

Effect of Narrative Information on Knowledge, Health Beliefs, and Protective Behaviors of Pregnant Women Towards Climate Change

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Abstract

Background: The greatest threat to public health in the twenty-first century is climate change, yet little attention has been paid to how it affects the perinatal period. It is essential to use crafted narrative messages to inform expectant mothers about their vulnerabilities to the negative health effects of climate change, and help encourage and enable women to take proper protective behaviors.

Aim of the study: Evaluate the effect of narrative information on the knowledge, health beliefs, and protective behaviors of pregnant women toward climate change.

Research design: To conduct the current study, a quasi-experimental approach was used.

Setting: The study was carried out at Zagazig University Hospital's family planning and antenatal care unit, which is part of the outpatient clinic.

Subjects: Purposive sample of sixty expectant mothers.

Data Collection Tools: Five tools were used for data collection.

Tool I: A structured interviewing questionnaire,

Tool II: The women's Knowledge questionnaire about climate change,

Tool III: Health Beliefs Model (HBM),

Tool IV: Protective behaviors related to climate change scale.

Tool V: Narrative information for pregnant women toward climate change.

Results: A highly statistically significant difference was found regarding the total score of knowledge and its domains and the health beliefs model for pregnant women about climate change, as reported by the studied pregnant women throughout the intervention phase ($p < 0.001$). Furthermore, knowledge and preventive behavior were statistically significantly correlated before and after the intervention ($r = 0.275$, $p = 0.033^*$), and the correlation coefficient was positive. **Conclusion:** It was concluded that narrative information significantly improves the knowledge, health beliefs, and protective behaviors scores of pregnant women towards climate change throughout the study phases.

Recommendations: Educational training and communication activities should be conducted for pregnant women about climate change and its effect on pregnancy using narrative messages.

Keywords: *Narrative, Knowledge, Health Beliefs, Protective Behaviors, Climate Change*

Introduction

Climate change is considered the biggest global health crisis that affects health of women and has implications for the health of future generations. It is recognized as one of the greatest health threats and global challenges in the 21st century, according to the World Health Organization (WHO). Currently, the rhetoric is changing from climate change to the climate crisis, as it is causing multiple health challenges (*Yeboah, et al., 2024*).

The United States National Climate and Health Assessment identifies eight key impacts of climate change on health, including health harms associated with heat waves, poor outdoor air quality, extreme weather events, food- and water-related infections, vector-borne diseases, nutritional deficiencies, and mental health impacts (*Abd-Elhamed, et al., 2023*). Women, especially pregnant women, are among the groups most directly threatened by climate change. Increasing the frequency of extreme heat events and altering precipitation patterns worldwide pose a number of health risks and exacerbate the health disparities of the most vulnerable populations and individuals (*Spencer, et al., 2022*).

Due to physiological and anatomical changes that impair thermoregulation throughout pregnancy and the neonatal period, climate change influences maternal and perinatal health through several pathways (*Pandipati et al., 2023*). Gestational heat exposure is a well-established teratogen in human pregnancies. It can also cause pregnant women to become dehydrated and develop renal failure. Additionally, they are more vulnerable to heat stroke and fatigue. Furthermore, it has been linked to infant mortality, premature delivery, and low birth weight (*Lusambili & Nakstad, 2023*).

Furthermore, excessive heat can cause high blood pressure and even preeclampsia, which can reduce blood flow to the placenta by rerouting blood flow for other urgent needs. As a result, the fetus's oxygen levels may drop, which may impact both the fetus's growth and the risk of difficulties during delivery. (*Moffett et al., 2022*). The World Health Organization (WHO) placed both climate change and air pollution among the top ten global health hazards, in addition Many observational studies in the obstetrical literature have shown a link between heat and air pollution and a higher risk of unfavorable delivery outcomes (*Bekkar, et al., 2020*).

The growing fetus is particularly vulnerable to the dangerous chemicals that a pregnant woman's breath contains. Through the pulmonary alveoli, hazardous chemicals found in PM_{2.5} (particulate matter less than 2.5 µm in diameter) enter the exposed woman's bloodstream. Once there, they combine with blood to enter the placenta and fetal circulation, where they have a harmful effect on the fetal cells (*UNEP 2022*).

