

Effect of Educational Program regarding Climate Changes on Knowledge, Attitudes and Practices of Pregnant Women

Hadeer Yahia Abd-Elshakour¹, Amel Ahmed Hassan Omran², Amira Mohamed Salama³ and Ola Abdel-Wahab Afifi Araby⁴

(1) B.Sc. Nursing, (2020), Benha University, Nursing specialist in Technical Institute of Nursing Benha University, (2) Professor of Obstetrics and Gynecological Nursing, Faculty of Nursing-Benha University, and (3,4) Assistant Professor of Obstetrics and Gynecological Nursing, Faculty of Nursing-Benha University.

Abstract

Background: Climate changes are the greatest threat to public health in the twenty-first century, which put pregnant women and their developing fetuses at serious risk. Pregnant women's health may be improved by educating them about the hazards involved in their pregnancy. **Aim:** To evaluate effect of educational program regarding climate changes on knowledge, attitudes and practices of pregnant women. **Design:** A quasi-experimental study design one group (Pre-posttest) was used to fulfill this study. **Setting:** This study was conducted at Obstetrics and Gynecological Outpatient Clinic in Benha University hospitals. **Sample:** A purposive sample of 120 pregnant women according to inclusion criteria was included in the study. **Tools:** Four tools were used for data collection. **Tool (1):** A self-administered questionnaire. **Tool (2):** Maternal knowledge questionnaire. **Tool (3):** Modified Likert scale. **Tool (4):** Maternal reported practices. **Results:** There were highly statistically significant difference between the results of the post-intervention phase compared with pre-intervention about knowledge, attitudes and practices regarding climate changes and heat stress. **Conclusion:** There was a marked improvement in pregnant women's total knowledge, attitudes and practices regarding climate changes and heat stress after implementation of educational program. **Recommendation:** Dissemination of the current research educational program to all antenatal clinics and maternity hospitals at Benha city.

Keywords: Attitudes, Climate changes, Educational program, Knowledge, Practices, Pregnant women.

Introduction:

Pregnancy is the most beautiful and gratifying occurrence in the life of women. Pregnancy is a term used to describe the period in which a fetus develops inside a woman's uterus. Pregnancy usually lasts about 40 weeks as measured from the last menstrual period to delivery. During pregnancy, series of changes take place in a woman's organs and tissues because of a developing fetus (Banafshi et al., 2024).

The World Health Organization (WHO) has identified climate changes are the phrase

used to describe the gradual rise in global temperatures that are mostly accelerated by human activities. Climate changes as a severe health emergency are considered the biggest threat to global health in the 21st century, with devastating impacts on human health and the environment, which sustains our well-being. Climate changes are a major global health concern that has become a top priority on the global health agenda (Siiba et al., 2024).

Climate changes are caused by human activities and results in a rise in temperature,

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precipitation, sea level and extreme weather events. Climate change has already affected and will continue to affect population health, such as malnutrition, diarrhea, malaria, dengue fever, injuries, and deaths. Pregnant women and newborns are particularly vulnerable to the impacts of climate changes due to the physical and socio-cultural changes that occur during pregnancy and childbirth (**Shalaby et al., 2023**).

Furthermore, Extreme heat can overwhelm thermoregulatory mechanisms in pregnant women, especially during labor, cause dehydration and endocrine dysfunction, and compromise placental function. Clinical sequelae include hypertensive disorders, gestational diabetes, preterm birth, and stillbirth (**Meltzer et al., 2024**).

Rising temperatures and changing seasonal patterns can lengthen the times when insects and ticks are most active and widen their range. Changes may increase the prevalence of insects that transmit viruses, such as the Zika virus and dengue fever. Infected pregnant women with Zika can be passed to their fetuses. Infection can cause certain brain defects. In addition, pregnant women and fetuses are at more risk of developing complications from other insects-transmitted illnesses, like dengue fever, due immune system changes during pregnancy (**Mansfield et al., 2024**).

The effects of climate changes on water resources are numerous. Exposure to untreated contaminated water can lead to gastrointestinal and other illnesses, particularly for pregnant women who are at higher risk. In severe cases, these illnesses can result in pregnancy loss and premature birth. Floods and droughts also pose a threat

to food quality, production, transportation, availability, and safety. Foodborne illnesses like listeria and toxoplasma can be life threatening and increase the risk of miscarriage, stillbirth, or premature delivery (**Banerjee et al., 2024**).

Climate changes may result in an increase in outdoor air pollutants, including dust from droughts, wildfire smoke, and ground-level ozone. Pregnant women are particularly sensitive to the harmful effects of car smoke. It is advisable for them to take extra precautions to reduce their exposure to car smoke, which could affect the development of the fetus and increase the risk of low birth weight and premature birth (**Arshad et al., 2024**).

Increasingly, experiencing extreme weather events can lead to psychological stress, exacerbate mental illnesses, and increase emotional stress for pregnant women. Additionally, these events can disrupt support networks, behavioral health services, and access to treatment, all of which can negatively affect women's ability to cope (**Pardon et al., 2024**).

