovation is not only a process but also an activity rather than a good. Innovation is deemed as a strategic approach which produces new methods of providing care at high-quality and solving issues usually originating from workarounds and other tactical actions **(Hara et al.,2022).**

Innovation in health organization is considered as crucial component for maintaining and keeping up recent world dynamic and highly competitive environment. Individuals are primary drivers of innovation **(Baig et al.,2022).** Strengthen innovation in health care setting triggering by factual perception and embrace of innovation **(Allameh, 2018)**.

Innovation process gives rise to solving issues, organizational activities and process by

novelty, it constitutes arguing the current situation by initiation for taking the chance thinking in creative way freely for advancing result. Moreover, achieve competent /efficient care when converting creative concepts into concrete outcomes **(Jain, 2023**). Additionally, innovative behavior has several effects on organizations including work potency, satisfaction, retention, obligation and creating novel solutions for any obstacles **(Asurakkody & Shin, 2018)**. In addition to, GIC may guarantee alignment among the organization's operational aspect, philosophy culture and strategic decisions as well as its intangible origins, capacity for innovation **(Benevene et al., 2021).**

## Significance of Study

GIC being shown to improve an organization's functions **(Yadiati et al., 2019)** and gaining a competitive edge **(Yusliza et al., 2020; Astuti & Datrini, 2021)**, green practices are becoming more and more important to societies and public organizations as a means of reducing environmental harm **(Yasmeen et al., 2019; Zameer et al., 2020).** As a result, organizations need both GIC and physical capital to build a green environment. Accordingly, GIC's importance has grown internationally. Furthermore, efficiency and ongoing progress depend heavily on innovation. Nursing is one of the professions where innovation and change are experienced intensely **(Carlucci, et al., 2021).**

Although the crucial interest, the GIC has received little attention from researchers, and only a few studies have been examined **(Ali et al., 2021).** Also, there is limited direct information about GIC influence on innovation among doctors specifically. **Kawilarang et al., (2023)** recommended further studies to understand the specific implications of GIC in the healthcare sector and among medical professionals. During my work, I observed that health care providers facing critical situations and dealing with vulnerable patients that require innovative/quickly decisions, so to this study applied among two crucial personnel of health care organizations, namely doctors and nurses to make them mastery and aware with GIC as a factor provokes innovation as well as required green perspective picture. Therefore, the current study aimed at investigating green intellectual capital and its effect on innovation among health care providers.

## Aim of the study

This study aimed at investigating green intellectual capital and its effect on innovation among health care providers through:

1- Assessing green intellectual capital level among health care providers.

2- Assessing innovation level among health care providers.

3- Finding out the effect of green intellectual capital on innovation among health care providers.

## Research Questions:

What is the effect of green intellectual capital on innovation among health care providers?

Operational Definition

The term “A health care provider” is refers to a people who provides medication, services, remedy and medical care related to health. In hospital healthcare providers doctors and staff nurses are all included in this study **(Davis,2023).**

## Subjects And Methods

### Research design

A descriptive correlational design was applied in the study.

### Research Setting

This study was carried out at Cardio - Vascular Hospital, which is associated with Ain Shams University Hospitals. The hospital consists of different critical and non-critical units including (Emergency department, Chest ICU, CCU, Thoracic surgery operating room, Cardiac Cath operating room, Pediatric ICU, Inpatient departments as 6th and 7th floors). Total bed capacity is (150) beds.

**Research Subjects**

Two groups included in the study, the first group included all staff nurses, their number was (145), and the second group is doctors, their number was (52).

**Sampling technique**

A convenience sampling technique was included in this study.

**Data collection tools**

Two tools were used for data collection.

Tool I: Green intellectual capital Scale

This tool was used to assess green intellectual capital levels among health care providers. This tool was developed by the researcher based on review relevant literatures **(Dang and Wang, 2022; Chen ,2008).** It involved two parts:

Part 1: Staff nurses /doctors characteristics. Include personal and job characteristics such as age, gender, marital status, educational qualifications, work unit, experience years and attending training courses.

