Effect of Climate Change Training Program on Staff Nurses' Knowledge and Perceived Practice

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Abstract

In the 21st century, climate change is recognized as one of the most significant global health challenges. Nurses can play a crucial role in reducing the effects of climate change and assisting individuals and communities worldwide to adapt to its impacts. **Aim:** To evaluate the effect of climate change training programs on staff nurses' knowledge and perceived practice. **Research Design:** A Quasi-experimental design was utilized. **Setting:** The study was conducted at Abou El Matamir Central Hospital, El Behera Governorate-Egypt. **Sample:** A convenient sample of 35 from 68 staff nurses working in the previously mentioned setting. **Tools**: Staff nurses' knowledge questionnaire regarding climate change and staff nurses' perceived practices regarding climate change. **Results:** The study found a significant improvement in staff nurses' knowledge regarding climate change across all dimensions post-program, except for the knowledge on reducing its effects ($t = 84.58$, $p = 0.55$). There was a significant improvement in perceived practices, except for discussing climate change with patients, and indoor and outdoor daily life practices ($t = 31.84$, $p = 0.39$; $t = 29.14$, $p = 0.24$; $t = 19.73$, $p = 0.12$ respectively). A significant positive correlation was observed between total knowledge and perceived practice post-program ($r = 0.787$, $p = 0.000$). Additionally, total knowledge strongly impacted perceived practice (Beta = 0.984, $p = 0.00$). **Conclusion**: The study demonstrated significant improvements in staff nurses' knowledge and perceived practices related to climate change post-program, supporting both research hypotheses. **Recommendations**: Encourage leaders on health care institutions to updates their hospitals policies to include climate change health impact and develop mechanisms for their implementation, application, and follow-up that will affect on sustainability and Egypt vision 2030.

Keywords: Climate change, Knowledge, Perceived practice, Staff nurses, Training program

Introduction

Climate change (CC) represents a pressing challenge associated with detrimental environmental and human health effects. Since the 1960s, there has been an increasing acknowledgment of the imperative to address CC and the adverse impact of greenhouse gas (GHG) emissions, contributing to global warming **(Nicholas & Breakey, 2017).** Climate change also significantly influences our health, encompassing both physical and mental well-being. Moreover, while healthcare systems are pivotal in combating CC, they are profoundly impacted by its consequences. Hospitals, health centers, and other healthcare providers are responsible for tending to individuals experiencing the health ramifications of CC **(Seervai et al., 2022).**

Climate change already exerts a wide-ranging impact on health, manifested through various channels. These include heightened mortality and sickness stemming from more frequent extreme weather occurrences like heat waves, storms, and floods, alongside disruptions in food systems and rises in diseases transmitted through food, water, and vectors. Additionally, climate change contributes to mental health concerns. Moreover, it undermines critical social determinants of health, such as livelihoods, equity, and access to healthcare and support networks. Significantly, these health risks associated with climate change disproportionately affect the most vulnerable and marginalized groups, including women, children, ethnic minorities, impoverished communities, migrants or displaced individuals, older adults, and those with pre-existing health conditions **(World Health Organization (WHO), 2018; Watts et al., 2020).**

Climate change can be described as a gradual alteration in weather patterns, encompassing deviations from typical temperature and precipitation norms for a specific location and time spanning decades. This phenomenon has significant implications for human health through direct or indirect impacts. Climate change has garnered increased attention as a vital focal point of the Sustainable Development Goals **(Buriro et al., 2018).**

The World Health Organization WHO **(2020)** outlines four essential requisites for ensuring safe and high-quality care within the context of climate change. These include ensuring an adequate number of skilled healthcare workers operating in safe and conducive working conditions, equipped with the knowledge and empowerment to address environmental challenges; implementing sustainable and secure management

practices for water, sanitation, hygiene (WASH), and healthcare waste services; establishing sustainable energy services; and deploying appropriate infrastructure, technologies, products, and processes essential for the efficient operation of healthcare facilities.

Health-sector officials wield considerable influence in mitigating the future intensity and occurrence of extreme weather and climate events by reducing GHG emissions. Given the substantial carbon footprint associated with healthcare-related activities such as energy consumption, food production, use of anesthetic gases, and transportation, there exists ample opportunity for GHG reduction efforts **(Karliner et al., 2019).** Moreover, well-designed GHG mitigation initiatives offer significant health co-benefits, such as enhanced respiratory and cardiovascular health resulting from improved air quality, contributing to resilience **(Ebi et al., 2021).**

The International Council of Nurses (2018) highlighted the intricate interplay between health and climate change. Heat-related incidents, extreme temperatures, and severe weather events such as floods, droughts, and storms can directly impact health. Indirectly, health can be affected by changes in water quality, air pollution, land use, and ecological shifts. These changes interact with various social dynamics, leading to adverse health outcomes.

