Effect of Motivational Interviewing on Pregnant Women's Health Awareness and Risk Perception Regarding Climate Change

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Abstract

Background: Pregnant women are more vulnerable to heat stress than non-pregnant women, and greater attention should be prioritized to climate change, which has a negative impact on maternal and fetal health during pregnancy. This study **aimed** to investigate the effect of motivational interviewing on pregnant women's health awareness and risk perception regarding climate change. **Study Design:** A quasi-experimental one-group pre-post-test design was utilized. **Study Setting:** The Antenatal Outpatient Clinic of Obstetrics and Gynecological Specialty Center of Mansoura University Hospital, Dakahlia Governorate, Egypt. **Study Subjects**: A convenient sample of 69 pregnant women were recruited. **Study Tools**: Three tools were used for data collection, structured interview questionnaire, pregnant women's risk perception scale, and structured daily life practices interview questionnaire. **Results:** Post-intervention, 86.1% of the pregnant women exhibited good knowledge regarding climate change as compared to 95.7% exhibited poor knowledge pre-intervention. Concerning the risk perception score, it was significantly improved post-intervention as compared to pre-intervention (94.2% vs. 42%, respectively). Moreover, a significant positive shift in the total practices score of pregnant women related to climate change post-intervention as compared to pre-intervention (85.7% vs. 68.1%, respectively). **Conclusion**: The majority of pregnant women had significantly improved their knowledge, risk perception, and practices about climate change after applying the motivational interviewing sessions. **Recommendation:** Apply antenatal motivational interviewing sessions to enlighten pregnant women on how to mitigate the harmful effects of climate change.

Keywords: Climate change, Health awareness, Motivational interviewing sessions, Pregnant women & Risk perception

Introduction

Climate change is the greatest global environmental crisis, with a significant threat to all people's health. Between 2030 and 2050, it is predicted by the World Health Organization (WHO) to result in an additional 250 000 deaths/ per year from heat stress and its consequences **(Acar & Öter, 2024; WHO, 2023)**. Climate change refers to a gradual rise in global temperatures that is mostly caused by human activities. Burning fossil fuels is estimated to be the primary reason. Because of the resulted greenhouse gas emissions, carbon dioxide and methane wrap around the earth like a blanket, trapping the sun's heat and steadily raising the earth's temperatures **(Veenema, et al., 2023)**.

Greenhouse gas emissions exacerbate number of catastrophic disasters as flooding, hurricanes, storms, intense droughts, severe wildfires, increased ultra-violet radiation and the episodes of heatwaves, air and land pollution, water scarcity, food insecurities and increasing the transmission of vector-borne diseases, which directly or indirectly affects the health of all human beings **(Olson & Metz, 2020; Roos et al., 2021; Segal & Giudice, 2022)**.

Pregnant mothers and their fetuses rank at the apex of the health impact pyramid. Poor thermoregulation occurs during pregnancy due to increased hormonal sensitivity and changes in circulation, resulting in increased blood volume and hydration demands, increasing the risk of dehydration. As a result, the combination of dehydration and extreme heat exposure promotes the release of prostaglandins or oxytocin, which causes early contractions. It may also reduce maternal blood flow to the placenta or lower amniotic fluid, leading to more serious maternal and fetal complications **(Samuels et al., 2022; Baharav et al., 2023)**.

Miscarriage, intrauterine growth retardation, preterm birth, stillbirths, and low birth weight can result from extreme heat exposure. Additionally, salinity of the water, poor food quality as well as prenatal exposure to air pollution and smoke from wildfires can increases the chance of maternal gestational diabetes, gestational hypertension, preeclampsia, respiratory

problems, malnutrition, anemia and foodborne diseases e.g., listeria and toxoplasma **(Bonell et al., 2024; Pace et al., 2021; Shashar et al., 2020)**.

Therefore, finding suggestions for improving pregnant women's awareness of heat-related risks and implementing new interventional methods that can address factors such as women's cognitive and behavioral beliefs is mandatory to mitigate adverse outcomes **(Zolfaghari, et al., 2018)**.

Motivational interviewing (MI) is an effective novel counseling method. It is a directive, collaborative, women-centered communication approach for eliciting and enhancing motivation for behavior change by helping women to resolve the differences between potential optimal and actual actions. The four core processes of MI are engaging, focusing, evoking motivation, and planning action **(Herval, Oliveira, Gomes, & Vargas, 2019; Nijs et al., 2020; Miller & Rollnick, 2023)**.

Engaging processes promote rapport, trust, and a sense of safety in the interaction between health care professionals and women. The focusing process involves negotiating an agenda with women to agree on a domain for exploration and discussion. The third process, evoking motivation, seeks to increase women's inherent motivation for change. The final planning action process strives to help the women formulate a particular action plan to initiate, improve, or otherwise modify a desired health behavior **(Baricchi et al., 2023; Cole, Sannidhi, Jadotte, & Rozanski, 2023)**.

Motivational interviewing differs fundamentally from other types of traditional educational programs. This technique employs a communication style that stresses women's commitment, participation, and involvement in the process of behavior modification. As a result, the women's resistance to changing their behavior is reduced, and they are more motivated to modify and promote their health. This occurs in a positive, supportive, and hopeful emotional environment created by empathy and unconditional positive respect **(Anastasiadou et al., 2023)**.

Significance of the study

According to recent important facts issued by the **WHO** in **October 2023**, climate change is directly contributing to humanitarian emergencies from heatwaves. The climate change in Egypt is rapidly accelerating. Temperatures have increased at an alarming pace of 0.53 °C every decade during the last thirty years. Furthermore, if global emissions persist, further rises are predicted. This is highly concerning for Egypt's human security, particularly among populations who are more vulnerable to heat, such as pregnant women. Heat-related mortality is anticipated to rise by 2,000 to 5,000 deaths per year, resulting in an annual cost of 20 to 48 billion Egyptian pounds **(Hamzawy, et al., 2023; WHO, 2023)**.

To manage the challenges of climate change, Egypt developed its first comprehensive national climate change strategy until 2050. It also, updated the guiding principles of Egypt Vision 2030 to focus on the human being as the fundamental core of development. Citizens with special risk factors will receive special attention, particularly pregnant and lactating women and their children. In this context, maternity nurses can be leaders in efforts at mitigation, adaptation, and support these strategies for maintaining pregnant women's health **(Egypt Ministry of Environment, 2024; El Baradei & Sabbah, 2024)**.