Part 2: Green intellectual capital scale includes (17 items), it divided into three dimensions as the following: "green human capital" (four items), "green structural capital "(nine items), and "green relational capital" (four items).

**Scoring system**

A five point Likert scale was utilized to evaluate subjects' responses starting from 1 strongly disagree to 5 rated strongly agree. The total score of scale was calculated and ranged from 17 to 85 and classified as low if score 17-39 points, while moderate level fall between 40-62 points and indicated as high when range 63-85 points **(Dang and Wang, 2022).**

**Tool 2: Innovative Behavior Inventory:**

The tool was adopted from (**Lukes and Stephan ,2017).** This tool was used to assess innovation level among staff nurses and doctors. It comprises a total number of twenty three items, which covering seven basic dimensions namely: "idea generation dimension", "idea search dimension", "implementation starting dimension", "involving others dimension", and "innovation outputs dimension" each of these dimensions involves three items. While "idea communication dimension" and "overcoming obstacles dimension" each one of them includes four items.

**Scoring system**

A 5-point Likert scale, ranking from 1 denoting strongly disagree and to 5 denoting strongly agree, was used to measure the responses. The total inventory score was classified into low, moderate and high innovation, ranging from 23 to 115. It was calculated by summing up the average scores of all dimensions, then were converted into percentage scores. Low innovation is a score below 60% (23-68 points) indicates, while a score between 60% and 74% (69-85 points) represent moderate innovation and if the score 75% or more (86-115 points) denotes high innovation **(Ahmed et al., 2024).**

**Preparatory phase**

This phase covered 3 months and started from the middle of November to mid-February 2024. During this phase, A researcher developed and prepared data collection tools, acquainted with the health care providers and collect data by visited study setting. All of these occurred after reviewing green intellectual capital and innovation literatures.

**Tools validity**

Green intellectual capital scale tool was translated into Arabic and back translated into English. The consistency between the English and Arabic versions was ascertained and presented to a panel of experts their number were (5), specialized in nursing administration (3) experts included one professor and two assistant professors and two assistant professors from psychiatric mental health

nursing for examine face and content validity. They reviewed the content of the tools for their comprehensiveness, accuracy, clarity, and relevance. While innovative behavior inventory was validated by **(Mahgoub, 2019).**

**Reliability**

Cronbach's alpha coefficient used to determine the internal reliability of study tools. The results revealed that the green intellectual capital scale had a score of 0.88, indicating strong reliability, while innovative behavior inventory had a score of 0.91, reflecting even higher reliability.

**Pilot study:**

A pilot study was conducted on 10% of participants (19) staff nurses and doctors of study sample. It was done to assess tool feasibility, clarity as well as its applicability and determined the time required to complete the questionnaire which was 15-20 minutes.

**Field work:**

Once formal permission and approval to carry out the study was obtained, the researcher visited the hospital's medical and nursing director to find an appropriate time to collect data, then the researcher met the study subjects and explicated the goal and methodology of the study, so enabling them to be ready, accept to participate. Tools were distributed to the subjects individually, then completed tools once they were finished were gathered and checked for completeness. The researcher was present to give the required direction during the process of collecting data. Each doctor or staff nurse took fifteen to twenty minutes to complete the questionnaire and forward it back to the researcher. Every week three days, on Saturday, Sunday, and Tuesday morning data were collected.

**Administrative Design:**

Pertinent authorities granted a formal letter issued from the Dean of the Faculty of Nursing to hospital directors of the study setting to gain official approval. Then the researcher met doctors and staff nurses in all units, the study's objectives and data collection methods were explained to secure permission for conducting the research. Confidentiality was guaranteed and has been anonymous data collection forms.

**Ethical consideration:**

A written ethical approval was secured from the ethical committee and scientific research at the Faculty of Nursing, Ain Shams University before conducting the study, The researcher explained the study's aims and objectives to the studied staff nurses and doctors prior to commencement. Each participant asserted that information gathered confidentially utilized solely for research purposes. Also informed them that allow to withdraw at any time from study. Informed written consent was obtained from them.