Nurses play a crucial role in addressing the impact of climate change on public health. Nurses have a responsibility to promote and support pregnant women's well-being. It is important to identify and address the impact of climate change on pregnant women and communities. In addition, nurses can advocate for policy change at the local, regional, national, and global levels by supporting clean energy, protecting natural resources, and supporting the effort to reduce greenhouse gas emissions (**ElSayed et al., 2024**).

Moreover, maternity nurses play an important role in educating pregnant women regarding the recognition of climate change

indicators and symptoms of heat stress. Furthermore, Maternity nurses emphasize the significance of maintaining proper hydration levels before, during, and after their work shifts, as well as the importance of consuming a well-balanced and nutritious diet along with an adequate intake of fluids. These nurses also stress the importance of taking breaks at appropriate intervals, monitoring hydration levels and using personal protective equipment (PPE) in conjunction with protective clothing, such as cotton garments, when working outdoors. Lastly, nurses emphasize the necessity of seeking medical advice when needed (Mahmoud, 2023).

Significance of the study:

According to a recent assessment by the United Nations Intergovernmental Panel on Climate Changes (IPCC), climate changes are occurring more quickly than anticipated. There is clear evidence that climate change is already having a negative impact on the health of vulnerable populations, particularly pregnant women who are at risk of experiencing health problems related to climate change. (Bonell et al., 2024).

Climate change is predicted to cause 250,000 deaths annually between 2030 and 2050 due to heat stress, diarrhea, malaria, and malnutrition. This crisis exacerbates high maternal and newborn mortality rates, particularly for pregnant women. The global health community must take immediate steps to protect expectant mothers, babies, families, and communities (Parums, 2024).

Egypt is considered one of five highly vulnerable countries in the world to climate changes due to its triple effect: the weather, low rainfall, and hot summers; the nature of the land (large desert) and densely populated cities and geography (Akhtar, 2024). The

crisis of the Egyptian Ministry of health confirmed during the year (2021) that the number of deaths due to heat stress reached 95 cases and 1914 injured, since the beginning of the heat wave, and the most of deaths, most of them are over the age of 60 years, and among them are pregnant women in different months of pregnancy, and most of them suffer from pathological problems due to failure or decline in the heart muscle or chronic high blood pressure (Affi et al., 2024).

Such research has not been conducted before at Benha university hospitals. Therefore, this study aimed to evaluate effect of educational program regarding climate changes on knowledge, attitudes and practices of pregnant women.

Aim of the Study:

The aim of current study was to evaluate effect of educational program regarding climate changes on knowledge, attitudes and practices of pregnant women.

Study Hypotheses:

H1: Pregnant women would exhibit better level of knowledge regarding climate changes after implementation of educational program than before.

H2: Pregnant women would have positive attitudes towards climate changes after implementation of educational program than before.

H3: Pregnant women would have satisfactory level of reported practices regarding climate changes after implementation of educational program than before.

Subjects & Methods:

Research design: A quasi-experimental study design one group (Pre – posttest) was used to fulfill this study.

Setting: This study was conducted at Obstetrics and Gynecological Outpatient Clinic in Benha University Hospital.

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Sample type: A purposive sample was used to achieve the aim of the study.

Sample size: (120) pregnant women admitted to previous mentioned setting for six months according to the following inclusion criteria: **Inclusion criteria:** Pregnant women in the 1st and 2nd trimester, Free from any medical or obstetrics complications, Free from any psychological disease and can read and write.

Tools of data collection: Four tools were used for collecting data:

Tool I: A self-administered questionnaire: it was constructed by researchers after reviewing related literature. It included two parts:

Part (1): General characteristics of pregnant women: It consisted of 5 items: (age, residence, level of education, occupation and source of information).

Tool II: Maternal knowledge questionnaire regarding climate changes and heat stress: it was designed by researchers after reviewing a related literature (La Torre et al., 2023); (Affi et al., 2024); (Abdelrahman et al., 2024). It was designed to assess pregnant women's knowledge regarding climate changes and heat stress, it consisted of two parts:

Part (1): Knowledge regarding climate changes included 6 questions (concept of climate changes, causes, gases that cause climate changes, impact of climate changes on the health of pregnant women, people most affected by climate changes and individual actions to reduce climate changes).

Part (2): Knowledge regarding heat stress included 6 questions (concept of heat stress, causes, symptoms, complication, ways to prevent exposure to heat stress and ways to overcome heat stress associated with climate changes).

Scoring system:

All knowledge variables were weighted according to items included in each question (multiple-choice questions). Each item was given a score (1) when the answer was correct and a score (0) when the answer was incorrect or don't know. The total score was calculated by summation of the scores of all questions.

Total knowledge score was classified as the following:

- Good: (> 60 % correct answer).
- Average: (50≤60 % correct answer).
- Poor: (< 50 % correct answer).