More research is needed to identify vulnerable populations, to prevent unfavorable health consequences, fill knowledge gaps, and implement strategies for heat prevention and mitigation. Clinicians often evaluate women during times of climate exposure, with a significant opportunity for timely education that can minimize morbidity and mortality (*Atwoli et al., 2023*).

There is a vast literature in the humanities and health discussing the rhetorical use of storytelling in environmental narratives and growing interest in how they might function as forms of evidence and communication within climate change research (*Ma, et al 2024*).

It has been discovered that narrative information has a greater impact on risk perceptions, beliefs, and recall than didactic or fact-based communication alone. According to theory, narrative transportation is a mental process brought on by the interplay of feelings, visuals, and attention when watching a story (*Bieniek et al., 2020*).

As knowledge may be essential for elevating concern about climate change, narratives may be specifically suited to communicate about polarized issues because they may reduce counter-arguing. Providing educational materials to women in this format may notably improve communication of clinically important climate information (*Sbiroli, et al 2022*).

The women's behavior, practices, knowledge, and awareness of risks are crucial in mitigating the negative health effects of heat waves. Understanding the seriousness of the danger and seeing the advantages of taking action to lessen the threat are linked to an individual's behavior and practices, according to the health belief model, which developed gradually in response to very practical public health problems (*Adekola, et al., 2023*).

By certain health adaptive measure of improving women's knowledge and awareness, which influences their actions and behaviors during heat waves, the negative health impacts of heat waves can be anticipated and avoided. The goal of heat wave adaptation is to lessen the negative effects on human health by making people less susceptible to the extremes of heat waves (*Sayili, et al, 2022*).

Significance

The researches suggests that climate change messages can affect risk perceptions, efficacy beliefs, and behavioral intentions (*Ashley et al., 2022*). Therefore, using a suitable narrative messages to educate pregnant women about their and their developing baby's vulnerabilities to the adverse health effects of climate change, including the actions that can be taken to decline the risks, and help motivate and enable women to take appropriate protective behaviors (*Shaffer et al., 2018*). Only one study to date tests educational methods intended to improve pregnant women's protective behaviors and understanding of their risk using the narrative approach in this context (*Adebayo et al., 2020*). So the current study will be conducted to fill this gap by evaluating the effect of narrative information on the knowledge, health beliefs, and protective behaviors of pregnant women towards climate change.

Aim of the study:

The present study aims to evaluate the effect of narrative information on the knowledge, health beliefs, and protective behaviors of pregnant women towards climate change.

Such an aim will be fulfilled through the following objectives:

1. Assess pregnant women's knowledge of climate change.
2. Define the effect of narrative information on the health beliefs of pregnant women towards climate change.
3. Identify the effect of narrative information on protective behaviors of pregnant women towards climate change.
4. Establish, implement and evaluate the effect of narrative information on knowledge, health beliefs, and protective behaviors of pregnant women towards climate change.

Research hypothesis:

Knowledge, Health beliefs and protective behaviors of pregnant women towards climate change will be enhanced after the application of a narrative information.

The Subjects and Methods:

A-Technical Design

Research design:

Quasi-experimental design was used through the current research problem.

Study Setting:

The research took place in the family planning and antenatal care unit located within the outpatient clinic at Zagazig University Hospital. This site was selected as it serves as the primary health facility in Zagazig for women seeking antenatal care services. The unit is situated on the second floor, adjacent to the gynecological unit, and comprises two rooms: a smaller space designated for the assisting nurse and a larger room outfitted for examinations. It operates daily from 9 AM to 1 PM.

Study Subjects:

The study's participants comprised 60 expectant mothers who fulfilled the following criteria:

- Pregnant women who are free of any medical or psychiatric disorders.
- Women who can read & write.
- Women who are willing to participate in the study.

Sample size calculation:

The sample size needed was 60 women plus 10% of women for the pilot study. The pilot study is excluded so the total sample size was 60 women. Sample size calculated using G*power free software. We estimated an effect size of 0.66 on the knowledge mean score in the intervention group compared with the control. Thus, with the power of 95% at α error 0.05. the required sample size is 60 pregnant women (*Adebayo et al., 2020*).