Furthermore, nurses should anticipate increased illnesses from climate change in the following years. Beyond their roles in promoting and supporting health and well-being, nurses have a professional duty to educate patients and clients about the health implications of climate change. Additionally, they should advocate for and implement sustainable policies and practices. Nurses can proactively address this global challenge by acknowledging climate change's historical and current effects, planning for future needs, and preparing patients for potential climate-related disasters **(Leffers et al., 2017; Mahmoud & Mahmoud, 2023).**

Given the escalating adverse health effects of climate change worldwide, it is imperative for nurses to promptly prepare for existing health issues and forthcoming challenges. Through governmental and non-governmental organizations, nurses play a pivotal role in delivering healthcare services and support across various health stages, including during natural disasters and extreme weather events. Nurses must discern climate change's direct and indirect impacts on human health, identify gaps in existing policy standards, and explore current and forthcoming strategies **(Buriro et al., 2018).**

While individual lifestyle changes, opting for walking or cycling over driving, reducing meat consumption, minimizing food waste, and conserving energy, can yield personal health benefits and contribute to reducing our environmental footprint, they alone are insufficient to address the collective challenge. Powerful opposing forces, including financial interests in the fossil fuel industry, governmental denial of climate science, and institutional inertia, necessitate concerted and forceful efforts to effect change **(Solomon & LaRocque, 2019).**

Experts in climate change emphasize the significance of increasing awareness, particularly within educational institutions, to influence youth perceptions regarding the causes, effects, and alternative solutions to climate change. Enhancing youth awareness and understanding of climate change can translate into positive daily practices to mitigate environmental and health consequences. Notably, recent collaborative efforts between the ministries of environmental affairs, health, and education, alongside other non-governmental agencies in Egypt, have been observed across various settings, including universities and schools, aimed at improving awareness, attitudes, and practices regarding climate change among different populations **(Al Ahram Center for Political & Strategic Studies, 2021; Abdallah & Wagdy Farag, 2022).**

Significance of the study

Climate change impacts health's social and environmental determinants, including access to adequate food, clean water, and shelter. Projections suggest an additional 250,000 deaths annually from malnutrition, malaria, diarrhea, and heat stress attributable to climate change between 2030 and 2050. To be precise, it is estimated that 38,000 of these deaths will be linked to heat-related issues among the elderly, 48,000 to diarrhea, 60,000 to malaria, and 95,000 to undernutrition in children **(WHO, 2018).**

In Egypt, research has been conducted on the effects of climate change. **Mahmoud and Mahmoud (2023)** conducted a study on the impact of climate change on health and the practice of critical care nurses at New Elkasr ElAini Teaching Hospital in Cairo. The findings revealed that many nurses do not perceive responsibility toward addressing climate change, and the majority believe climate change exacerbates nursing practice's burden.

Additionally, **Abdallah & Farag (2022)** conducted a study on the effects of an awareness program regarding the health consequences of climate change on the knowledge, perception, and daily life practices of nursing students at the Faculty of Nursing, Modern University for Technology and Information (MTI), Egypt. The results showed an increase in the overall level of good knowledge scores, positive perception, and appropriate daily life practices among nursing students regarding climate change in the

posttest compared to the pretest, with a statistically significant difference.

Furthermore, **Ghazy and Fathy (2023)** conducted a study on the impact of an awareness program regarding climate change on the knowledge, attitudes, and practices of university students at the Faculty of Nursing, Kafr-Elsheikh University. The results indicated improvements in the students' reported daily life practices and an increase in the overall level of good knowledge scores and practices related to climate change post-program compared to pre-program.

Recently, climate change has emerged as a significant challenge for the healthcare sector, including nursing, as it directly and indirectly impacts health and society. Consequently, to ensure that nurses comprehend the effects of climate change on health, some nursing schools in developed countries have integrated climate change-related knowledge into their teaching modules. Research indicates that nurses in developed nations are more aware of climate change than those in developing countries.

By the nature of their profession, nurses can comprehend complex scientific information and apply this knowledge to deliver high-quality, compassionate, patient-centered care. This blend of skills positions nurses as influential leaders who might create practical solutions to real-world challenges. Collaborating with nursing colleagues and allied health professionals to gain broader insights on implementing climate change initiatives within healthcare settings. Engaging with patients to assess their healthcare needs and discuss potential action plans, including self-preparedness strategies for extreme climate events, assessing workplace readiness for emergencies, and considering essential factors such as supplies, human resources, space allocation, and knowledge acquisition are necessary.

Previous research conducted in Egypt indicated a need for more knowledge and practice among nurses regarding climate change; there is a need to develop recommendations for implementing training programs to enhance nurses' knowledge and practice in addressing climate change to mitigate its impact on health in clinical settings. The objective of this study was to evaluate the effectiveness of a climate change training program on staff nurses' knowledge and perceived practice. Nurses can educate individuals, communities, and populations about the interconnections between the environment, climate change, and health. They can encourage them to adopt lifestyles that reduce the impact of human activities on climate and environmental change.

Aim of the Study

This study aimed to

- Assess the impact of a climate change training program on staff nurses' knowledge regarding climate change
- Evaluate the effect of a climate change training program on staff nurses' perceived practice in implementing environmentally sustainable healthcare practices.

The following hypotheses were devised:

H_1: Staff nurses' total mean scores about climate change knowledge will be higher post-program than pre-program scores.