Climate change should receive more attention because its negative impact on maternal and fetal health during pregnancy. Raising pregnant women's awareness by making climate change a hot topic and generating more discussions is critical. However, few studies have been conducted in Egypt to assess pregnant women's awareness of health risks resulting from climate change **(Jungudo, 2023)**. Using new techniques as MI can encourage pregnant women to adapt a healthier lifestyle and face the negative effects of climate change, which is the aim of this study.

Study Aim

The aim of the current study was to investigate the effect of motivational interviewing sessions on pregnant women's health awareness and risk perception regarding climate change.

Study Hypothesis

To reach the aim of this study, the following hypotheses were formulated:

Hypothesis 1. Pregnant women who receive MI sessions regarding climate change will have differences in their knowledge levels than before.

Hypothesis 2. Pregnant women who receive MI sessions regarding climate change will have differences in their risk perception levels than before.

Hypothesis 3. Pregnant women who receive MI sessions regarding climate change will have differences in their practices' levels than before.

Operational definitions

Pregnant women's health awareness: it refers to pregnant women's knowledge and practices about climate change. The evaluation of awareness was conducted using structured interviewing questionnaire to measure the knowledge and daily life practices regarding climate change.

Risk perception: it refers to how pregnant women understand the health risks of climate change, and how this influences their decision-making toward adapt a healthier life style. It was evaluated by the pregnant women's risk perception scale.

Subjects and Method
Study Design:
This study adopted a quasi-experimental one-group pre-post-test design to examine the effect of the independent variable (motivational interviewing) on the dependent variables (knowledge, risk perception, and practices). This type is one of the most frequently used quasi-experimental research designs in which a single group of participants is pretested, given an intervention, and then post-tested. If there is a significant difference between the pre- and post-test scores, this difference can be attributed to the independent variable.

Study Setting:
The study was conducted at the Antenatal Outpatient Clinic of the Obstetric and Gynecologic Specialty Center affiliated to Mansoura University Hospital (MUH) a major tertiary teaching and referral hospital located in Egypt's delta region. It consists of one floor separated into reception, two antenatal follow-up clinics, the gynecological examination clinic, the vesicular mole clinic, the four-dimensional ultrasound clinic, a laboratory room, a waiting area for women, and a rest area for health care professionals. The antenatal outpatient clinic was open from 9 a.m. to 1 p.m., and care was provided by 4 nurses and 5 obstetricians each day.

Study Sampling
For the current study, 69 pregnant women were invited to participate as a convenient sample. Pregnant women over the age of 20, less than 28 weeks gestation, had scheduled antenatal follow-up visits at outpatient clinic of MUH, and not experiencing high-risk pregnancy complications were the inclusion criteria. Pregnant patients who were hospitalized and having major medical and psychological diseases were the exclusion criteria.

Sample size
The sample size was determined using the WHO algorithm for health studies (**Lwanga, Lemeshow & WHO, 1991**), with 80% power (Zβ=0.84), 0.05 significance level (Zα/2=1.96), 95% confidence interval, 5% margin of error (d), and moderate effect size (d=0.5). The sample size was determined as 69.

Study subjects
Ninety-seven pregnant women were examined for research eligibility. Twenty-one women did not visit MUH for antenatal outpatient follow-up, seven women declined to participate in the study (personal details will not be shared), while the majority of the subjects were eligible to participate in the study (69 pregnant women). No subjects in the research study were lost in follow-up (Consort Diagram).

CONSORT Diagram
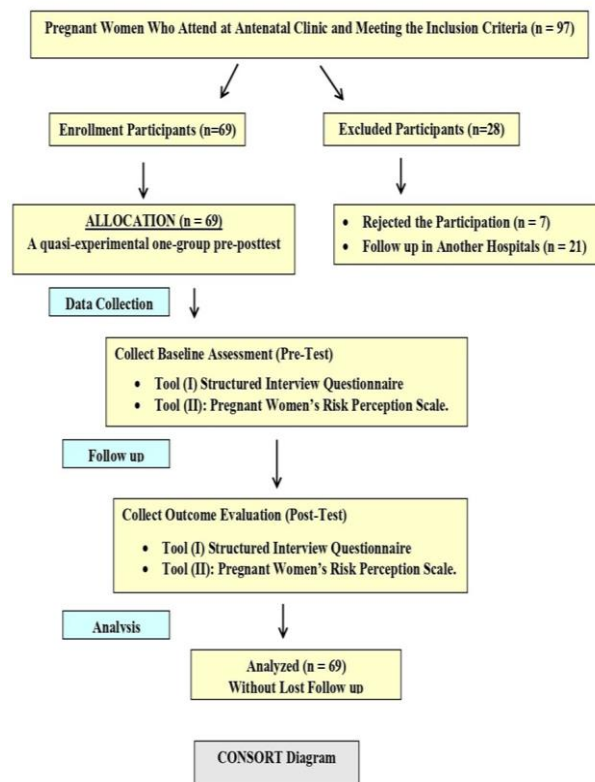
Study Tools:
Three tools were used for data collection.
Tool (I): Structured Interviewing Questionnaire:
This tool was developed by the researcher after reviewing the relevant literatures (**Adebayo, Davidson Mhonde, DeNicola, & Maibach, 2020; Baines, 2023**). It included three main parts:
Part I: Demographic data of pregnant women included age, residence, education, and occupation.
Part II: Pregnant women's obstetrical history included gestational age, gravidity, parity, and mode of last delivery.
Part III: Assessment of pregnant women's knowledge regarding the health risks of climate change:
It included 17 multiple-choice questions covering the following fundamental information regarding climate change: The definition of climate change and global warming; the factors contributing of it; the effects of global warming and climate change; the groups most at risk from its effects on health; the diseases most closely linked to it; the effects of climate change on pregnant women; mitigation strategies to lessen its effects; preventive measures to keep the effects of at bay; at-home activities that pregnant women should take up to protect the environment and lessen its effects; the necessary health screenings for the mother and fetus to detect early effects of climate change, as

well as their knowledge of Egypt's plan to address the health hazards associated with climate change.

Scoring system

The cumulative score for all knowledge-related questions amounted to 85 marks, which represented 100% of the total possible score. Each question had a "correct" or "incorrect" response. The incorrect response or don't know was marked (zero), whereas the correct answer was marked (1). The range of the total knowledge score was 0 to 85. Each correct response in the questionnaire contributes to the total knowledge score of 85. For instance, correctly defining climate change and global warming earns 2 points. Identifying the causes or factors contributing to climate change grants 1 point per correct answer, totaling 9 points. Similarly, the other questions contribute to the total score based on the number of correct responses in each question. So, the total score (85) is calculated based on the number of correct responses provided by the respondent across all the questions. The overall score was divided into three categories: poor knowledge', which is less than fifty percent (<42.5 marks), fair knowledge', which is between 50 and 70 percent (42.5 and 59.5 marks), and good knowledge', which is above 70 percent (>59.5 marks).