Tool III: Modified Likert scale regarding climate changes and heat stress: It was adapted from (La Torre et al., 2023); (Sambatha et al., 2022). It was used to assess pregnant women's attitudes regarding climate changes and heat stress; it was consisted of two parts:

Part 1: Attitudes regarding climate changes included 11 statement (climate changes will make the weather worse, it's not too late to do something about climate changes, climate change is leading to coastal erosion, pregnant women are more affected by climate changes than others, climate changes poses threats to food security, climate changes affects agricultural crops negatively, climate change will have harmful effects on future generations, my health and the health of my fetus are threatened by climate change, the impact of climate change will be more harmful to the developing world than the developed world, climate changes causes a threat to sustainable development and climate changes is just natural fluctuations in the earth's temperature).

Part 2: Attitudes regarding heat stress included 6 statement (heat waves are putting my health at risk and the health of my fetus, human activities have a major impact on global temperatures, heat poses a

very strong danger to future generations, there is a risk of virus transmission during the heatwave, heat can cause an immediate toxic effect on the fetus, maternity and childhood nurses raise enough awareness to deal with high temperature).

Scoring system:-

Each item rated on a 3-point Likert scale and was assigned as agree (2), uncertain (1) and disagree (0). Total attitude score was classified into:

- Positive attitude > 60%
- Negative attitude ≤ 60%

Tool IV: Maternal reported practices regarding climate changes and heat stress:

It was adapted from (Toing et al., 2020); (ElSayed et al., 2024). It was used to assess reported practices of pregnant women regarding climate changes and heat stress, it consisted of two parts:

Part 1: Reported practices regarding climate changes divided into 5 categories;

- **General measures** included 6 items (avoid leaving the house during high heat waves, use portable fans or ceiling fans especially in bedrooms during severe heat waves, use the air conditioner during severe heat waves, maintain good ventilation inside the house, wear sunglasses when exposed to sunlight outside the house and shower with cold water during severe heat waves).

- **Nutritional practices** included 4 items (drink a glass of water every 15-20 minutes and drink before feeling thirsty, drink plenty of juices and shakes, eat fresh vegetables and fruits such as watermelon, eat ice cream and ice cream).

- **Clothes** included 4 items (wear light clothing, wear a head covering during heat waves and sunlight, wear shorts when it is very hot in the house and change sweat-soaked clothes regularly).

- **Sports exercises** included 7 items (avoid physical stress, changing the schedule of daily activities and organizing time during

severe heat waves, arrange outdoor activities at a relatively cooler time when a high temperature warning is issued, use sunscreen while outside the home, pay more attention to signs and symptoms of heat cramps, heat exhaustion and heat stroke and drink more fluids during daily exercises, practice sports activities in the shade and avoid direct sunlight).

-**Seeking medical care** included 2 items (contact your doctor for help if you feel dizzy during severe heat waves and call the ambulance number if the situation is bad).

Part 2: Reported practices regarding heat stress divided into 4 categories;

-**Necessary measures for sunstroke** included 4 items (apply wet and cold compresses, drink cold water, lie flat on your back in the shade or in an air-conditioned place and seek immediate medical attention).

-**Necessary measures for heat exhaustion** included 4 items (Lie flat on the back in the shade or in an air-conditioned place, raising the legs, drink cold water and Unpacking clothes).

-**How to avoid heat cramps** included 4 items (keep in a cool environment, drink water constantly, massage tight muscles and eat foods rich in minerals (such as bananas or oranges)).

-**How to avoid heat rash** included 5 items (keeping the skin clean, reduce exposure to heat, wear 100% cotton clothes and change sweat-soaked clothes with clean, dry clothes).

Scoring system:

All practices variables were weighted according to items included as always (2), sometimes (1) and never (0). Total practices score classified as the following:

- Satisfactory level: ≥60%-100%.
- Unsatisfactory level: < 60 %.

Validity of the tools: Tools of data collection were investigated for content validity by a panel of three jury experts in the field of

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obstetrics and gynecological nursing at Benha University to judge clarity, relevance, comprehensiveness, understanding and applicability of tools. The opinions were elicited regarding the layout, format and sequence of the questions and all of their remarks were taken into considerations and the tools were considered valid from the experts' point of view.

Reliability of the tools: Reliability for tools was applied by the researchers for testing the internal consistency of the tools by administrating the same tool to the same subjects under similar condition. Internal consistency reliability of all items of the tools was assessed using Cronbach's alpha coefficient test. The internal consistency of knowledge was 0.85, attitudes was 0.79 and practices was 0.91.

Ethical considerations: Ethical aspects were considered before starting the study as the following: The study approval was obtained from scientific research ethical committee of the faculty of nursing at Benha University for fulfillment of the study, Before applying the tools, the researchers explained the aim and importance of the study to gain women's confidence and trust, The researchers took oral consent from women to participate in the study and confidentiality was assured, The study did not have any physical, social or psychological risks on the women, All tools of data collection were burned after statistically analysis to promote confidentiality of the participating women, The study tools didn't include any immoral statements and respect human rights and The women were free to withdraw from study at any time.