Tool for data collection:

In order to fulfill the objectives of the study *five tools* were used to collect necessary data:

Tool I: A structured interviewing questionnaire. It was created by the researcher in plain Arabic to gather the data required to complete the study (Appendix I). It was composed of two parts:

Part 1: Features of the research sample's demographics: Four questions were included in order to gather information on the demographic traits of the women under study. (Question 1-4) (Age, employment, domicile, and educational attainment).

Part 2: This part included questions that cover the obstetric history which includes (present and previous obstetric history)

Present obstetric history: it is composed of 1 question (Question5) which includes the gestational age of the present pregnancy

Previous obstetric history is composed of 3 questions (Questions 6-8): number of gravida, number of parity, and mode of delivery.

Tool II: The pregnant women's Knowledge questionnaire about climate change and its effect on the pregnancy and the fetus

The researcher developed it in a simple Arabic questionnaire to collect data to assess the women's knowledge about climate change and its effect on pregnancy and the fetus. It is composed of 13 questions (Questions 9-22) divided into 2 types of questions as the following:

1. Yes, no, and I don't know question: it involved 3 questions (9-11), related to the heat waves and their effect on the fetus and pregnancy and another 3 questions (12-14) about the impact of the air pollution on the fetus and pregnancy.
2. MCQ question: it involved 7 questions (15-22), about the definition of climate change, the risk of heat waves on pregnant women, the risk of heat waves on the fetus, the negative effects of exposure to air pollution on pregnancy, long-term effects on offspring resulting from maternal exposure to heat stress, adaptive behavior

to mitigate the maternal and fetal risk of exposure to air pollution, and the adaptive behavior to mitigate the risk of exposure to **extreme heat**.

Scoring system of women knowledge

Scoring System: Each item was assigned: a score (1) was given when the answer was correct, and a score (0) was given when the answer was wrong or don't know.

Total knowledge regarding climate change and its effect on pregnancy was calculated as:

Total degrees=13

Satisfactory score $\geq 60\%$

Unsatisfactory $<60\%$

Tool III: Health Beliefs Model for pregnant women about climate change (HBM).

This scale is used for evaluating the health beliefs of pregnant women about climate change; it is adapted from (*Adebayo et al., 2020*). It is modified and supplemented by the researcher through expert validation.

It is divided into two scales, the first to evaluate the health beliefs of pregnant women towards heat waves, which includes 25 items distributed on six sub-scales: (Perceived vulnerability, perceived severity, perceived threat, perceived benefit, perceived barrier, cues to action, and self-efficacy).

The second is to evaluate the health beliefs of pregnant women about air pollution which includes 24 items distributed on six sub-scales: (Perceived vulnerability, perceived severity, perceived threat, perceived benefit, perceived barrier, cues to action, and self-efficacy).

Scoring system of Health Beliefs Model for pregnant women about climate change (HBM).

This questionnaire asks the respondents to evaluate the health beliefs of pregnant women about climate change on a 5-point Likert scale (i.e., Strongly Disagree, Disagree, Unknown, Agree, Strongly Agree; scored from "1" to "5" respectively). Adapted from (*Adebayo et al., 2020*), and modified by the researcher.

The total score of the Health Beliefs Model for pregnant women about climate change (HBM).

Total degrees=245

high score $\geq 60\%$

low score $<60\%$

Tool IV: Protective behaviors related to climate change scale

The scale measured how often the Participants undertook several behavioral adaptations during a heat wave. Derrick et al. (2013), with modifications made by the researcher. The entire scale includes 30 items and is divided into 2 parts, the first part includes 20 statements assessing the protective behaviors of the women related to the heat waves for example: Drinking plenty of water to stay hydrated, listening to daily weather forecasts, etc.

The second part includes statements assessing the protective behaviors of women related to air pollution for example download a free air quality app on the phone to check the air quality, and stay indoors as much as possible when the air quality is bad outside.

Scoring system of pregnant women's protective behaviors:

The statements related to protective behaviors have the scores and response choices (1 = Never, 2 = Sometimes, 3 = Always).