**Statistical Design:**

IBM Statistical Package for Social Sciences (SPSS) version 25 was used for processing data entry and for carrying out statistical analysis. Descriptive statistics data were displayed with frequencies and percentage for categorical data, and quantitative data presented by mean (X) and standard deviation. Chi square test, P-value is used to test association between two variables. and Pearson correlation (r- test) used to test the correlation between the study variables and multiple linear regression analysis was used to calculate the direct effect of two variables. The reliability of the scales was evaluated using Cronbach's alpha. Value of p 0.05 or less denoted to statistically significant, and if p value less than 0.001 were deemed as highly statistically significant.

**Results:**

**Table (1):** indicates that staff nurses and doctors age were less than 30 years, with Mean± SD 29.4±5. 32,. 27.88±4.39 respectively. More than half of staff nurses were female 55.2 %, married 51.7%, more than half (51%) worked in non-critical unit, more than two fifths (48.3% & 41.4%) had bachelor's degree, and had experience years ranged between 5 and 10 years. While doctors two third of them 67.3 were male, unmarried 61.5 %, more than half 57.7 % , 55.8 % & 63.5% of them had experience 5-10 years in critical care unit and had a bachelor's

degree. More than half (55.2%& 57.7%) of both doctors and staff nurses did not attend the training course.

**Table 2** demonstrates that green structural capital dimension was the highest mean score 3.71, among staff nurses. While doctors had the highest mean score in green human capital.

**Figure 1**, Total green intellectual capital levels among health care providers. Shows that more than half of staff nurses and doctors (58.90%, 58.60%) had moderate levels of green intellectual capital. While around one third of them had a high level as shown among staff nurses (30.10%) but slightly increased among doctors (32.40%) and finally the minority of staff nurses and doctors (11%, 9%) respectively had a low level of total green intellectual capital.

**Table (3)** presents that involving others dimension was the highest mean among staff nurses 3.71,while the lowest mean 3.02 was regarding implementation starting activities. Doctors had the highest mean 3.80 regarding innovation outputs and the lowest mean score 3.21 was in idea communication.

**Figure (2)** demonstrates that one quarter of staff nurses (25%) had a high level of innovation, but less than one fifth (17%) of doctors had a high level. While, more than three quarters of doctors (76%) had moderate level of total innovation, while (60%) of studied staff nurses had moderate levels and lastly a minority of both heath care providers had low innovation level (15%, 7 %).

**Table (4)** presents that there are relations statistically significantly between health care providers' green intellectual capital score and their personal and job characteristics included their age, work unit, marital status, educational qualification, and experience year in work and attending training courses at ($p< 0.01$*).It is evident that both doctors and staff nurses in middle age group 30-40, male, worked in critical care unit had high green intellectual capital score. Also. It is noticed that those married staff nurses with technical institute qualifications, and more than 10 years of experience, had the highest perceived score. Additionally unmarried doctors, their age 30 - 40 yrs, master's degree, had experience in their works 5-10 years.

**As shown in table 5**, there is a relation statistically significant between health care providers' innovation score and their personal and job characteristics at ($p< 0.01$*). It is noticed that female staff nurses who their age more than 40 yrs, had experience more than 10 years in critical care unit had highest innovation score. Also, male doctors, in middle age group30-40 years, with master's degree and had experience less than 5 year in their jobs had highest innovation mean scoring.

**Table (6)** identifies a positive correlation highly statistically significant between green intellectual capital and innovative behavior among health care providers.