H_2: Staff nurses' total means scores regarding climate change perceived practice will be higher post-program than pre-program scores.

Ethical Consideration

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Ethical approval was granted by the Scientific Research Ethics Committee at the Faculty of Nursing, Cairo University, before commencing the study. Additionally, medical and nursing directors obtained official authorization to proceed with the study. Participation was strictly voluntary, with everyone having the autonomy to consent to or decline participation. By completing the questionnaires, participants implicitly consented to their involvement. Data were coded to preserve confidentiality, and participants were assured of their right to withdraw from the study at any stage. It was emphasized that collected data would only be used for research purposes and would not be repurposed without participants' explicit consent. Ethical considerations encompassed clearly explaining the study's objectives and procedures, ensuring participant safety, and safeguarding against potential risks.

Subjects and Methods

Research Design:

A Quasi-experimental design (one group pre-posttest) was utilized to achieve the aim of the present study. A quasi-experimental design is a study design in which participants cannot be randomly assigned to an experimental or control group for practical or ethical reasons. However, like a true experiment, it is used to evaluate the effects of an intervention, or in other words, to establish a cause-and effect relationship between independent and dependent variables. The intervention could be a training program, a policy change, a medical treatment, etc. (Sreekumar, 2024)

Setting:

The research was conducted at Abu El Matamir Central Hospital in El Behera Governorate, Egypt. The hospital is structured across three floors; the first houses the renal dialysis department, outpatient clinics, and laboratory facilities; the second accommodates the x-ray department and administrative offices. Additionally, it features a general Intensive Care Unit (ICU) with a capacity of 14 beds, catering to

various diagnoses such as respiratory, cardiac, and gastrointestinal diseases. The third floor is dedicated to the general medicine ward, which comprises 18 beds divided into separate sections for male and female patients. The study targeted the general ICU and general medicine ward for data collection.

The study was conducted in the northwest region of Egypt, specifically in EL Behera Governorate. This area is known for its wide range of agricultural activities, including wheat, corn, citrus fruits, and cotton. Additionally, the region has a significant industrial presence, including wine production (due to these areas' extensive vineyards), brick and cement factories, and tobacco and cigarette manufacturing facilities.

These industrial activities contribute directly to the greenhouse effect, pollution, and waste generation, leading to various health issues among the local population. The most common health problems include respiratory disorders such as tuberculosis (TB) and chronic obstructive pulmonary disease (COPD). Additionally, during the summer, many children are admitted to the hospital with gastroenteritis. Urban expansion and construction of homes on agricultural land are also threatening the region's farming activities. The hospital experiences a shortage of nurses and high turnover rates, mainly due to low wages and proximity to industrial zones.

Regarding the availability of healthcare facilities, the only other hospital in this area is a Fever Hospital, which has also recently become a shelter for Gaza refugees.

Sampling:

A convenience sample was utilized to recruit 35 staff nurses working at Abu El Matamir Central Hospital - El Behera Governorate.

Tools of Data Collection:

The authors created two questionnaires to achieve the study's goal:

1st: Climate Change Knowledge Questionnaire: It was developed based on extensive reviewing of related literature Mahmoud and Mahmoud (2023), Abdallah and Farag (2022) Butterfield, Leffers, and Vásquez (2021). It was used to assess staff nurses' knowledge of climate change. This questionnaire consisted of two sections as follow:

The first section focused on personal data, including educational level, years of experience, department, gender, and age.

The second section of the questionnaire delved into eight dimensions of staff nurses' knowledge concerning climate change, encompassing 59 items. These dimensions were as follows: Climate change (14 items), general causes of climate change (8 items), environmental causes of climate change (4 items), the influence of climate warming (6 items), the impact of climate change on human health (5 items), the greenhouse effects (8 items), ways of reducing climate change effect (10 items), and nurses' role in reducing the effect of climate change on the health (4 items).

Scoring system

Participants responded to each item using a 2-point Likert scale: Yes (scored as 1) or No (scored as zero). Scores falling within the <35% to <60% range were considered unsatisfactory, while scores from >60% to ≤ **100**% were deemed satisfactory.

2nd: Climate change perceived practices questionnaire. It was developed based on an extensive review of related literature. Abdallah and Farag (2022), Nurses and nurse practitioners of British Colombia (2022), and Wei et al. (2014)

It was used to assess staff nurses' perceived practices regarding climate change. It comprised five main dimensions, totaling 39 items: a workplace green nurse team (9 items), talking to patients about climate change (7 items), encouraging greener choices as part of a healthy lifestyle (5 items), ways to decrease GHG emissions in the organization (4 items), indoor daily life practices (7 items), and outdoor daily life practices (7 items).

Scoring system

Participants responded to each item using a 2-point Likert scale: Yes (scored as 1) or No (scored as zero). Scores falling between <23% and <60% were considered Unsatisfactory, while scores from > 60% to ≤100% were deemed Satisfactory.