Tool (II):Pregnant Women's Risk Perception Scale

This self-rating, which has five domains with all items scored on a 5-point Likert scale, was adopted from **Adebayo et al. (2020)** to evaluate pregnant women's perceptions of the health hazards associated with climate change. **The first domain** was perceived knowledge about the health relevance of climate change (3 items). **The second domain** was actual knowledge about how climate change can adversely affect maternal and fetal health (4 items). **The third domain** was perceived climate change risk as it affects pregnant women and their fetuses (3 items). **The fourth domain** was self-efficacy, which measured pregnant women's confidence in their ability to take actions to protect against specific impacts of climate change (2 items). **The fifth domain** was behavioral intention that pregnant women can take to protect themselves from the adverse effects of climate change (4 items).

Scoring system

Pregnant women's perceptions of risk were rated on a scale of 1 to 5, with 5 denoting strong agreement, 4 agree, 3 neutrality, 2 disagreement, and 1 highly disagreement. For items 2, 8, and 12, the scoring methodology was reversed. The difference in risk perception scores between the five domains was calculated using the mean and standard deviation (SD). The overall risk perception score ranged from 1 to 80. Two categories were created from the total score: positive perception is greater than or equal to

60% (>48 points), while negative perception is less than 60% (<48 points).

TOOL III: Structured Daily Life Practices Interview Questionnaire

This tool was developed by the researcher after reviewing the relevant literatures **(DeNicola, et al., 2019)**. It included 33 items across the following domains: **Saving energy (5 items)** covered turning off electrical appliances when not in use, and when leaving the room, purchasing energy efficient appliances, and setting the air conditioner to 24 degrees. **Green purchasing (3 items)** involved buying recyclable products, green product (e.g., organic food) and used products**. Reuse (3 items)** included reusable water bottle, food box, and paper**. Recycling (3 items)** comprised repairing items (such as shoes, handbags), recycling old clothing in good condition, and selling paper and metal waste to scrap metal collectors. **Waste management (2 items)** covered ensuring that waste is sorted by type in recycling bins and that hazardous waste is collected separately**.

Food safety (2 items) involved how to prepare food in accordance with requirements and check the expiry date of frozen foods products before purchase. **Saving water (3 items)** included turning off taps when washing face and hands, turning off running water when washing hair and body, and reducing the duration of use**. Environmental protection (3 items)** comprised internet searches for information on environmental health, reporting illegal outdoor burning and growing plants on balconies.

Health behaviors for preventing impacts of climate change (9 items) covered avoiding strenuous physical activity when the temperature rises, drinking plenty of water and fluids, educating the family about proactive health measures to prevent the effects of climate change, cancelling outdoor activities when the bulletin warns of a dust or sand storm, sleeping under a mosquito net to prevent insect bites, seeking psychological support during and after extreme weather events, seeking medical attention for psychological symptoms after extreme weather events, and seeking medical attention for pregnancy monitoring after extreme weather events.

Scoring system

Each question was answered with a "yes" or "no" response, where the presence of practices was assigned a score of 1 and the absence of practices was assigned a score of 0. The total practices score ranged from 0 to 33. Based on the overall practices score, two categories were established: 'unsatisfactory practices,' which was defined as a score below 60% (less than 19.5 marks), and 'satisfactory practices,' which was defined as a score of 60% or above (greater than or equal to 19.5 marks.

Content Validity and Reliability

Five expert panels with substantial experience in woman's health and midwifery nursing, as well as community health nursing, provided feedback on the tools' content validity. The experts assessed the tools to improve their clarity, relevance, completeness, simplicity, and applicability; only minor changes were made before creating the final version. A translation and back-translation were performed to ensure the accuracy of tools I, II, and III. Cronbach's alpha ($\alpha=$) indicated that the study tools were reliable, with values of 0.947 for knowledge, 0.71 for risk perception, and 0.923 for practices questionnaire.

Study Method

Study Preparation:

Ethical Considerations:

Prior to the study, the Research Ethics Committee of the Faculty of Nursing, Mansoura University provided ethical approval **(Ref. No. P. 0559)** for the year **2023**. All pregnant women provided formal consent after being informed of the study's nature and goal. Participants were informed that their participation in the study was voluntary and that they might withdraw at any moment. Anonymity, privacy, safety, and confidentiality were guaranteed during the study. The findings were used as part of the necessary research as well as for publication and education.

Preparation of Study Tools:

After conducting a thorough assessment of relevant and contemporary literature, the researchers designed Tools I and III and translated them into Arabic to better align with the Egyptian language. Tool II was adopted.

Preparation of MI Sessions Content:

After conducting a thorough review of relevant and current literature, the researchers developed content for MI sessions as well as an educational booklet. The researchers prepared a booklet in simple Arabic with illustrative photos and diagrams based on the Environmental Protection Agency's (EPA) article "Climate Change and the Health of Pregnant Women".

Pilot Study:

A pilot study of seven pregnant women (10% of the sample) was conducted to assess the applicability and relevance of the study tools, as well as the clarity of the MI sessions and an educational booklet that were created. The necessary revisions were implemented, and these pregnant ladies were removed from the study sample.

Study Procedure:

Over the course of six months, from November 2023 to the end of April 2024, data were collected. The researchers visited the antenatal clinics three days per week (Saturday, Monday, and Wednesday) from 9 a.m. to 1 p.m. Following a detailed description of the study's aim, the relevant authority in the study setting approved the official data collection. The MI sessions consisted of four processes: engaging, focusing, evoking motivation, and planning action.

Phase 1: Engaging Process

The researchers interviewed the pregnant woman who met the inclusion criteria, obtaining informed consent to their participation in the study and gathering the pregnant woman's demographic data and obstetrical history. In the engaging process, the researchers gave the pregnant women's panel discussion of their knowledge, risk perception, and current practices regarding climate change, and baseline assessment pre-MI sessions were obtained.

Phase 2: Focusing Process

In the focusing process, clear objectives were set to help the pregnant women developing a realistic plan for change, included: Enhancing pregnant women's awareness of climate change and its specific health risks to pregnancy outcomes. Facilitating the adoption of health-promoting practices in response to climate change risks among pregnant women. Empowering pregnant women by providing them with practical tools and strategies to mitigate climate-related health risks. The MI sessions were developed based on the identified needs and objectives. It consisted of four sessions; three theoretical and one practical.