Total score of Protective behaviors related to climate change scale

Total degrees=93

positive score $\geq 60\%$

negative score $<60\%$

Tool V: Supportive material (Narrative information book for pregnant women towards climate change).

It developed by the researcher after reviewing the Environmental Protection Agency's (EPA) brochure titled "Climate Change and the Health of Pregnant Women (EPA Climate Change and Health Fact Sheets, 2019) and from the recent related literature. It developed in a simple Arabic language. After reviewing the brochure to identify the important factual information conveyed in the modified brochure. It takes the form of a full-color image book. The book characters are a pregnant woman (the main character), her nurse, her child, and one of her friends. The story illustrates her interactions with her doctor, her child, and her friend. During these interactions, she learns about risks of climate change on the maternal and child health from the nurse and shares the information with her child and friend, meanwhile, she suggests to her child that they avoid risky behavior, thereby in effect modeling the recommended behavior, which should elevate the reader's sense of self-efficacy.

B) Operational design:

It includes the description of the preparatory phase, the validity of the tools, reliability, pilot study, fieldwork, and ethical considerations.

Preparatory phase:

Using books, papers, the internet, periodicals, and scientific magazines, a survey of relevant literature from the past and present as well as theoretical understanding of different study aspects was conducted. This was necessary for the research problem to develop the structured interview questionnaire and the educational narrative book.

Content of validity and reliability:

Validity of the tools: The validity of the tools was tested for content validity by a Jury of three experts (Community Health Nursing professor, professor of the Gynecological and Obstetric Health Nursing Department), and nursing administration department professor. These professionals evaluated the tool's comprehensiveness, applicability, clarity, relevance, and comprehension. All recommendations in the tools were made. Additionally, based on the respondents' indicated requirements and the relevant literature, the researcher created a guidebook for them that included all topics pertaining to climate change and its impact on pregnancy (Appendix V). The same specialists who validated the instrument also updated and approved the guide.

Reliability of the tools:

Scale	Cronbach's Alpha	No. of Items
pregnant women's Knowledge questionnaire about climate change and its effect on the pregnancy and the fetus	0.735	13
Health Beliefs Model for pregnant women about climate change	0.944	49

Protective behaviors related to climate change scale	0.755	30
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Pilot study

Prior to conducting the main investigation, a pilot study was carried out to evaluate the study's viability and clarity. About 10% (6) of the main study sample size that met the predetermined criteria were included in the pilot sample. It was carried out one month prior to the data collection. The goal was to determine the viability of the tools and identify any issues specific to the statement. Estimating the amount of time required for women to complete the study's instruments was also beneficial. Following the pilot study, it was discovered that the tool's questions were pertinent and understandable, although certain wording needed to be changed for clarity. The subjects of the pilot sample were excluded from the main study sample.

Fieldwork: To fulfill the aim of the study, the following phases were carried out: assessment, planning, implementation, and evaluation.

The activity took place in the study waiting area, and the researcher verbally got the women's consent to participate after explaining the purpose of the study and collecting the data using the interview form. The sample was drawn from the outpatient clinic's prenatal care unit between 9 a.m. and 1 p.m. The researcher asked the women to complete the questionnaire. The average interview time with each participant was thirty minutes. The investigation was conducted between May 2024 and October 2024. Based on an actual assessment of the subjects' educational needs, an educational narrative book was created to enhance their understanding, attitudes toward health, and protective behavior in relation to climate change. It was used as follows.

Assessment phase:

This was the initial stage that was accomplished following obtaining consent in the context of research. Women were given plenty of time to answer questions in the questionnaire if they intended to take part in the study. The questionnaire took an average of 15 to 20 minutes to be completed. The replies that each participant provided were only accessible to the researcher. where the pregnant woman needs of knowledge, health beliefs, and protective behaviors regarding climate change were found in the pre-test by gathering and examining the baseline data from the completed items.. This helped the researchers to become acquainted with the magnitude of the issues and guided them in developing the appropriate data collection tools. As a result, the program was developed in part

Planning phase:

According to the Using the findings from the evaluation stage, the researcher created the intervention plan. and the session content related to the identified women's needs . Identified needs, requirements, and deficiencies in knowledge, health beliefs and protective behaviors regarding climate change were translated into aim and objectives of the narrative book.