Pilot study: The pilot study was conducted on 10% of the total duration of data collection (3 weeks in which 12 pregnant women) to test applicability of the constructed tools, the clarity of the included questions and the time needed for each subject to fill the questions

and identify problems that may be encountered during the study. According to the results of the pilot study, required modifications were done in the form of paraphrasing of some questions for example question number (4) in knowledge from Does climate change affect the health of pregnant women? To what is the impact of climate change on the health of pregnant women? Women involved in the pilot excluded from the study to avoid contamination of the sample.

Fieldwork: This study was carried out through 6 months starting from the beginning of January 2024 to the end of June 2024. The researchers visited the obstetrics and gynecological outpatient clinic 2 times /week (Sunday and Wednesdays) from 9.00 a.m. to 12.00 p.m. until the predetermined duration was completed. To fulfill the aim of this study, the following phases was adopted; interviewing and assessment phase, planning phase, implementation phase and evaluation phase.

Interviewing and assessment phase: At the beginning of the interviewing and assessment phase the researchers greeted the woman, introduced herself to each pregnant woman included in the study, explained the purpose of the study, provided the woman with all information about the study and took oral consent to participate in the study. The researchers distributed tool (I): A self-administered questionnaire to assess general characteristics of pregnant women and obstetrical history. The researchers used tool (II): maternal knowledge questionnaire to assess pregnant women's knowledge regarding climate changes and heat stress, tool III: Modified Likert scale to assess pregnant women's attitudes regarding climate changes and heat stress and tool IV: maternal reported practices to assess reported practices of pregnant women regarding climate changes and heat stress. Average time needed for

completion of questionnaires was around (45-50 minutes). The number of interviewed women ranged from 3-4 women /week.

Planning phase: Based on the results that were obtained from assessment phase, the educational program regarding climate changes and heat stress was developed by the researchers in a form of educational sessions and simple clarified booklet. The booklet was designed according to pregnant women needs regarding climate changes and heat stress in simple Arabic language to suit the level of understanding and to satisfy the studied pregnant women's deficit knowledge and practices regarding climate changes. Sessions number and its contents, different methods of teaching and instructional media were determined. Objectives were constructed to be attained after completion of educational program. By the end of the educational program, pregnant women would be able to acquire essential knowledge, positive attitude and healthy reported practices related to climate changes.

Implementation phase: The researchers implemented the educational program through three scheduled sessions. Each session took about 30-45 minutes according to studied women's achievement and feedback. At the beginning of the first session pregnant women was oriented with the intervention contents. The subsequent session started by feedback about the previous session and the objectives of the new session, simple Arabic language was used to suit women's level of understanding. At the end of each session, five minutes devoted to permit women to ask questions to clarify the session contents and to correct any misunderstanding. Each woman was informed about the time of the next sessions. Different methods of teaching were used such as lectures, group discussions, critical thinking, problem solving and brainstorming. Instructional media included the booklet was distributed to all recruited

women in the study from the first session to achieve its objectives. Moreover, the researchers used supportive tools that function as stimulus control to support desired changes include stickers and flyers that reinforce the concepts of the intervention and emphasizing the effects of educational program on women's knowledge, attitudes and practices .

- **The first session** was about climate changes included (definition of climate changes, causes, high risk persons, effect of climate changes on pregnant women's health).
- **The second session** was about heat stress included (definition of heat stress, causes, symptoms, complication and prevention) and its effect on pregnant women included (preterm birth, stillbirth and low fetal weight, abortion, maternal hypertensive disease and placental abruption).
- **The third session** was about practices regarding climate changes and heat stress.

Evaluation phase: The effectiveness of the educational program was evaluated after implementation using the same format of tools, which were used during the assessment phase, and the researchers evaluated women's knowledge, attitudes and practices 4 weeks post-intervention from the last session and during outpatient follow up or via telephone in case of absenteeism.

Statistical analysis: Data was verified prior to computerized entry. Data analysis was performed using SPSS (Statistical Package for Social Sciences) statistical software version 25.0. Descriptive statistics were applied (e.g., mean, standard deviation, frequency and percentages). Test of significance (Paired t test, chi-square) as well as person correlation coefficient was used to investigate correlation between study variables. Degrees of significance of results were considered as follows: P-value > 0.05 No significant (NS). P-value ≤ 0.05* Significant (S). p- value ≤ 0.001** Highly Significant (HS).

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Results:

Table (1): Shows general characteristics of the studied sample. It was cleared that more than half (58.3%) of studied sample were in age group <25 years with a mean age of 25.55±5.38 years. As regards the residence, less than two-thirds (60.8%) of them lived in rural areas. Regarding the educational level, more than one-third (34.2%) of them had university education. Furthermore, more than half (57.5%) of them were housewives.

Table (2): Mentions that there was highly statistically significant difference in total mean scores of studied women's knowledge regarding climate changes and heat stress at pre-intervention and post-intervention phases with $P \leq 0.001$. The total mean score of knowledge was improved from 4.71±1.89 to 9.29±1.14.