Phase 3: Evoking Motivation Process:

In the evoking motivation process, the researchers helped pregnant women to take steps toward change by exploring the reasons for changing or modifying their current behaviors, identifying the risks of not change, and supporting their self-efficacy to perform the steps necessary for behavior change through sharing and exchanging information about climate change. The interview began with a friendly greeting for the pregnant women, a brief explanation of the session's aim, and the teaching technique that would be used.

The implementation of the evoking motivation process lasted about 12 weeks. The researchers divided the total of 69 pregnant women into seven groups and implemented the MI sessions with 10 pregnant women in six groups; the seventh group had 9 pregnant women. Each group had a visit every two weeks for follow-up, in which they received one session. In accordance with the study, pregnant women scheduled antenatal follow-up visits, and the researcher arranged a phone call to remind them with the session's time. Within four antenatal follow-up visits, the researchers conducted the sessions with each group in a teaching hall at the previous mentioned setting using different educational methods as follows:

Sessions	Objectives	Contents	Martials/ Visual aids	Time	Evaluation
1st Theoretical Session:	To understand climate change and related health risks.	▪ Definition of climate change and global warming. ▪ Factors contributing to climate change. ▪ How global warming affects the planet and human health.	▪ Video ▪ PPT Slides ▪ Booklet	60 min	▪ Pre/Post-Test ▪ Discussion ▪ Feedback Forms
2nd Theoretical Session:	▪ To identify the impacts of climate change on the environment, and vulnerable groups. ▪ To identify the impact of climate change on pregnant women	▪ Common impacts of climate change on the environment. ▪ The groups most vulnerable to the health effects of climate change. ▪ The diseases most closely associated with climate change. ▪ The impact of climate change on pregnant women.	▪ Video ▪ PPT Slides ▪ Booklet	60 min	▪ Pre/Post-Test ▪ Discussion ▪ Feedback Forms
3rd Theoretical Session:	▪ To identify the maternal and fetal screenings ▪ To explore Egypt's plan for climate change health risk management.	▪ Maternal and fetal health screening to detect effects of climate change. ▪ Egypt's plan to mitigate the risks of climate change.	▪ Video ▪ PPT Slides ▪ Booklet	60 min	▪ Pre/Post-Test ▪ Discussion ▪ Feedback Forms
4th Practical Session:	▪ To teach pregnant women effective mitigation actions for minimizing climate change risks. ▪ To teach pregnant women engaging in home activities that support environmental sustainability.	▪ Effective mitigation actions and home activities that pregnant women should adopt to minimizing climate change health risks and support the environment sustainability such as: saving energy, recycling, waste management and food safety.	▪ Video ▪ PPT Slides ▪ Booklet	60 min	▪ Demonstration ▪ Redemonstration ▪ Post-Session Reflection

Phase 4: Planning Action Process:

In the planning action process, the researchers motivated the pregnant women to maintain commitment with the adapted healthy behavior and raise their motivation to continue applying the learned strategies to reduce the risks of climate change on pregnancy outcomes and followed their changed behaviors to prevent relapse via a telephone call using the following questions: Did you agree that the aforementioned everyday living habits should be encouraged during pregnancy?, did you think you should maintain your previous activities?, and were you aware of the potential dangers of not changing your behaviors?.

After hearing the pregnant women's responses, the researchers continued to urge change by asking them to rate, on a scale of 1 to 10, how essential modifying everyday life behaviors could reduce the health impacts of climate change. The participants were then asked to rate their confidence in making the necessary changes on a scale of one to ten.

One month of applying the MI sessions, the researchers met pregnant women based on their antenatal follow-up visits and a posttest evaluation was done. A comparison was made between pre- and post-MI sessions to determine the effectiveness of MI sessions in raising pregnant women's health awareness, risk perceptions, and practices regarding climate change.

Data Analysis:

Data entry and analysis were carried out using IBM Statistical Package for Social Science (SPSS) Statistics for Windows (Version 27.0). Categorical data were displayed as numbers and percentages. Kolmogorov's test was used to assess the normality assumptions of quantitative variables. The quantitative variables were presented using descriptive statistics such as means, standard deviations, ranges, medians, and interquartile ranges (25%-75%). The paired sample t-test was used to compare the mean pre- and post-MI scores. The Pearson correlation coefficient was used to investigate the relationship between knowledge, risk perception, and climate change-related practices. All statistical tests were two-tailed, with p-values < 0.05 indicating statistical significance.

Results

Table (1): Distribution of Pregnant Women according to Demographic Characteristics (N=69)

Variables	Studied pregnant women (N=69)	
	Frequency	**%**
Age (Years):		
▪ <20	**4**	**5.8**
▪ 20-24	**34**	**49.3**
▪ 25-29	**16**	**23.2**
▪ 30-34	**9**	**13.0**
▪ ≥35	**6**	**8.7**
Age (Years): Mean±SD	25.3±4.8	
Range (Minimum-Maximum)	19 (17-36)	
Residence:		
▪ Rural	47	68.1
▪ Urban	22	31.9
Education:		
▪ Primary/Preparatory	4	5.8
▪ Secondary	27	39.1
▪ University	33	47.8
▪ Postgraduate	5	7.2
Occupation:		
▪ Housewife	62	89.9
▪ Worker	7	10.1

Table (2): Distribution of Pregnant Women according to Obstetrical History (N=69)