Description of the program:

To developing this program The first step was to determine the main aim and objectives. The sample's assessed needs served as the basis for these objectives, which were then divided into more focused goals and tasks that were arranged in a sequential fashion that complied with the teaching and learning process. The program was set in one main session.

General objective of the program:

To improve pregnant knowledge, health beliefs, and protective behaviors of the pregnant women toward climate change.

Specific objectives:

At the end of the self- reading of the narrative book the Women ought to be capable of Define climate change

Enumerate the causes of climate change

Explain how climate change (heat waves/ air pollution affect pregnant women.

List the adverse effects of (heat waves/ air pollution) on the fetus.

Identify the adaptive behavior against the heat waves

Enumerate the adaptive behavior against air pollution.

Note: The program consisted of two session

Initial session: After finishing the pretest, the researcher sat with each woman separately and briefly introduced the research using a narrative teaching technique to ensure comprehension and engagement.

Second session: Facilitate a discussion then address any questions or concerns.

➤ Deciding whether to give the study sample a narrative book to read themselves or to read it to them or even use the hybrid approach depends on several factors related to the research objectives, the characteristics of the study women, and the context in which the study is conducted. Here are some considerations to help the researcher decide the best approach:

Factors to Consider

1. Literacy Levels and Reading Ability
2. Comprehension and Engagement
3. Time Constraints

Hybrid Approach

The researcher uses the hybrid approach, it considered a combination of both: For example, the researcher started with a reading session to introduce the material and ensure a woman understands the key points, then allowed her to continue reading on her own at home with the option to ask questions in follow-up sessions.

➤ **The researcher implements this approach as the following:**

1.Initial Session:

- Read the first few pages aloud.
- Facilitate a discussion to ensure comprehension and engagement
- Address any questions or concerns.

2.Individual Reading:

- Provide the rest of the book for the participant to read on her own.
- Provide supplementary materials like glossaries or summaries if the text is complex.
- Set a timeline for completion and offer support if needed.

3.Follow-Up Session:

- Reconvene the women to discuss the book for discussion and clarification.

Implementation phase

This study included pregnant women who went to the prenatal clinic for a check-up during their pregnancy to manage their pregnancy issues. - The researchers conducted two or three interviews per day with women who met the inclusion criteria (two days per week). Two to three women were interviewed daily (4-6 women per week). The women received a narrative information book from the researcher in the antenatal care unit, the researcher met each woman separately. The average length of this conversation was about 30 minutes per each woman. The interview started with, a kind greeting, a brief introduction of the researchers and a clarification of the objectives of the study and the teaching strategy that will be used. Before providing information about climate change and its effects using the narrative method, the researchers evaluated the

pregnant women's understanding of the topic and its impact on their developing fetus. The researcher started with reading, to introduce the material and ensure the woman understood the key points, then allowed her to continue reading on their own and allow her to ask questions.

The comic book's main characters were a pregnant woman, her husband, their child, and her friend. The narrative illustrated the interactions with the nurse, her child, her friend, and her husband. The nurse informed her about the risks that climate change poses her and her fetus health through these encounters, and she shared this knowledge with her kid and friend. The mother also counseled her child to avoid engaging in risky activities.

N.B: Narration, is a time-honored technique for oral conveyance of knowledge, aided pregnant women in learning rapidly by making the subject matter attractive and simple to understand. The researchers use narrative teaching to present stories about climate change and its impact on pregnant women and their growing fetus. It involves integrating narratives or stories into lessons to make content more engaging and relatable. Here are some key aspects:

1. Engagement: Stories capture women's attention and make learning more interesting, which can increase motivation and participation.
2. Relatability: Narratives can help subjects connect new information to their own experiences, making it easier to understand and remember.
3. Context: Stories provide a context for facts and concepts, helping women see how information fits together and applies in real-world situations.
4. Memory: Humans are naturally inclined to remember stories better than isolated facts. Using narratives can improve retention of information.
5. Emotional Connection: Stories often evoke emotions, which can deepen learning and make it more meaningful.
6. Critical Thinking: Analyzing stories can develop critical thinking skills as subjects interpret, question, and draw conclusions from the narrative.