Validity

The questionnaires were reviewed by Community and Environmental Health professors from the ethical research committee at the faculty of nursing at Cairo University. Additionally, it underwent content validation by three experts in nursing administration and the medical-surgical department who have attended several workshops, symposia, and training programs related to climate change and its impact on the healthcare systems. Modifications were made based on the panel's feedback regarding sentence clarity and content appropriateness. Additionally, the experts commented on the instruments' structure and layout, focusing on the clarity of the questionnaire instructions, readability, and ease of understanding, question sequence, format, overall appearance, and completion time.

Reliability

To ensure consistency, an expert statistician evaluated the reliability of the tools using the alpha coefficient test. Cronbach's alpha result for the total knowledge regarding the climate change questionnaire was 0.78, indicating acceptable internal consistency. Similarly, Cronbach's alpha result for the total perceived practice regarding the climate change

questionnaire was 0.83, indicating acceptable internal consistency.

A sub-categorization for the knowledge and self-reported practice tool, was done depending on testing the reliability by Cronbach-alpha.

Procedure: Data was collected through 4 phases:

In the first phase (preparation and assessment), the researchers collected staff nurses' schedules from the unit managers to determine each one's workday they then selected two days (Sunday and Wednesday)

- After explaining the study's aim to all the participants, the researchers did the pretest.
- The researchers planned two weeks for the pretest, from January 15 to January 30, 2024.

Second phase (planning phase): The climate change training program was designed based on the literature review and staff nurses' assessment data (tool I: Climate Change Knowledge Questionnaire and tool II: Climate Change Perceived Practices Questionnaire). After translation into Arabic, the program schedule was developed and submitted to the ethical research committee's experts, including community health professors. It was then resubmitted to an Arabic linguistic expert to assess its translation and grammar context.

Based on the revision of the experts. The climate change training program's content was developed. It included information regarding Climate Change, such as basic facts, sources of information, general and environmental causes, the influence of climate warming, the impact on human health, the greenhouse effect, ways to reduce the effects of climate change, and the nurses' role in mitigating these effects.

Time plan: The training program content is divided into twelve sessions, each lasting 30 minutes. Each subgroup was scheduled according to their working shifts; each must attend 12 sessions over 8 weeks of training. PowerPoint presentations, feedback, and group discussions met the training objectives.

Third Phase (Program Implementation): Based on the data analysis of the pretest **(staff nurses' knowledge and perceived practice regarding climate change)**, Handouts were provided to all participants before starting. The training program lasted twelve sessions, starting on February 15, 2024. Each session lasted 30 minutes.

Each subgroup's schedule was planned according to their working shifts; each subgroup must attend 12 sessions over 8 weeks of training. PowerPoint presentations, feedback, and group discussions met the training objectives.

Fourth phase (program evaluation)

After the implementation of the climate change training program, the authors distributed the posttest immediately one week after completing the 12 sessions using the same questionnaires used in the first phase as previously mentioned in the first phase. The evaluation phase lasts two weeks.

Statistical Analysis:

Data sheets were distributed after explaining the study's purpose, and data collection was completed over two weeks. The researchers were present during data collection and had directly collected the completed forms. The collected data were coded, manually entered into the Statistical Package for the Social Sciences (SPSS) program, version 25 (SPSS), and reviewed again to ensure data accuracy.

Data analysis employed appropriate statistical methods. Descriptive statistics were used to analyze the data, including frequency, mean, and standard deviation. Relative statistical significance tests, such as the paired t-test, Pearson correlation, one-way ANOVA, and linear regression, were applied to identify relationships between study variables. The p-value was used to determine the degree of significance, with a threshold of ≤ 0.05 for all statistical analyses.

Results

Table (1) Frequency distribution of staff nurses' characteristics (n = 35)

Personal data		No.	%
Department	Medicine	23	65.7
	ICU	12	34.3
Gender	Male	10	28.6
	Female	25	71.4
Age	20- <30 years	3	8.6
	30- <40 years	26	74.3
	40- <50 years	2	5.7
	≥50 years	4	11.4
	$\bar{x}$± SD	36.73±6.98	
Level of education	Bachelor's degree	7	20
	Technical	23	65.7
	Diplomas	5	14.3
	<5 years	17	48.6
Years of experience in the current hospital	5-<10 years	8	22.9
	10-<15 years	6	17.1
	≥15 years	4	11.4
	$\bar{x}$± SD	6.42±2.09	
Information source	TV	35	100

Table (1) shows that 65.7% of the staff nurses worked in the medical department, 71.4% were female, 74.3% were in the age group of **30- <40 years**, and only 5.7% were in the age group of 40 to less than 50. Moreover, 65.7% of the staff nurses had a technical nursing degree, 48.6. % had less than 5 years of experience in the current hospital. According to their responses, the only source of information about climate change was TV.