| Variables	Studied pregnant women (N=69)	
	Frequency	**%**
Gestational age:		
▪ First trimester (≤12 weeks)	**23**	**33.3**
▪ Second trimester (13-27 weeks)	**31**	**44.9**
▪ Third trimester (≥28 weeks)	**15**	**21.8**
Gestational age (Weeks): Mean±SD	18.3±10.0	
Range (Minimum-Maximum)	32(5-37)	
Median (25-75 IQ)	16 (12-25)	
Gravidity:		
▪ Primi-gravida	30	43.5
▪ Multi gravida	39	56.5
Mode of last delivery for multigravida (n=39)		
▪ Caesarian section	34	87.2
▪ Normal vaginal delivery	5	12.8
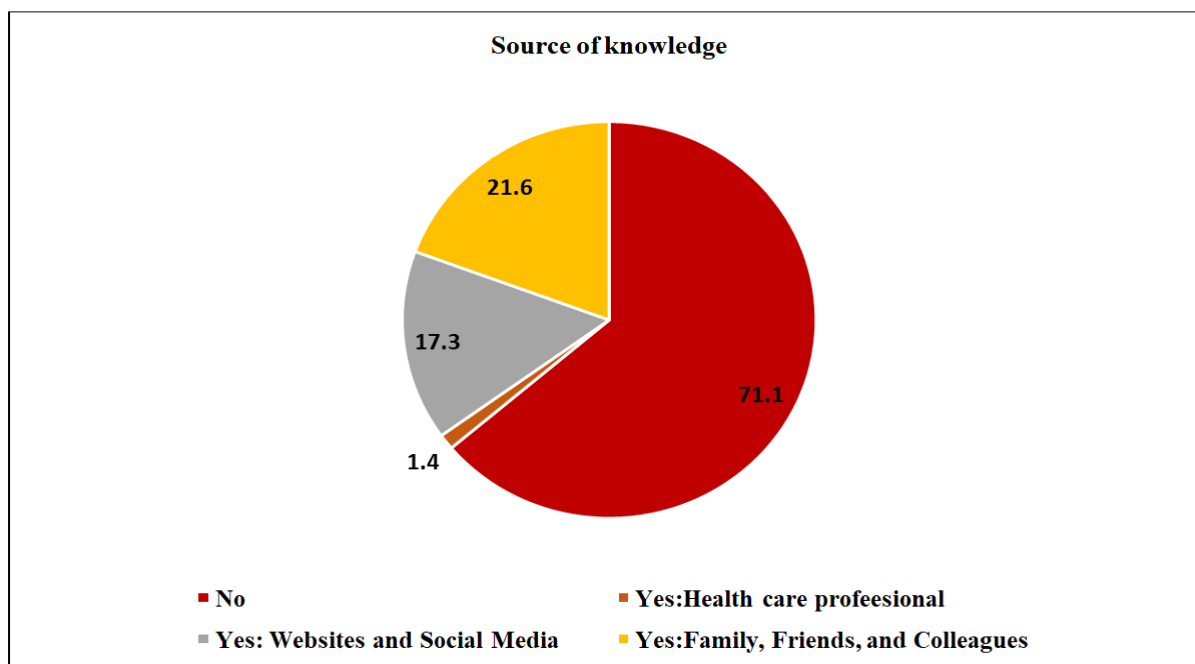
Figure (1): Source of Knowledge regarding Climate Change (N=69)

Table (3): Knowledge of Pregnant Women regarding Climate Change Pre and Post Motivational Interviewing (N=69)

Pregnant women's knowledge about climate and climate change #	Before Mean±SD	After Mean±SD	p value*
Definition of climate and global warming (Total 2)	0.5±0.6	2.0±0.0	**<0.001****
Causes or factors contributing to climate change (Total 9)	2.2±1.7	5.0±0.0	**<0.001****
The impact of global warming on planet Earth (Total 6)	0.7±0.8	3.9±0.5	**<0.001****
Common effects of climate change on the environment (Total 7)	1.1±1.7	6.0±0.0	**<0.001****
The effects of climate change on human health (Total 7)	1.2±1.5	6.0±0.0	**<0.001****
The most vulnerable groups to the health impacts of climate change (Total 8)	1.8±2.1	4.6±1.2	**<0.001****
Some of the diseases most closely associated with climate change (Total 4)	0.4±0.7	3.0±0.0	**<0.001****
The effects of climate change on pregnant women (Total 9)	0.5±0.7	9.0±0.0	**<0.001****
Mitigation measures to reduce the impacts of climate change (Total 8)	0.7±1.1	8.0±0.0	**<0.001****
Measures taken by governments to reduce the health impacts of climate change (Total 5)	0.4±0.9	5.0±0.0	**<0.001****
Egypt's plan to address climate change (Total 4)	0.3±0.7	4.0±0.0	**<0.001****
Preventive measures that pregnant women should follow to avoid negative effects of climate change (Total 7)	2.0±2.5	7.0±0.0	**<0.001****
Home activities that pregnant women should adopt to protect the environment and reduce the effects of climate change (Total 5)	1.9±2.1	5.0±0.0	**<0.001****
The essential health screenings for the mother and fetus to detect early effects of climate change (Total 4)	0.8±1.1	3.9±0.3	**<0.001****
Total Knowledge Score (Total number of questions 85)	15.2±12.9	72.5±1.2	**<0.001****

*# Only correct answers were presented *Paired sample t test.*
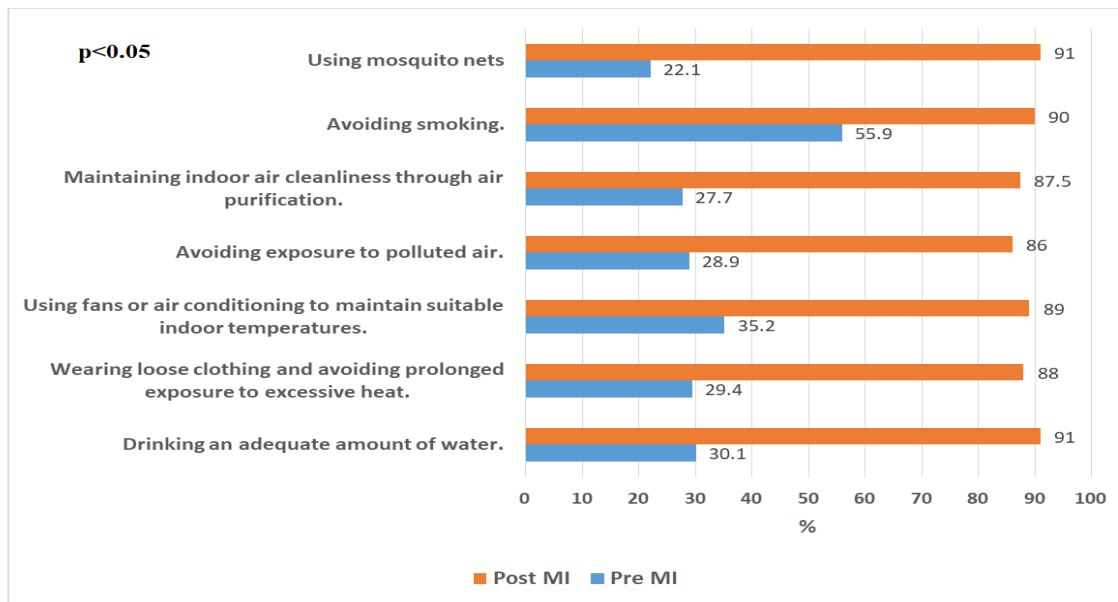 **Statistically significant (p<0.05).*

p<0.05

Preventive Measure	Post MI	Pre MI
Using mosquito nets	91	22.1
Avoiding smoking.	90	55.9
Maintaining indoor air cleanliness through air purification.	87.5	27.7
Avoiding exposure to polluted air.	86	28.9
Using fans or air conditioning to maintain suitable indoor temperatures.	89	35.2
Wearing loose clothing and avoiding prolonged exposure to excessive heat.	88	29.4
Drinking an adequate amount of water.	91	30.1