**Table (1). Frequency and percentage distribution of the personal and job characteristics of health care providers**

| personal /job characteristics | Staff nurses in studied sample (n=145) | | Doctors in studied sample (n=52) | |
|---|---|---|---|---|
| | F | % | F | % |
| **Age (in year)** | | | | |
| Less than 30 yrs | 62 | 42.7 | 25 | 48 |
| 30 - 40 yrs | 60 | 41.4 | 15 | 28.9 |
| More than 40 yrs | 23 | 15.9 | 12 | 23.1 |
| Mean±SD 29.4±5.32 | | | 27.8±4.39 | |
| **Gender** | | | | |
| Male | 65 | 44.8 | 35 | 67.3 |
| Female | 80 | 55.2 | 17 | 32.7 |
| **Marital Status** | | | | |
| Married | 75 | 51.7 | 20 | 38.5 |
| Unmarried | 70 | 48.3 | 32 | 61.5 |
| **Work unit** | | | | |
| Critical care unit | 71 | 49 | 29 | 55.8 |
| Non -critical care unit | 74 | 51 | 23 | 44.2 |
| **Educational qualifications** | | | | |
| Technical degree | 50 | 34.4 | 0 | 0 |
| Bachelor degree | 60 | 41.4 | 33 | 63.5 |
| Master's degree | 20 | 13.8 | 14 | 26.9 |
| Doctorate degree | 15 | 10.4 | 5 | 9.6 |
| **Years of experience in work** | | | | |
| Less than 5 yrs | 40 | 27.6 | 10 | 19.2 |
| 5 - 10 yrs | 70 | 48.3 | 30 | 57.7 |
| More than 10 yrs | 35 | 24.1 | 12 | 23.1 |
| Mean ±SD | 7.08±2.4 | | Mean ±SD | 6.04±1.3 |
| **Attending Training courses** | | | | |
| Yes | 65 | 44.8 | 22 | 42.3 |
| No | 80 | 55.2 | 30 | 57.7 |

**Table (2) Green intellectual capital dimensions level among health care providers**

| Green intellectual capital dimensions | Green intellectual capital dimensions among health care providers | | | |
|---|---|---|---|---|
| | Staff nurses in studied sample (n=145) | | Doctors in studied sample (n=52) | |
| | x | SD | x | SD |
| Green human capital | 3.42 | ±0.32 | **3.90** | **±0.39** |
| Green structural capital | **3.71** | **±0.51** | 3.41 | ±0.30 |
| Green relational capital | 3.60 | ±0.22 | 3. 27 | ±0.25 |

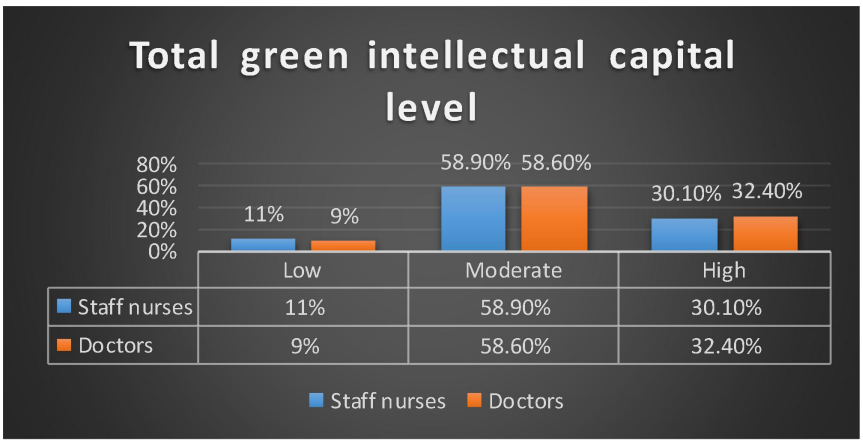


**Figure (1): Total green intellectual capital levels among health care providers**

**Table (3) Innovative behavior dimensions level among health care providers regarding their dimensions**

| Innovative behavior dimensions | Innovative behavior dimensions among health care providers | | | |
|---|---|---|---|---|
| | Staff nurses in studied sample (n=145) | | Doctors in studied sample (n=52) | |
| | x | SD | x | SD |
| **idea generation** | 3.12 | ±0.24 | 3.44 | ±0.30 |
| **idea search** | 3.61 | ±0.40 | 3.51 | ±0.22 |
| **idea communication** | 3.33 | ±0.33 | 3. 21 | ±0.28 |
| **implementation of starting activities** | 3.02 | ±0.39 | 3.63 | ±0.41 |
| **involving others** | **3.71** | **±0.60** | 3.47 | ±0.55 |
| **overcoming obstacles** | 3.40 | ±0.21 | 3. 24 | ±0.26 |
| **innovation outputs** | 3.39 | ±0.27 | **3.80** | **±0.39** |