Table (2): Pre- and Post-program Mean knowledge scores of staff nurses regarding climate change dimensions (n=35)

Climate change knowledge dimensions	Pre-program	Post-program	Paired t-test	
	$\bar{x}$±SD	$\bar{x}$± SD	t	P
Basic information	23.97±1.77	25.54± 0.78	4.80	**0.00**
General causes	14.49±0.89	15.69± 0.72	6.22	**0.03**
Environmental causes	6.77±0.43	8.00± 0.00	17.06	**0.00**
The influence of climate warming	6.97± 0.17	12.00± 0.00	176.0	**0.04**
Impact on human health	7.80± 0.41	10.00± 0.00	32.07	**0.00**
The greenhouse effects	8.00± 0.00	15.69± 0.47	96.54	**0.00**
Ways of reducing climate change effect	11.83±0.38	19.80± 0.41	84.58	**0.55**
Nurses' role in mitigation	4.00± 0.00	8.00± 0.00	-	-
Total Knowledge	**83.83±3.72**	**114.71±2.07**	**42.92**	**0.00**

Table (2) indicates that the staff nurses had a higher level of total knowledge post-program (114.71±2.07) than pre-program (83.83±3.72). It also highlights the significant improvement in knowledge levels post-program regarding all dimensions, except for the dimension related to reducing climate change effects (t=84.58, p=0.55).

Table (3): Pre and post-program perceived practices mean scores of staff nurses regarding climate change dimensions (n=35)

Climate change perceived practices dimensions	Pre-program	Post-program	Paired t-test	
	$\bar{X}$±SD	$\bar{X}$±SD	T	P
A workplace green nurse team	11.20± 1.16	18.00± 0.00	34.74	0.00
Talk to patients about climate change	8.09± 0.70	13.57± 0.74	31.84	0.39
Encourage greener choices as part of a healthy lifestyle	6.17± 1.01	10.00± 0.00	22.33	0.00
Ways to decrease GHG emissions in the organization	5.51± 0.74	8.00± 0.00	19.81	0.00
Indoor daily life practices	9.09± 0.78	13.63± 0.49	29.14	0.24
Outdoor daily life practices	9.06± 1.11	13.31± 0.63	19.73	0.12
Total perceived practices regarding climate change	49.11± 2.45	76.51± 1.36	57.92	0.02

Table (3) reveals the higher levels of total perceived practice regarding climate change post-program (76.51± 1.36) compared to pre-program (49.11± 2.45). Furthermore, there was a statistically significant difference between staff nurses' responses pre and post-program for all dimensions of climate change perceived practice except for talking to patients about climate change, indoor daily life practices, and outdoor daily life practices dimensions (t=31.84, p=0.39), (t=29.14, p=0.24), and (t=19.73, p=0.12) respectively.

Figure (1): Total Staff nurses' knowledge level regarding climate change pre- and post- program (n=35)

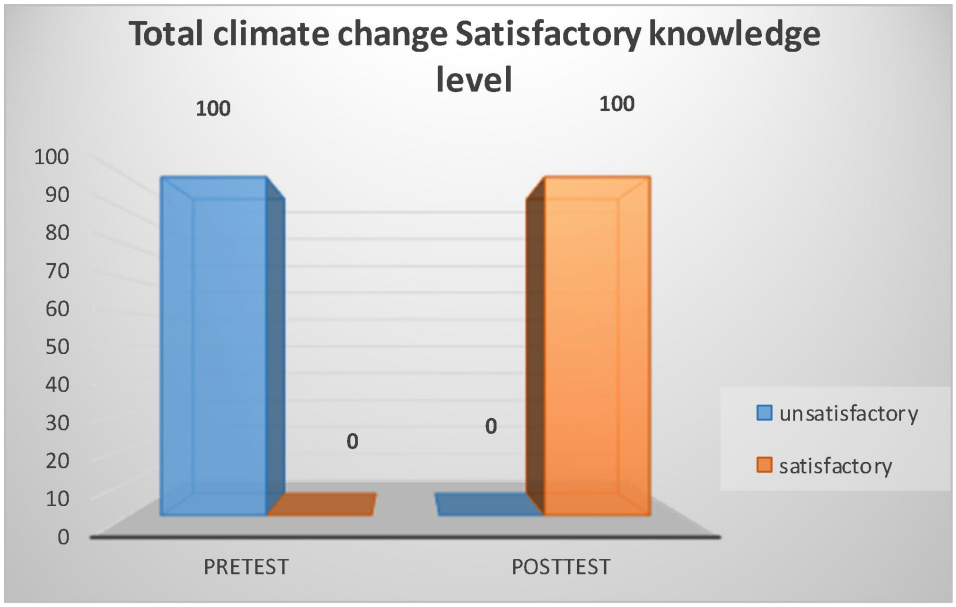

Figure (1) illustrates the staff nurses' satisfactory level of total knowledge (100%) regarding climate change post-program compared to pre-program.