Figure (1): Displays that, (33.3%) and (78.3%) of studied sample had positive

attitude toward climate changes and heat stress at pre-intervention and post-intervention phases respectively. While it was cleared that (66.7%) and (21.7%) of studied sample had negative attitude at pre-intervention and post-intervention phases.

Table (3): Reveals that, there were high statistical significant difference in total mean scores of studied women's reported practices toward climate changes and heat stress at pre-intervention and post-intervention phases with $P \leq 0.001$. The total mean score of reported practices was improved from 40.85±4.81 to 67.291±2.817.

Table (4): Clarifies that; there were highly significant statistical positive correlation between total knowledge score and (total reported practices & total attitude) scores regarding climate changes and heat stress at pre-intervention and post-intervention phase ($P \leq 0.001$).

Table (1) Distribution of the studied sample according to their general characteristics (n=120).

General characteristics	No.	%
Age:		
<25	70	58.3
25 - <30	24	20.0
30 - <35	13	10.8
≥35	13	10.8
Mean ± SD = 25.55±5.38		
Residence:		
Urban	47	39.2
Rural	73	60.8
Level of education:		
Read and write	10	8.3
Primary education	16	13.3
Secondary education	24	20.0
University education	41	34.2
Postgraduate education	29	24.2
Occupation:		
Housewife	69	57.5
Employed	51	42.2

Table (2): Mean Scores of studied women's knowledge regarding climate changes and heat stress at pre-intervention, post-intervention and follow up phases (n=120).

Knowledge parts	Min./Max. score	Pre-intervention	Post-intervention	Paired t test	P-value
		Mean ± SD	Mean ± SD		
Knowledge regarding climate changes	0/6	2.68±1.30	5.00±0.84	15.52	0.000**
Knowledge regarding heat stress	0/6	2.03±1.39	4.29±0.83	15.55	0.000**
Total score	0/12	4.71±1.89	9.29±1.14	22.63	0.000**

** highly statistically significance

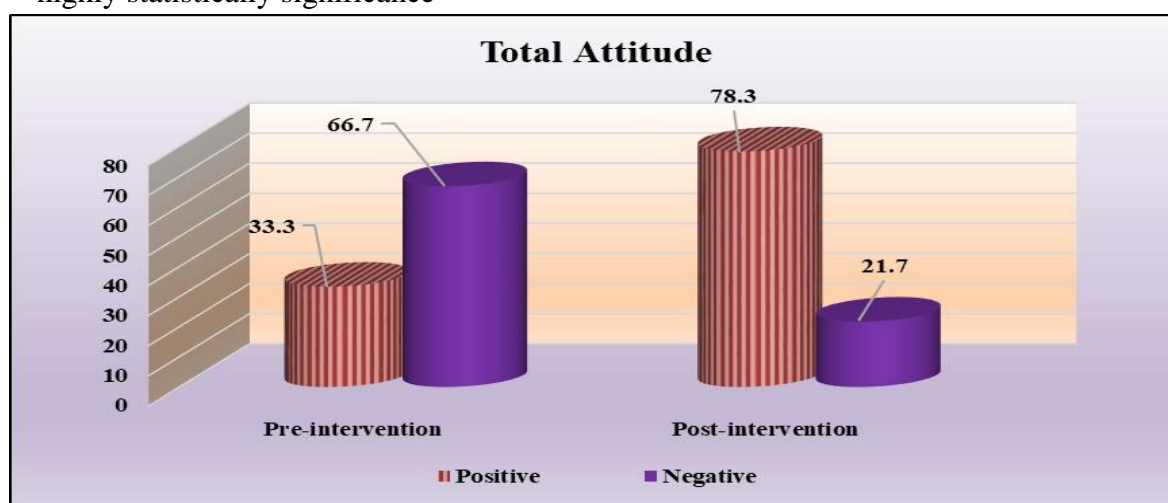


Figure (1): Percentage distribution of studied sample regarding their total attitudes score toward climate changes and heat stress at pre- intervention and post- intervention phases (n=120).

Table (3): Mean Scores of studied women's reported practices toward climate changes and heat stress at pre-intervention and post-intervention (n=120).

Reported practices parts	Min./Max. score	Pre-intervention	Post-intervention	Paired t test	P-value
		Mean ± SD	Mean ± SD		
Reported practices regarding climate change in general:					
General measures	0/12	4.93±2.28	10.60±1.20	24.45	0.000**
Nutritional practices	0/8	4.19±1.49	6.36±1.18	12.66	0.000**
Clothes	0/8	4.47±0.81	7.23±0.92	24.95	0.000**
Sports exercises	0/14	8.16±1.86	10.47±1.33	10.94	0.000**
Seeking medical care	0/4	2.37±0.95	3.51±0.63	11.02	0.000**
Reported practices towards heat stress problems:					
Necessary measures in the event of sunstroke	0/8	3.80±1.49	6.96±0.83	20.87	0.000**
Necessary measures in the event of heat exhaustion	0/8	4.47±0.96	6.63±1.11	12.68	0.000**
How to avoid heat cramps	0/8	2.73±1.12	6.56±0.92	29.04	0.000**
How to avoid heat rash	0/10	5.73±1.59	8.93±1.23	16.78	0.000**
Total score	0/80	40.85±4.81	67.291±2.817	48.91	0.000**

** highly statistically significance

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Table (4): Correlation coefficient between total knowledge, total attitude & total practices scores of the studied sample at pre and post-intervention phases.