Figure (2): Knowledge of Preventive Measures that Pregnant Women Should Follow to Avoid Negative Effects of Climate Change Pre and Post Motivational Interviewing (N=69)
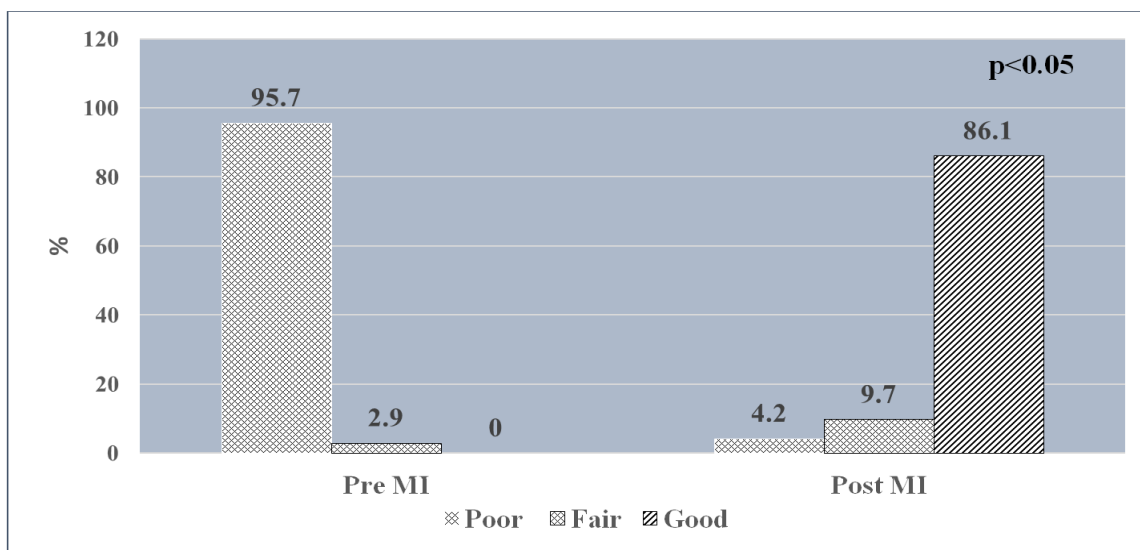

p<0.05

Pre MI: Poor 95.7, Fair 2.9, Good 0
Post MI: Poor 4.2, Fair 9.7, Good 86.1

Figure (3): Classification of Knowledge towards Climate Change among Pregnant Women Pre and Post Motivational Interviewing (N=69)

Table (4): Pregnant Women's Risk Perception of Climate Change Pre and Post Motivational Interviewing (N=69)

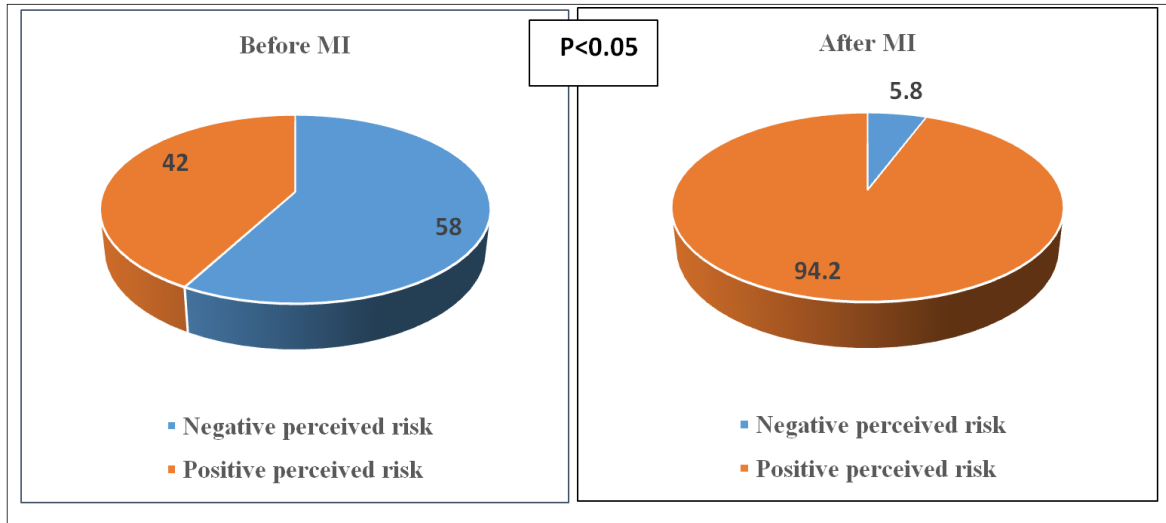| Variables	Before MI (N=69) Mean±SD	After MI (N=69) Mean±SD	Paired sample t-test p-value
Perceived Risk	10.9±2.0	13.1±0.7	**<0.001**[*]
Perceived Knowledge	6.0 ±0.0	12.0±0.4	**<0.001**[*]
Actual Knowledge	12.4±1.0	17.1±0.7	**>0.001**[*]
Self-Efficacy	4.8±1.3	5.8±0.7	**>0.001**[*]
Behavioral Intention	11.6±1.3	17.8±2.2	**>0.001**[*]
Total risk perception score	45.9±4.1	65.8±3.4	**>0.001**[*]

Statistically significant ($p<0.05$).