Figure (2) Staff nurses' satisfactory perceived practice regarding climate change pre and post-program (n=35)

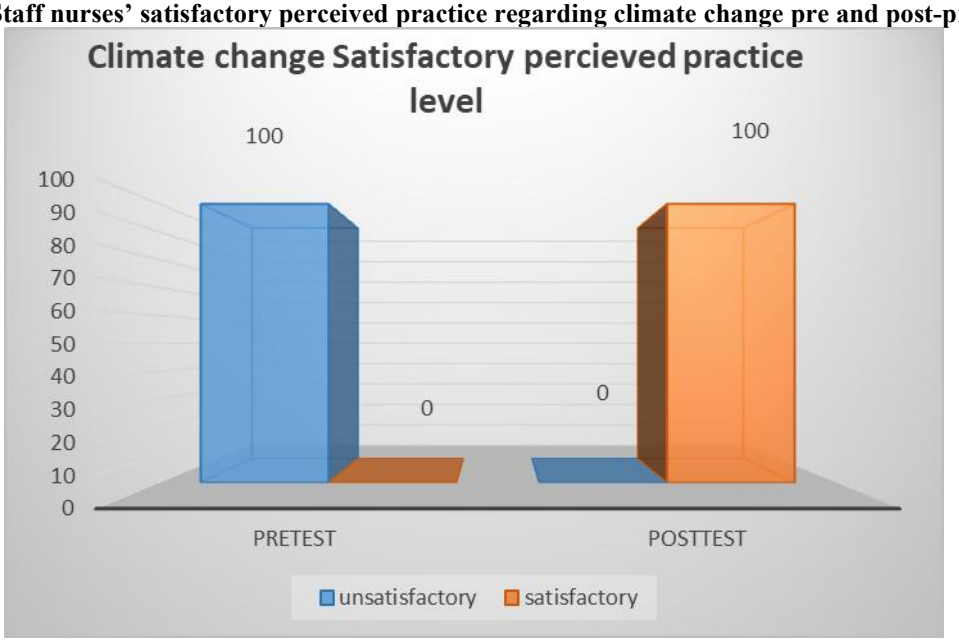

Figure (2) displays a satisfactory level of total perceived practice regarding climate change post-program compared to pre-program.

Table (4): Pearson Correlation between staff nurses' total Knowledge and total perceived practice regarding climate change pre and post-program (n = 35)

Variables	Total Knowledge			
	Pre-program		Post-program	
	R	P	R	P
Total perceived practice	0.335	0.049	0.787	0.000

Table (4) shows a statistically significant positive correlation between total knowledge and total perceived practice regarding climate change pre- and post-program.

Table (5) Difference between staff nurses' characteristics regarding their total Knowledge and total perceived practice (n=35).

Personal data	Total Knowledge		F	P	Perceived Practice		F	P
	$\bar{x}$	SD			$\bar{x}$	SD		
Unit:								
Medicine	84.22	3.41	.73	0.40	49.43	2.54	1.16	0.29
ICU	83.08	4.32			48.50	2.24		
Gender:								
Male	83.30	4.35	.28	0.60	48.40	1.26	1.20	0.28
Female	84.04	3.52			49.40	2.75		
Age:								
20- <30 years	80.33	4.93	1.54	0.23	49.67	3.79	1.39	0.27
30- <40 years	83.77	3.80			48.69	2.00		
40- <50 years	86.00	0.00			49.50	2.12		
≥50 years	85.75	0.50			51.25	3.95		
Level of education:								
Bachelor's degree	86.00	0.00	3.26	**0.05**	49.43	2.64	1.34	0.28
Technical	82.74	4.21			48.70	2.03		
Diplomas	85.80	0.45			50.60	3.71		
Years of experience in the current hospital:								
<5 years	83.41	4.14	1.26	0.31	49.06	2.14	1.32	0.29
5-<10 years	85.13	2.47			48.75	1.67		
10-<15 years	82.00	4.52			48.33	2.88		
≥15 years	85.75	0.50			51.25	3.95		

Table (5) indicates no association between staff nurses' characteristics and their total Knowledge except the level of education (F=3.26, P=0.05). In addition, there was no association between staff nurses' characteristics and their total perceived practice regarding climate change.

Table (6): Effect of staff nurses' total knowledge regarding climate change on total perceived practice (n=35).

Linear regression model	R^2	Unstandardized Coefficients		Standardized Coefficients	t	p
		B	Std. Error	Beta		
(Constant)	.968	-23.144	1.912		-12.103	0.00
Total Knowledge		.866	.019	.984	45.512	0.00
a. Dependent Variable: Total perceived practice						

Table (7) reveals that total Knowledge positively affects the total perceived practice of staff nurses (Beta=0.984, sig=0.00) regarding climate change.

Discussion

The study's **personal data,** indicated that most staff nurses were aged between 30 and 40, with fewer falling within the 40–50-year category. Additionally, nearly two-thirds of the nurses worked in the medical department and held technical nursing degrees. The majority of the nurses were female. About half had less than five years of experience, whereas a smaller fraction had 15 or more years of experience at the current hospital.

Regarding information sources, all nurses identified television as their sole source of information about climate change. This study finding aligns with a study by **Wang et al. (2022)**, which noted that a significant portion of their study's primary school children also primarily received climate change information via television. However, in this context, a study by **Barreda (2018)** found that the primary sources of information were mass media, family, and educational seminars and workshops.

Egypt has a different level of nursing education as follows, (Bachelor's degree in nursing science, Technical nursing institute and Secondary technical nursing school in addition to postgraduate nursing programs, and finally the accelerated program which has been recently introduced); Bachelor's degree which encompasses 4 study years and 1 year internship, technical nursing institutes which include 2 study years and 6 months internship, secondary technical nursing schools which encompasses 5 study years after finishing the preparatory school. Yet, the target hospital had no nurses with postgraduate or accelerated program qualifications.