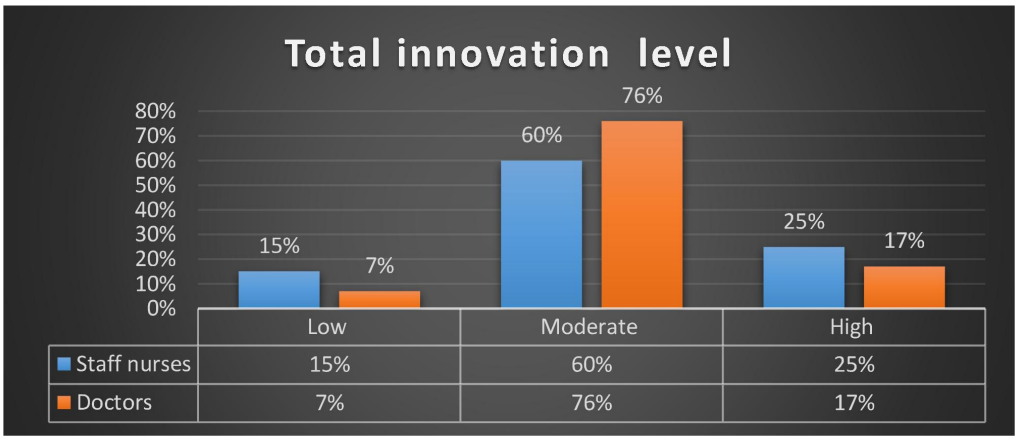


**Figure (2) Total innovation level among health care providers**

**Table (4) Relations between total health care providers' green intellectual capital levels and their personal and job characteristics**

| Items | | Total green intellectual capital levels | | | |
|---|---|---|---|---|---|
| | | Staff nurses in studied sample (n=145) | | Doctors in studied sample (n=52) | |
| | | x | SD | x | SD |
| **Age** | Less than 30 yrs | 57.32 | ±8.11 | 54.40 | ±7.11 |
| | 30 - 40 yrs | 58.68 | ±8.40 | 61.23 | ±7.40 |
| | More than 40 yrs | 58.46 | ±8.61 | 59.07 | ±8.61 |
| **X2 Test \P-Value** | | **71.65 0.000**** | | **70.12 0.000**** | |
| **Gender** | Male | 58.40 | ±8.84 | 60.30 | ±6.84 |
| | Female | 57.30 | ±8.36 | 53.20 | ±5.36 |
| **X2 Test \P-Value** | | **1.413 0.235** | | **14.012 0.324** | |
| **Marital Status** | Married | 58.21 | ±8.70 | 57.11 | ±7.50 |
| | Unmarried | 57.90 | ±8.17 | 59.11 | ±8.23 |
| **X2 Test \P-Value** | | **10.74 0.001**** | | **10.313 0.421** | |
| **Work unit** | Critical care unit | 56.34 | ±8.23 | 56.25 | ±8.19 |
| | Non crtical care unit | 55.15 | ±8.03 | 55.18 | ±8.45 |
| **X2 Test \P-Value** | | **57.136 0.000**** | | **45.127 0.000**** | |
| **Educational Qualifications** | Technical degree | 58.21 | ±8.33 | 58.51 | ±8.28 |
| | Bachelor degree | 57.23 | ±7.92 | 57.66 | ±6.85 |
| | Master degree | 58.17 | ±8.72 | 59.29 | ±8.12 |
| | Doctorate degree | 57.32 | ±8.15 | 59.25 | ±8.72 |
| **X2 Test \P-Value** | | **52.106 0.000**** | | **41.11 0.000**** | |
| **Years of experience in work** | Less than 5 yrs | 58.12 | ±8.28 | 58.22 | ±8.23 |
| | 5 - 10 yrs | 58.23 | ±8.17 | 59.21 | ±8.86 |
| | More than 10 yrs | 58.90 | ±9.07 | 58.02 | ±9.90 |
| **X2 Test \P-Value** | | **60.895 0.000**** | | **58.136 0.000**** | |
| **Attending Training courses** | Yes | 56.78 | ±8.32 | 55.81 | ±8.34 |
| | No | 57.20 | ±8.39 | 57.12 | ±8.52 |
| **X2 Test \P-Value** | | **71.011 0.000**** | | **66.367 0.000**** | |

(**) highly statistically significant at P <0.01. (*) statistically significant at P <0.05.