Variables	Total knowledge			
	Pre- intervention		Post- intervention	
	r	P-value	r	P-value
Total reported practices	0.494	0.000**	0.624	0.000**
Total attitude	0.536	0.000**	0.558	0.000**

** highly statistically significance

Discussion:

Climate changes are seen as a major environmental problem in the 21st century; climate changes refer to the alteration of weather conditions and the overall temperature around the world and their effect on human, animal and plant life. The primary causes of climate changes are the elevation of temperatures worldwide, primarily attributed to the release of greenhouse gases resulting from the combustion of fossil fuels, such as carbon dioxide and methane (Liverpool Jhon Mooder University, 2023).

Climate changes poses the greatest health hazard to humanity and has led health professionals worldwide to take action against the health risks arising from this unfolding crisis. Pregnant women are particularly susceptible to unfavorable environmental conditions (Kasimanickam and Kasimanickam, 2021). Elevated ambient temperatures resulting in heat stress can have adverse pregnancy outcomes, such as preterm birth, stillbirth and low fetal weight. The impact of heat stress extends to the disruption of hormonal balance. This disruption may be responsible for the threat posed by heat stress to the successful progression of pregnancy and fetal development (Adur et al., 2022).

Regarding general characteristics of the studied pregnant women, the present research results cleared that, more than half

of studied sample were in age group <25 years with a mean age of 25.55±5.38 years. As regards the residence, less than two-thirds of them lived in rural areas. Regarding the educational level, more than one-third of them had university education. Furthermore, more than half of them were housewives.

This result was in the same line with Afifi et al., (2024) who conducted “Knowledge and Health-Related Behaviors toward Climate Changes and Heat Stress among Pregnant Women Working Outdoors” found that more than two-thirds of study group and more than half control groups respectively were between the ages of 25 - < 35 years old with a mean age of 24.18 ± 1.63 years and 25.80 ± 3.43 years and three quarter of them was lived in rural area respectively. Also, the result of present study was in agreement with Elsayed et al., (2024) who studied “Effect of Nursing Instructional Module on Pregnant Women' Knowledge and Practice Regarding Climate Changes” revealed that the more than half of the studied pregnant women are from 26-30 years old with mean age of 1.89±0.694, more than half are from rural areas, nearly less than one third are high education and less than two-thirds of them are housewives.

Additionally, the result was similar to Abdelrahman et al., (2024) who studied “Knowledge and Beliefs regarding Climate Change among Pregnant Women Attending

Outpatient Clinics” found that forty-six percent of the pregnant women their age ranged between 25-30 years old with mean age of 26.68 ± 4.25 years and the majority of them were housewife. From the researchers point of view, the similarity of the findings might be explained by the fact that this age group represents the most common reproductive age group.

Increasingly, this result was in accordance with **Acar and Öter, (2024)** who studied “Climate Change Awareness in Pregnant Women” revealed that more than half of the studied pregnant women belonged to rural areas. In addition, this finding was in agreement with a study done by **Eltelt et al., (2023)** who conducted "Adverse Health Effects of Climate Change on Pregnant Women Working Outdoors" mentioned that about three quarter of them was lived in rural areas and one third of them had higher education. Also this result was in the same line with **Mohamed et al., (2024)** who studied "Effect of Climate Change Awareness Program on Knowledge, Attitude and Preventive Practices among Pregnant Women" revealed that more than half of the studied pregnant women were non-working. On the other hand, this result disagreed with **Abdelrahman et al., (2024)** that findings indicated that the majority of study sample were lived in urban areas.

Regarding the knowledge of studied pregnant women, the findings of the present study revealed that there was highly statistically significant difference in total mean scores of studied women's knowledge regarding climate changes and heat stress at pre-intervention and post-intervention phases. The total mean score of knowledge was improved from 4.71 ± 1.89 to 9.29 ± 1.14 . This significant improvement is very valuable because acquisition of accurate

knowledge is considered the basis of pregnant women regarding climate changes and heat stress, which is linked to positive attitudes and better practices. This finding can be attributed to the positive impact of the educational program and the well- structured educational sessions. The topic of the study was deemed important and sensitive to the women involved in the study, thereby resulting in their high level of interest and satisfaction during educational sessions. Additionally, an instructional booklet was given to the women in an attempt to reduce any potential risks to the mother and the fetus.