The concept of climate change has recently been introduced to healthcare and is viewed as a new subject. Most educational backgrounds lack knowledge in this area, but it has recently been added to nursing curricula.

The analysis of the pre- and post-program scores showed a significant increase in staff nurses' overall knowledge about climate change post-program. Specifically, basic information about climate change received the highest mean scores before and after the program. This improvement may be attributed to the engaging content and interactive scenarios presented during the training, which were new to most participants and likely captured their interest. The dynamic and relevant nature of the information provided also encouraged the nurses to remain engaged and motivated to adopt new practices within their clinical settings to mitigate climate change effects.

These findings aligned with a study by **Esringü & Toy (2022)**, which examined the impact of climate change education on Atatürk University students. Their study reported that a significant portion of the participants understood the meaning of climate change, its causes, and its potential health impacts on future generations, indicating effective knowledge transfer through educational initiatives.

The findings of this study were consistent with research conducted at the Faculty of Nursing, Suez Canal University, Egypt, by **Mohammed, Fahmy, & Megahed (2024),** which demonstrated significant enhancements in nursing students' knowledge, attitudes, and practices concerning climate change following an educational program. This correlation underscores the effectiveness of targeted educational interventions in elevating awareness and understanding of climate change among healthcare professionals. Furthermore, a similar study by **Kurup, Levinson, and Lix (2021)** showed that high school students exhibited a marked improvement in their knowledge about global warming and climate change post-intervention, reinforcing the positive impact of educational strategies on climate literacy across different educational settings.

Additionally, these results aligned with a study conducted by **Soliman, Saleh, and Eldeep (2023),** which examined the impact of a training program on sustainability and climate change for nursing internship students. Their findings indicated that half of students had poor knowledge pre-intervention, whereas a significant majority demonstrated good knowledge post-intervention. Conversely, the results of this study contrasted with a study from the Faculty of Nursing at Mansoura University by **Mohammed, Abd El-Mouty, and Ameen (2022).** That study found that more than two-thirds of the nursing students had poor knowledge regarding the health effects of climate change, highlighting a gap that may be addressed through more effective or targeted educational programs.

Regarding the statistical differences in staff nurses' perceived practices across various dimensions of climate change before and after the training program implementation, the study found that the total perceived practice levels significantly increased post-program. Specifically, the dimension related to a workplace green nurse team had the highest mean scores pre- and post-program. This improvement may be attributed to the influence of the program-acquired information and knowledge on the nurses' attitudes and practices, given the current relevance and daily impact of climate change.

The findings of this study were in line with those of **Mohammed, Abd El-Mouty, and Ameen (2022)**, who found that over one-third of the students exhibited moderate practices regarding recycling. However, these results contrast with the study by **Vicente-Molina et al. (2018)**, which investigated gender differences in pro-environmental behavior

among Basque Country University students and found that more than three-fourths of the students demonstrated a high level of practice regarding recycling.

Similarly, a study conducted by **Cavenghaus, Henseleit, and Belka (2022)** revealed significant improvements and adequate practices related to climate change. These results were supported by **Tiong et al. (2020)** in their study "Knowledge, Perceptions of Risks, Attitudes, and Practices of Environmental Health among University Students" in northern Malaysia, which found that more than half of the students engaged in practices like saving electricity and daily use of water and paper, while less than a quarter participated in recycling and gardening or tree planting. Additionally, **Kurup et al. (2021)** reported that most students were involved in tree planting and cleanliness drives, using public transport, and opting to walk instead of driving.

These findings were supported by a study conducted by **Abbasi and Nawaz (2020)**, which found that more than two-thirds of participants had adequate monitoring and mitigating climate change practices. Additionally, a study conducted by **Abdel Nabi, Shafik, and Saad (2023)** revealed that three-fifths of the nursing students exhibited adequate practices concerning climate change.

Moreover, the present study revealed that "ways to decrease GHG emissions in the organization" had the lowest mean scores both pre- and post-program. It could be attributed to the need for clear workplace policies guiding such practices and nurses' unawareness of their responsibility to reduce workplace environmental hazards and promote sustainability. Also, hospital management had not conducted training sessions on this critical issue.

This finding is consistent with a study by **Anåker, Spante, and Elf (2021)**, which explored nursing students' perceptions of climate change and sustainability actions. Their study found that while nurses recognized the need to address climate and environmental challenges, this responsibility was often overshadowed by other job demands perceived as more immediate. Furthermore, **Aronsson et al. (2020)** highlighted that climate change impacts health and healthcare delivery. Their study stressed the need for nurses to be prepared to adapt to these new challenges on both practical and policy levels.

However, this study revealed a statistically significant difference in staff nurses' perceived practices regarding all dimensions of climate change before and after the program, except for talking to patients about climate change and indoor and outdoor daily life practices. The difference may be due to nurses needing awareness about their role as health educators and the need for more training to modify their daily behaviors. The authors argued that this difference comes from the effect of the training program, which provides nurses with new information that enhances their perceived practice.