**Table (5) Relations between total health care providers' innovation levels and their personal and job characteristics**

| Items | | Total innovation levels | | | |
|---|---|---|---|---|---|
| | | Staff nurses in studied sample (n=145) | | Doctors in studied sample (n=52) | |
| | | x | SD | x | SD |
| Age | Less than 30 yrs | 61.58 | ±7.67 | 64.40 | ±7.13 |
| | 30 - 40 yrs | 64.42 | ±6.31 | 68.70 | ±7.30 |
| | More than 40 yrs | 68.75 | ±5.75 | 59.15 | ±8.57 |
| X2 Test \P-Value | | 53.375 0.007** | | 00.039 0.013** | |
| Gender | Male | 59.40 | ±8.11 | 61.11 | ±7.44 |
| | Female | 62.30 | ±8.16 | 58.67 | ±8.30 |
| X2 Test \P-Value | | 1.671 0.565 | | 13.468 0.670 | |
| Marital Status | Married | 58.31 | ±8.30 | 60.11 | ±7.50 |
| | Unmarried | 57.44 | ±8.67 | 61.11 | ±8.23 |
| X2 Test \P-Value | | 11.712 0.001** | | 11.319 0.000** | |
| Work unit | Critical care unit | 56.04 | ±8.14 | 66.25 | ±8.02 |
| | Non critical care unit | 55.13 | ±8.80 | 59.18 | ±8.05 |
| X2 Test \P-Value | | 49.136 0.000** | | 40.129 0.000** | |
| Educational qualification | Technical degree | 58.19 | ±8.16 | 57.51 | ±8.28 |
| | Bachelor degree | 57.40 | ±7.90 | 54.66 | ±7.19 |
| | Master degree | 58.70 | ±8.12 | 60.29 | ±8.22 |
| | Doctorate degree | 57.10 | ±8.18 | 58.19 | ±8.50 |
| X2 Test \P-Value | | 32.109 0.000** | | 29.11 0.000** | |
| Years of experience in work | Less than 5 yrs | 58.12 | ±8.28 | 59.22 | ±8.20 |
| | 5 - 10 yrs | 58.23 | ±8.17 | 56.21 | ±8.47 |
| | More than 10 yrs | 58.90 | ±9.07 | 55.02 | ±8.90 |
| X2 Test \P-Value | | 71.805 0.000** | | 61.136 0.398 | |
| Attending Training courses | Yes | 56.78 | ±8.32 | 61.81 | ±8.10 |
| | No | 57.20 | ±8.39 | 59.12 | ±8.20 |
| X2 Test \P-Value | | 71.011 0.000** | | 51.367 0.010** | |

(**) highly statistically significant at P <0.01. (*) statistically significant at P <0.05.

**Table (6) Correlation between health care providers' green intellectual capital and innovation.**

| Items | Innovation |
|---|---|
| green intellectual capital | r = 0.175 P = 0.000 ** |

**Discussion:**

Intellectual capital (IC) is the core for all organizations seeking development and gaining competitive advantage, contributes to raising human well-being and to maintaining the fiscal performance of the organization. Intellectual capital achieved individuals' efficiency and the effectiveness that has a significant beneficial impact **(Balajia & Mamilla,2022).** Green intellectual capital is more critical for achieving organizational innovation that eventually help their staff to operate well and generate long term profitability (**Januškaite & Užiene, 2018).**

Concerning green intellectual capital dimensions, this study revealed that staff nurses' highest mean score was regarding green structural capital dimension followed by green relational capital dimension. From a researcher perspective, this could be due to hospital managers focusing on developing, investing and organizing hospital processes and systems that enable staff nurses and the organization to become have organizational capabilities and then eventually lead to innovation. **Wang and Juo (2021)** agreed with this finding and evidence that green structural capital dimension was the highest one then pursued by green relational capital dimension. **Long & Liao, (2023)** supported this finding and noted that imposing improvement of green innovation, information sharing achieved by building effective relationships as seen in green relation capital. Conversely to the current finding **(Ali et al., 2021 b)** who reported that green structural capital had been the lowest dimension.