Figure (4): Risk Perception towards Climate Change among Pregnant Women Pre and Post Motivational Interviewing (n=69)

Table (5): Practices of Pregnant Women that related to Climate Change Pre and Post Motivational Interviewing (N=69)

Variables	Pre MI (N=69) Mean±SD	Post MI (N=69) Mean±SD	Paired sample t-test p-value
Energy conservation	3.4±1.5	5.0±0.0	**<0.001**[*]
Green purchasing	0.2±0.4	1.0±0.0	**<0.001**[*]
Reuse	1.2±0.8	1.9±0.3	**<0.001**[*]
Recycling	1.7±1.1	2.0±0.0	0.071
Waste management	1.1±0.8	1.9±0.3	[*]**0.001>**
Food safety	1.5±0.7	2.0±0.0	[*]**0.001>**
Water conservation	1.5±0.7	3.0±0.0	[*]**0.001>**
Environmental protection	0.4±0.5	1.9±0.1	[*]**0.001>**
Health behaviors for climate change mitigation	3.8±2.4	8.8±0.4	[*]**0.001>**
Total practices score	15.2±7.1	27.6±0.8	[*]**0.001>**

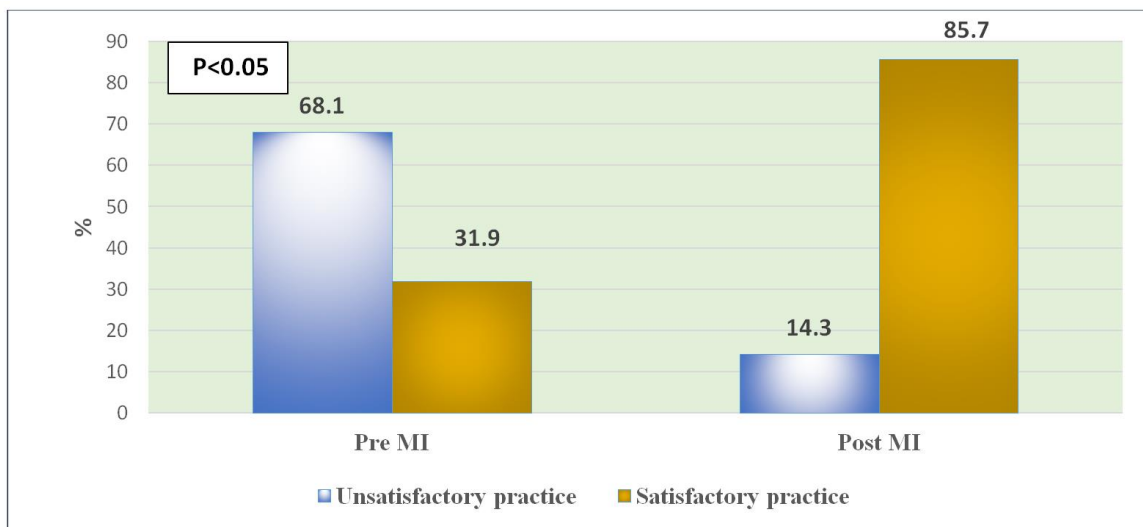**Statistically significant (p<0.05).*

Figure (5): Practices of Pregnant Women related to Climate Change Pre and Post Motivational Interviewing (N=69)

Table (6): Correlations between Knowledge, Risk Perception and Practices related to Climate Change among Pregnant Women (N = 69)

Correlation variables	Pearson correlation coefficient (r)	p-value
Pre-Motivational interviewing		
▪ Knowledge and risk perception score	0.06	0.625
▪ Knowledge and practices score	0.25	**0.033***
▪ Risk perception and practices score	0.12	0.290
Post-Motivational interviewing		
▪ Knowledge and risk perception score	0.24	**0.043***
▪ Knowledge and practices score	0.35	**0.003***
▪ Risk perception and practices score	0.29	**0.013***

Statistically significant correlation (p<0.05)

The results of the study provide information about the characteristics of the studied pregnant women, their obstetric history, their knowledge, risk perception, and practices related to climate change before and after motivational interviewing.

Table (1): Presents the demographic characteristics of the studied pregnant women. The mean age of pregnant women was 25.3± 4.8 years. Most of them resided in rural areas 68.1%. Regarding the education level, 47.8% of them completed their university education. The vast majority of the pregnant women were housewives 89.9%.

Table (2): Reveals the **obstetric history** of the studied pregnant women. The highest proportions of them were primigravida 43.5%. The mean gestational age was 18.3±10.0 weeks. Regarding the mode of last delivery for multigravida, 87.2% underwent cesarean section (CS).

Figure (1): Demonstrates that 71.1% of the studied pregnant women did not have any source for knowledge regarding climate change.

Table (3): Shows that the mean score of correct answers increased significantly from 15.2±12.9 to 72.5±1.2 across various aspects of climate change, included its definition, causes, impacts on the environment and human health, vulnerable groups, mitigation measures, and preventive measures for pregnant women after applying MI sessions (p < 0.05).

Figure (2): Illustrates that post-motivational interviewing sessions, the majority of pregnant women exhibited good knowledge regarding all aspects of the preventive measures that pregnant women should follow to avoid the negative effects of climate change as compared to pre- motivational interviewing.

As shown in **Figure (3):** Almost all pregnant women exhibited poor knowledge 95.7% pre motivational interviewing. Post motivational interviewing sessions 86.1% exhibited good knowledge regarding climate change.

Table (4): Clarifies the mean scores of perceived risk, perceived knowledge, actual knowledge, self-efficacy and behavioral intention significantly increased from 45.9±4.1 to 65.8±3.4 (out of 80 questions) after motivational interviewing (p < 0.05).

Figure (4): Shows that 42% of pregnant women exhibited positive perceived risk pre motivational interviewing. This percentage was increased to 94.2% post motivational interviewing.

Table (5): Presents the mean scores of practices related to energy conservation, green purchasing, reuse, waste management, food safety, water conservation, environmental protection and health behaviors for climate change mitigation were significantly higher post MI than pre it (p<0.05). The table highlighted that the total mean practices score increased significantly from 15.2±7.1 to 27.6±0.8 (out of 33 questions) post MI sessions (p < 0.05).

As shown in **figure (5):** A significant positive shift in the practices of pregnant women related to climate change after the motivational interview. Before the intervention, the pregnant women reported 68.1% unsatisfactory practices. After the intervention, 85.7% of pregnant women had satisfactory practices related to climate change.

Table (6): Presents the correlations between knowledge, risk perception, and practices related to climate change among pregnant women before and after motivational interviewing. Before motivational interviewing, there was a weak and non-significant positive relationship between knowledge and risk perception as well as risk perception and practices score (p>0.05). On the other hands, a weak but significant positive relationship between knowledge and practices related to climate change was found (p <0.05).

Correlations suggest that post MI, there are stronger and statistically significant associations between knowledge, risk perception, and practices related to climate change among pregnant women (p<0.05). A weak but significant positive relationship between knowledge and risk perception post the intervention. Moreover, a moderate and significant positive relation between knowledge and practices as well as risk perception and practices related to climate change post the intervention.

Discussion

Growing evidence suggests that pregnant women's health is particularly vulnerable to the direct and indirect impacts of a changing climate. The aim of this study was to investigate how applying the MI sessions affected pregnant women's health awareness, risk perception, and practices regarding climate change.