This finding contrasted with the results of a study conducted by **Abdallah and Farag (2022)**. They reported a noticeable improvement in most indoor and outdoor daily life practices among more than four-fifths of participants, such as switching off appliances and lights when not in use.

The present study indicated a highly statistically significant positive correlation between total knowledge and total perceived practice regarding climate change pre- and post-program. The training program effectively increased the nurses' knowledge about climate change, which positively influenced their perceived practice and resulted in more adequate practices to mitigate the effects of climate change on health.

This study's findings align with those of **Abdallah and Farag (2022)**, who found a statistically significant positive correlation between nursing students' daily life practices, perceptions, and knowledge levels about climate change. Similarly, **Abdel Nabi, Shafik, and Saad (2023)** reported a statistically significant positive correlation between total knowledge, attitudes, and reported practices regarding climate change among nursing students.

Additionally, this study's results are supported by a study conducted by **Korkmaz (2018)**, which found a highly positive correlation between nursing students' total knowledge scores and their daily life practices and attitudes. Furthermore, the findings align with a study by **Kolenatý, Kroufek, and Šinčera (2022)**, which investigated the impact of a climate change education program on students' climate literacy and willingness to act. They found that the studied sample exhibited significantly higher climate change knowledge, attitudes, and practices.

Furthermore, **Zhang et al. (2022)** explored the effects of climate change knowledge on adolescents' attitudes and willingness to engage in carbon neutrality education, finding a positive correlation between knowledge and practical application. It contrasted with the findings of **Abbasi and Nawaz (2020),** who reported a negative relationship between climate change awareness and climate change practices in their study on the impact of climate change awareness on adaptations to climate issues.

They were regarding the difference between staff nurses' characteristics and their total knowledge of climate change. This study result indicated no significant differences between staff nurses' characteristics and their total knowledge, except their level of education. This finding aligned with a study by **Mahmoud & Mahmoud (2023)**, which showed a

significant correlation between nurses' educational level and knowledge of climate change. Similarly, **Ofori et al. (2023)** found significant associations between undergraduate students' climate change knowledge and educational levels. However, these results contrast with findings from **Arya et al. (2020)** in Kollam, which indicated no significant associations between knowledge of climate change-related health problems and demographic variables such as education.

Concerning the effect of total knowledge on total perceived practice regarding climate change, this study revealed that increased knowledge about climate change positively affects staff nurses' perceived practices. This correlation may be attributed to the effectiveness of training programs that enhance knowledge and improve nurses' attitudes and practices regarding climate change. This finding aligns with research from **Abdel Nabi, Shafik, and Saad (2023)**, which demonstrated that an educational program significantly enhanced nursing students' knowledge, attitudes, and practices concerning the adverse health effects of climate change.

Additionally, these findings were consistent with a study by **Ghazy and Fathy (2023)**. That research concluded that an awareness program significantly positively affected university students' knowledge, attitudes, and reported daily life practices regarding climate change. Furthermore, they align with **Soliman, Saleh, and Eldeep's (2023)** conclusions, who found that a training program significantly enhanced climate change and sustainability knowledge and practices among nursing internship students.

Conclusion:

The study's findings supported the first hypothesis, evident through the highly statistically significant difference between staff nurses' knowledge pre- and post-program across all dimensions. Similarly, the results corroborated the second hypothesis, demonstrated by the significant difference in staff nurses' perceived practice pre- and post-program across all dimensions. Furthermore, a positive correlation was observed between total knowledge and total perceived practice among staff nurses regarding climate change.

Recommendation:

For nurse leaders.

- Encourage leaders in healthcare institutions to update their hospital policies to include climate change health impact and develop mechanisms for their implementation, application, and follow-up that will affect sustainability and Egypt's vision 2030.
- Encourage participation in climate change workshops focused on health impacts and sustainable practices.
- Conduct periodic climate change learning sessions and invite staff and patients to participate.
- Advocate for vulnerable populations by supporting vaccine equity, rural healthcare investment, and accessible public health services.

Hospital administrators should;

- Implement comprehensive education campaigns, interventions, and workshops for all nursing staff focused on the impact of climate change on health.
- Encourage nurses at their place of employment to contribute to developing strong, environmentally responsible nursing practices and improve the connection between nurses and the climate change team.
- Develop workplace green teams, influence workplace practices and policies, and educate patients and families on climate change and health to help provide climate—and environment-friendly care.
- Disseminate the developed health educational booklets about the adverse health effects of climate change to improve awareness and knowledge in this area.

Further Research.

- Ongoing research and replication are required for different hospital types and large samples, including all healthcare teams, to generalize and enhance their awareness about climate change, its mitigation, and adaptation.
- Additionally, the improvement in perceived practices might represent participants' immediate perceptions rather than actual changes in behavior. To address this, we plan to include an **observational measure** to evaluate changes in staff nurses' practices related to climate change post-education.

Limitations of the study

The observed results reflect the immediate effect of the training program among staff nurses rather than their long-term knowledge retention. While we initially planned to conduct a follow-up posttest three months after this training, logistical challenges, like staff nurses taking childcare leave or seeking employment abroad, prevented this.

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