This result was agreed with **Elsayed et al., (2024)** who found that the majority of studied pregnant women' knowledge had poor knowledge toward climate changes before the implementation of nursing instructional module and improved to most of them after the implementation. Also, this result was in the same line with **Eltelt et al., (2023)** who found that, less than two third of studied sample had poor knowledge regarding climate changes and heat stress, less than one third of studied sample had average knowledge, while nearly one tens of them had good knowledge. Moreover, our study findings agreed with **(Acar, & Öter, 2024)** who studied "Climate Change Awareness in Pregnant Women: A Qualitative Study" reported that participants' knowledge of the effects of climate change on maternal and infant health during pregnancy was incomplete and insufficient. In addition, this result was in accordance with **Mahmoud et al., (2023)** who studied "Knowledge and practices of maternity nurses related to the potential impacts of climate change on women's health" illustrated that general knowledge about

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climate change was fair in about two thirds of studied sample.

In assessing their knowledge about the potential impacts of climate change on women's health, it was found that more than one third of them have good knowledge. However, the mean score of the overall knowledge is 36.40 ± 7.84 with a total percent score of 62.77% indicating fair knowledge. The insufficient knowledge among pregnant women regarding climate changes and heat stress might be due to the nature of the women life as many of them were unemployed and from rural areas which made them unable to exchange the information and knowledge about the existing global events like in climate changes, also, being unemployed help them to be away somewhat from the heat, sun burn and other bad effects of climate changes that made them uninterested in the climate issues.

In addition, **Abd-Elhamed et al., (2023)** supported current research findings when indicated that the comparison between the women's knowledge levels during the pre and post intervention among the narrative and did active group. It is clear that the women's level of knowledge was similar between the two groups in the pre-intervention test, with poor level as the percentage was about more one third among the studied groups. While a clear improvement appeared in the women's level of knowledge in the post intervention test as the narrative group represented good level of knowledge with more than two third compared to the deductive group, which documented only less than one tens with a statistically significant differences between participants among both groups after implementation of the intervention as P-value was <0.001 .

However, this result contradicted with **Ngwenya et al., (2018)** who studied "Emerging heat-related climate change influences; a public health challenge to health care practitioners and policy makers: insight from Bulawayo, Zimbabwe. " reported that the majority of the studied sample had satisfactory knowledge level about climate changes meanwhile the minority had unsatisfactory knowledge level. This contradiction might be because of culture differences between two studies where in Zimbabwe there is more awareness about climate change since it is most susceptible to climate changes, droughts and floods.

Regarding attitude of studied pregnant women regarding climate changes and heat stress, the present study revealed that, the total attitude score, almost one-third and more than three-quarters of studied sample had positive attitude toward climate changes and heat stress at pre-intervention and post-intervention phases respectively. While it was cleared that two thirds and about less than one-quarter of studied sample had negative attitude at pre-intervention and post-intervention phases respectively. These findings of current study were in the same harmony with **Mohamed et al., (2024)** revealed that highly statistically significant difference between pre and post- test, where nearly one fifth of the women had positive attitude before implementation of the program and improved to more than three quarters of them after implementation of program indicating that climate change awareness programs significantly influence attitude regarding climate change.

Also, these findings agreed with **Menon, (2024)** who studied "Urgency of Breastfeeding Promotion in Climate Crisis"

concluded that targeted educational interventions can improve attitudes towards climate-related health risks, thereby encouraging pregnant women to adopt healthier lifestyle choices that mitigate climate impacts. On the other hand, this findings were disagreed with **Ibrahim et al., (2018)** who studied "Knowledge and Attitude regarding Global Warming Phenomenon among Assiut University Students" disclosed that most of the students they studied had completely favorable attitudes toward climate change and global warming.

Moreover, the current study of results were congruent with **Roos et al. (2021)** who studied "Maternal and newborn health risks of climate change" reported that climate change awareness programs can positively impact pregnant women's attitudes by educating them on risks, promoting adaptation strategies, and enhancing resilience to mitigate health risks for both mothers and newborns.

In addition, according to **Tiong et al., (2020)**, the majority of study participants exhibited supportive pro-environmental attitudes, with over two-thirds strongly believing that the pollution problem would have a more detrimental influence on human health. From researchers' point of view, climate change educational programs can positively impact the attitudes of pregnant women by increasing their understanding of the potential risks that climate change poses to maternal and fetal health. By educating expectant mothers about the link between environmental factors and pregnancy outcomes, these programs can empower women to make informed choices that protect themselves and their babies. Ultimately, by fostering a sense of responsibility towards the environment and

future generations, climate change educational program can help pregnant women develop a more proactive and protective attitude towards their own well-being and that of their unborn child.

Regarding reported practices toward climate changes and heat stress, the current study findings revealed that, there was high statistical significant difference in total mean scores of studied women's reported practices toward climate changes and heat stress at pre-intervention and post-intervention phases. The total mean score of reported practices was improved from 40.85 ± 4.81 to 67.291 ± 2.817 . This improvement in practices might be due to improvement in the knowledge of the pregnant women and educational sessions as most of the studied women were committed with the booklet. In addition, this change in women's practices reflected the effectiveness of educational program. In general, positively changed attitudes and improved knowledge affected the practices in a clear manner.

This result was in agreement with **Mohamed et al., (2024)** who revealed a highly statistical significant difference between pre and post- test, where only one fourth of the women had satisfactory level of practices before implementation of the program and improved to two thirds of the women after implementation of program indicating that climate change awareness programs significantly influence pregnant women's practices regarding climate change.