While the doctors had the highest mean score in green human capital then followed by green structural capital then green relational capital. From the researcher perspective, this might be due to health service organizations depending on their doctors as health care members who are committed to cooperating with team members to achieve contribution of environmental protection and concern with improve product and services better than others organization. This result aligned with **(Al Issa et al.,2023),** who mentioned that green human capital dimension was the highest mean among head nurses subsequent by green structural capital and lastly green relational capital. Another finding was in congruence the current study **Ullah et al., (2020)**, who illustrated that human capital was the highest mean ranking that can gain advantages from it when giving new knowledge, skills, and experience for employees. **Yadiati et al.,(2019),** was in congruence this finding and revealed that green relational capital was the lowest mean level. In the same line **(Jirakraisiri et al.,2021),** who summarized that green process innovative performance reenforcing through green human capital. The study finding disagreed with **(Bombiak, 2023)** who revealed that green structural capital was the highest mean score.

As regards total green intellectual capital, it noticeable that over than half of both staff nurses and doctors had moderate level of total green intellectual capital. While only around one third of both staff nurses and doctors had a high level of green intellectual capital that slightly increased among doctors and lastly a minority of them had low level of total green intellectual capital. From researcher point of view this may be due to they have capabilities to apply their knowledge, skills, and competencies in the hospital practices to achieve green intellectual capital as a required sustainable goal of development, but the variation between doctors and staff nurses in high level percent could be due to doctors' perceived characteristics that provokes their capabilities as referring to green human capital they perceived it higher more than staff nurses. Moreover, doctors in health care setting are considered expert knowledge, much autonomous/independent from routines for doing their performance that make the hospital tend strongly depend on them. In congruence with this findings, **Zaki (2023),** who reported that above than half of head nurses had perceived a moderate level of green intellectual capital, and a minority of them perceived a low level of green intellectual capital. **Dang and Wang(2022)** also agreed with this study finding and noted that most of nurses had a moderate level of green intellectual capital. Another study conducted by **(Dgham,2018),**

who summarized that intellectual capital influenced performance quality of physician and nursing staff and recommended that health organization should apply and maintain availability of three types of intellectual capital resources, paid attention about increased awareness of their different staff categories /department about role of intellectual capital.

Concerning innovation dimensions level among health care providers, the current study found that "involving others dimension" was the highest mean score among staff nurses. From a researcher perspective this could be as result of their hospital seeking to achieve success in today's competitive era that requires encouraging them to involve others for implementing and generating ideas to build continuous innovation. This result agreed with **(El-Sayed et al, 2022)** who ranked that the highest mean percent level was regarding involving others. While doctors had the highest mean score regarding innovation outputs. In the same context, **(Saeed, 2023)** who highlighted that doctors' innovative behaviour in healthcare setting is essential for improving patient outcomes, enhancing efficiency, and adapting to new challenges. In congruence with this result, **Abd-Elmoghith et al., (2024),** who found that nurses' highest mean score was in innovative output. Contrary to this finding **(Sönmez etal.,2019)** who revealed that innovation output was the lowest mean score perceived by study subjects. Another study was contrary to the present finding **Mekhael (2023),** who noted that implementation starting activities was the highest level.

Regarding the total innovation level among health care providers, the findings clarified that most doctors had moderate level of innovation, and their levels percentage was higher as compared with staff nurses. From the researcher's perspective this could be due to large number of them of them dealing in critical care units and exposure to different critical issues /diagnosis related patients which make them mastery and create innovative solutions for these issues. **Sönmez et al. (2019)** confirmed this finding and clarified that when nurses exerted innovative output led to increase their innovation level. In agreement with this study finding **(Asurakkody & Shin, 2018)**, who discussed that registered nurses had moderate levels of innovative behaviour, but their level was lower than technology, hospital pharmacists and organization worker level. Furthermore, **Yan et al. (2020),** agreed with this finding and concluded that nurses' innovation level was medium. Conversely to this finding **(Jing et al ,2021)** who summarized that nurse's innovative behaviour was at high level. Additionally **(Türkoğlu et al.,2022),** disagreed with the present result and explored that nursing student had low innovative level.