The study's major findings were that, the majority of pregnant women had significantly improved their knowledge, risk perception, and practices about climate change after applying the MI sessions. These findings supported the study's hypotheses that:
Hypothesis 1: Pregnant women who receive MI sessions regarding climate change will have differences in their knowledge levels than before.
Hypothesis 2: Pregnant women who receive MI sessions regarding climate change will have different levels of risk perception than before. Hypothesis 3: Pregnant women who receive MI sessions regarding climate change will have differences in their practices' levels than before.

The results of the current study showed that majority of pregnant women underwent CS. Recent Egyptian studies by **Abu Abla, et al., (2023) & Gad et al., (2022)** corroborate this finding, reporting that the frequency of CS was higher than vaginal deliveries. In addition, Egypt is the world leader in CS deliveries, accounting for 75–80% of all deliveries, compared to the global average of 25–30%, according to the Ministry of Health, which criticized the country's rapidly rising rates of CS. This finding highlights the alarming trend of CS deliveries across Egypt, raising concerns. There is a necessary need to establish appropriate monitoring systems to determine whether CS is necessary, particularly when it is done electively.

Regarding the level of knowledge toward climate change among the studied pregnant women pre and post MI, the current study revealed that pre-intervention, the majority of pregnant women had poor levels of knowledge. However, post-intervention, the level of knowledge dramatically improved, as all the pregnant women now had high levels of knowledge regarding climate change. Two possible explanations for these findings are the lack of health awareness programs and the role that obstetricians and nurses play as educators. These results demonstrate the efficacy of the teaching materials and MI technique used with the study participants.

This explanation is supported by an American study by **Baines (2023)** aimed at examining the information consumption and assessment of pregnant women regarding the health risks and impacts of climate change. According to his findings, lacks of knowledge, the absence of a centralized information hub, politicization, and concerns about false information make it difficult for pregnant mothers to educate themselves about the health hazards linked to climate change. Similarly, **Fan & Zlatnik (2023)** proposed in their study that obstetricians are uniquely positioned to protect pregnant women's health by advocating for policy changes that address climate change and providing clinical recommendations to protect themselves from the negative effects of climate hazards.

The present study findings are in line with a Turkish study conducted by **Acar & Öter (2024)** aimed at exploring pregnant women's awareness about climate change. According to their study, pregnant women did not have adequate knowledge about climate change. The study is anticipated to contribute to the literature's efforts to raise awareness about climate change. **ElSayed, et al., (2024)** also carried out study in Egypt aimed at examining the impact of a nursing education module on pregnant women's knowledge and practices about climate change in the Beni-Suef Governorate. Their results showed that pregnant women's knowledge of climate change had improved when a nursing education module was implemented, and the difference was highly statistically significant (p<0.000).

The current study examined pregnant women's risk perceptions related to climate change pre and post MI. The results showed that post MI, there was a significant increase in perceived risk, perceived knowledge, actual knowledge, self-efficacy, and behavioral intention (p < 0.05). Additionally, following MI, there was a significant increase in the total risk perception score (p < 0.05). This finding can be linked to the beneficial effects of MI and the well-planned instructional booklet that was provided to the women in an effort to lessen any possible hazards to the mother and the developing fetus. Pregnant women who participated in the study found the topic to be sensitive and significant, which led to their high level of attention and satisfaction during the learning session.

These findings are supported by the findings of **Adebayo et al. (2020)**, who conducted a study in the United States to determine the comparative effectiveness of narrative and didactic information formats on pregnant women's knowledge, risk perception, self-efficacy, and information seeking regarding health risks associated with climate change. Their findings revealed that participants had significantly higher levels of perceived knowledge, actual knowledge, perceived risk, self-efficacy, and behavioral intentions after receiving a narratively based educational intervention to reduce climate change-related risks during pregnancy.

Similarly, **Abd-Elhamed, et al., (2023)** also conducted another study in El-Minia Governorate, Egypt, to examine the effects of didactic vs. narrative information on the knowledge, attitude, and perception of pregnant women about climate change. Their findings revealed a higher level of perception after implementing the educational intervention, with statistically significant variations (0.004).

Concerning pregnant women's practices in relation to climate change. The present study's findings demonstrated that, prior to intervention, almost two-thirds of the studied pregnant women reported unsatisfactory practices. This finding also aligns with those of a study conducted in **2023 by Eltelt, et al.,** which examined climate change's adverse health effects on pregnant women who work outdoors in the Fayoum Governorate of Egypt. Their study revealed that nearly two thirds of pregnant women follow unsatisfactory practices related to climate change.

After applying MI intervention among the studied pregnant women, the current study's findings revealed that, there was a significant increase in the mean scores of practices for energy conservation, green purchasing, reuse, waste management, food and water conservation, environmental protection, and health behaviors for mitigating climate change ($p < 0.05$). Additionally, the overall practices score rose significantly post MI ($p < 0.05$).

This is a reasonable conclusion given that the majority of the pregnant women in the study had inadequate knowledge prior to the intervention. However, following the intervention, the pregnant women's level of knowledge increased because of the MI technique and the booklets they received, which contained information on a variety of topics related to climate change, such as its effects on the environment and the health of expectant mothers, mitigation strategies, and preventive measures. Lastly, pregnant women who are knowledgeable about a particular health behavior and recognize its importance feel more powerful, self-assured, and eager to apply their newfound knowledge and engage in that behavior. This explains the increase in practices that this study found.

The present study confirms the findings of **El Sayed et al. (2024),** who discovered a significant improvement in most pregnant women's practices about climate change following the application of nursing instructional modules. Likewise, the results also corroborate those of research by **Adebayo et al. (2020) & Abd-Elhamed et al. (2023)**, which also reported a noteworthy improvement in pregnant women's intention to take particular protective measures against the negative effects of climate change.

Conclusion

According to the current study's findings, the majority of pregnant women had significantly improved their knowledge, risk perception, and practices about climate change after applying the motivational interviewing sessions.

Recommendations

Based on the current study's findings, the following recommendations are made:

- Offer antenatal education classes in antenatal outpatient clinics to raise awareness about climate change among pregnant women.
- Apply antenatal motivational interviewing sessions to enlighten pregnant women on how to mitigate the harmful effects of climate change.
- Create effective communication tools, such as brochures, that describe the consequences of climate change on maternal and infant health and are distributed to pregnant women during antenatal follow-up.
- Incorporate climate change's impact on pregnant women's health into the maternity and midwifery nursing curriculum.
- Conduct future studies to examine the effects of preconception motivational interviewing sessions about climate change on pregnant women's health behaviors.
- Expand the study's generalizability by conducting it in other settings with a sizable representative sample.

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