In addition, this result agreed with **Elsayed et al. (2024)** reported that only few numbers of the women had satisfactory level of practices before implementation of Nursing Instructional Module and improved to two thirds of the women after implementation of Nursing Instructional

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Module. From researchers' point of view, climate change educational programs can have a positive impact on improving practices among pregnant women by increasing knowledge and promoting a better understanding of the potential maternal and fetal health risks associated with climate change, this program can empower pregnant women to take proactive steps to protect themselves and their unborn fetuses. Heightened education lead to changes in lifestyle habits, such as reducing exposure to pollutants or adopting sustainable practices, which can contribute to healthier pregnancies and better birth outcomes.

Concerning correlation, the findings of the present study revealed that, there was a highly significant statistical positive correlation between total knowledge score and (total reported practices & total attitude) scores regarding climate changes and heat stress at pre-intervention and post-intervention phase. This outcome could be explained by the fact that as women's knowledge increased, their attitudes about climate changes and heat stress were positively changed. This implies that women have more positive views the more knowledgeable they are. Therefore, educating pregnant women about climate changes and heat stress raises their awareness, which in turn boosts the women's compliance with their care regimen, improves care measures, and ultimately yields beneficial results.

This result was in accordance with **Mohamed et al., (2024)** who revealed that there was a highly positive correlation between post-program total knowledge level, total attitude and total reported practices scores of studied pregnant women. This result is congruent with **Afifi et al. (2024)** who reported that there was a highly positive

statistical correlation between total knowledge and total health-related behaviors of the studied women; in a study carried out to assess "Knowledge and Health-related behaviors toward climate changes and heat stress among pregnant women working outdoors: Tailored educational program". In addition, this result was supported by study of **Lykins et al. (2023)** who studied "Climate change anxiety positively predicts antenatal distress in expectant female parents" demonstrated that structured awareness programs not only increase knowledge but also empower women to make informed decisions about their health and environmental practices during pregnancy. Moreover, this result agreed with **Eltelt et al., (2023)** who mentioned that 60% of pregnant women have unsatisfactory done practice about climate change as heat stress.

Conclusion:

The educational program had a positive effect on enhancement of knowledge, attitudes and practices of pregnant women towards climate changes and heat stress. Additionally, there was highly significant statistical positive correlation between total knowledge score and (total reported practices & total attitude) scores regarding climate changes and heat stress at pre-intervention and post-intervention phase. Hence, the aim of the study was achieved and research hypotheses were accepted.

Recommendations:

- Dissemination of the current research educational program to all antenatal clinics and maternity hospitals at Benha city.
- Establishing and maintaining effective antenatal care in the face of harsh life circumstances through new educational interventions.

Further researches:

- Establishing continuous educational programs for maternity nurses is essential because they act as health educators and play pivotal role in fostering pregnant women's awareness regarding effect of climate changes and heat stress on their health and fetuses.
- Replication of the study on large representative probability sample is recommended in to generalization of the results.

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تأثير برنامج تعليمي فيما يتعلق بالتغيرات المناخية على معلومات واتجاهات وممارسات السيدات الحوامل

هدير يحيى عبد الشكور- أمل أحمد حسن عمران- أميرة محمد سلامة- علا عبد الوهاب عفيفي عربي

تشكل التغيرات المناخية أكبر تهديد للصحة العامة في القرن الحادي والعشرين، مما يعرض السيدات الحوامل وأجنتهن لخطر جسيم. يمكن تحسين صحة السيدات الحوامل من خلال توعيتهن بالمخاطر التي تنطوي عليها فترة الحمل. لذلك هدفت هذه الرسالة إلى تقييم تأثير البرنامج التعليمي المتعلق بالتغيرات المناخية على معرفة وإتجاهات وممارسات السيدات الحوامل. و تم استخدام تصميم دراسة شبه تجريبية لمجموعة واحدة (اختبار ما قبل وبعد) لاستكمال هذه الدراسة. و أجريت هذه الدراسة في عيادة التوليد وأمراض النساء الخارجية في مستشفيات جامعة بنها. وقد شملت على ١٢٠ امرأة حامل وفقاً لمعايير الإدراج في الدراسة. و قد أسفرت النتائج على أن هناك فرق كبير إحصائياً بين نتائج مرحلة ما بعد التدخل مقارنة بمرحلة ما قبل التدخل فيما يتعلق بالمعرفة و الإتجاهات والممارسات المتعلقة بتغيرات المناخ والإجهاد الحراري. وقد لخصت الدراسة إلى أن هناك تحسن ملحوظ في إجمالي المعرفة والمواقف والممارسات لدى السيدات الحوامل فيما يتعلق بتغيرات المناخ بعد تنفيذ البرنامج التعليمي. و قد أوصت الدراسة إلى نشر البرنامج التعليمي البحثي الحالي على جميع عيادات ما قبل الولادة ومستشفيات الولادة بمدينة بنها.