Concerning the relation between study variables and staff nurses'/doctors' characteristics, the findings pointed out statistically significant relation among studied staff nurses and doctors and their personal and job characteristics. With regards staff nurses It was obvious that the higher level of green intellectual capital level and innovation level was among older married who had experienced more than ten years in critical care units, they don't attend training courses, but green intellectual capital was higher among those who graduated from technical institute. This might be because they confront many situations and responsibilities while performing their nursing role that require creative and innovative strategies to deal with family and vulnerable critical patients' issues. Besides, it is noticeable that innovation level was higher between both doctors and staff nurses who granted master's degrees. This could be returned to their desire/ initiation to be updated with green resources.

While, doctors' highest level of study variables was associated with those in middle age group, unmarried men, who had master's degree, worked in critical care units and not attend training courses related study variables. Nonetheless green intellectual capital was highly related to those who had experience from five to ten years and innovation level was higher among doctors who experience less than five years. This could be because they don't have family responsibilities that allow them to have enough time to develop themselves by

searching for new knowledge then indeed allow to be independent and autonomously take innovative decisions to better patient outcome.

In congruence with these study findings, (**Lv et al., 2021; Abd El Muksoud et al., 2022; Sun etal,2023),**who illustrated that higher innovative behaviour scores were among staff nurses who are characterized by higher degrees of education, job position, senior group and attendance at training courses and marital status. Additionally, Studies supported these findings and reported that development of green intellectual capital among healthcare providers required to encourage providing training and education **(Agyabeng-Mensah and Tang., 2021)**. Also, **Galindo-Martín et al., (2020)** who highlight on significance of experience and suppose learning capability of managerial personal can positively affect the knowledge acquisition and performance of their subordinates.

Concerning correlation matrix, between green intellectual capital and innovation among health care providers. The result demonstrated a highly statistically significant positive correlation. From a researcher's it may be explained that, when health organizations are aware and demonstrate green intellectual capital, it eventually triggers health care providers innovation. In agreement with this finding **(Asiaei et al., 2022)** who concluded that green intellectual capital components were associated positively with innovation, as well as revealed that higher levels of three types of GIC are useful for enhancing organization green innovation. Another study was in congruence with this finding, **Liu et al. (2022)** illustrated that green intellectual capital is required for the organizations seeking improve green innovation and summarized that it had positive impacts /consequences on green innovation.

## Conclusion:

The study revealed that there was a highly statistically significant positive correlation between green intellectual capital and innovation among health care providers. Additionally, around one third of both doctors and staff nurses had a high level of total green intellectual capital but slightly increased among doctors than staff nurses , while more than half of them had moderate level and finally minority of them were had low level of green intellectual capital. As well as a quarter of staff nurses had high level of innovation and less than one fifth of doctors were had high innovation level, but more than three quarters doctors had moderate innovation level and their level percentage was higher as compared with staff nurses and lastly minority of them had low innovation level.

## Recommendations:

- Implement training program for health care providers that focus on increasing their awareness about green intellectual capital and innovation that foster different innovative ways of decision making.
- Establish online forums or platforms, conferences for health care providers to allow them to exchange innovative practices.

### Further research

- Discovering how staff personal characteristics impact green intellectual capital and innovation.
- Explore the moderator and other variables affect green intellectual capital.
- Investigate the relation between green intellectual capital, innovation and quality of care.

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### Authors' contribution

The author contributed all parts of paper from review literature, design methods, result analysis, collect data from subjects, revised and agreed the submitted final copy of paper.

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**Informed Consent Statement**

An informed consent was obtained from all participant in the study.

**Conflicts of Interest**

The author declares no conflict of interest.

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