➤ After the session, the narrative book has been kept with the pregnant women and the researcher remained in touch with her, to answer her queries and obtain the posttest in her next visit.

Evaluation phase

Data regarding the knowledge, health beliefs, and protective behaviors of pregnant women towards climate change were collected from the women at two points the first is in the assessment phase (pretest). The second at the evaluation phase at her next visit in order to evaluate the effect of the narrative information program, the post-test was administered after women finished the reading of the narrative book. to determine women's familiarity with the recommendations and evaluate how well the pregnant women understood climate change and how it affected the development of their fetuses. The same tools used in the pre-test were re-used.

Ethical consideration and administration: -

***Ethical consideration:**

The Zagazig University Faculty of Nursing's scientific and ethics committee has granted its ethical approval under M.D.ZU.NUR/130/13/7/2023. Each woman was given an explanation of the study's purpose before the instruments were used to win her trust and confidence. Each woman who participates in the study gives her verbal agreement after being assured that the information gathered will be kept private and that the study procedures won't negatively impact her pregnancy. They also stated that they are free to leave the study at any moment and without providing an explanation.

Administrative design.

Obtaining an official permission to collect data and implement the educational program in the administrative structure at Zagazig University by delivering a formal letter from the dean of the Faculty of Nursing Zagazig University to the dean of the Faculty of Medicine then the Institutional Review Board (IRB) unit to obtain the permission for data collection. To make the participant aware of the objective of the educational program, meetings and discussions were held between the researcher and the participants concerning the ethical considerations.

Statistical design

All data were collected, and SPSS 20.0 for Windows was used to tabulate and statistically analyze the data (SPSS Inc., Chicago, IL, USA 2011). The mean $\pm$ SD was used to convey quantitative data, while absolute frequencies (numbers) were used to express qualitative data. & relative frequencies (percentage). Marginal homogeneity or to compare between two dependent groups of categorical data Mc nemar test was used. Paired t-test was used to compare between two dependent groups of normally distributed variables. While, Wilcoxon Signed Ranks Test was used to compare between two dependent groups of not normally distributed variables. using the Chi-square test or Fisher's exact test to compare Percent of categorical variables. Person correlation coefficient was calculated to assess relationship between study variables, (+) sign indicate direct correlation & (-) sign indicate inverse correlation. To predict factors which affect knowledge, health beliefs and attitude scores Multiple linear regression (step-wise) were used. Cronbach alpha coefficient was calculated to assess the reliability of the scales through their internal consistency. P-value < 0.05 was considered statistically significant, p-value < 0.01 was considered highly statistically significant, and p-value ≥ 0.05 was considered statistically non-significant

Results:

Table 1 shows that 45% of the studied women their age was 25-<30 years and the mean of age was 26.74 ± 3.93 years, as regards to the educational level it was obvious that 53.3% of the studied women have Secondary school. The same table reveals that 66.7% of the studied women were house wife..

Table 2 demonstrates that 55.0% of the studied women were ≤ 24 weeks of gestation. As for the number of gravidity, it was found that 65.0% of the studied women were multigravida, meanwhile 43.3% of the studied women were primipara.

Figure I demonstrates a highly statistically significant ($p < 0.001$) of the total score of knowledge as stated by pregnant study participants during the various stages of the investigation. It was demonstrated that 90% of the women in the study received subpar scores regarding knowledge and its domains at pre intervention phase, and this percentage was decreased to 11.70 % at post intervention.

Table 3 presents a significant difference regarding mean score of knowledge and its domains as reported by studied pregnant women throughout the intervention phase ($p < 0.001$).

Table 4 demonstrates that the difference between the before and post-mean scores for the health beliefs model concerning heat is statistically significant ($p < 0.001$). waves and its domains as reported by studied pregnant women throughout study phases. Furthermore, the total Mean $\pm$ SD was 59.36 ± 13.78 at pre-intervention phase compared with 101.05 ± 9.00 at post-intervention phase.

Table 5 presents the mean scores of health beliefs related to air pollution before and after an intervention among pregnant women. The results show statistically significant improvements ($p < 0.01$) across all domains of the health beliefs model. The total score shows a dramatic improvement across all domains (t-test: -22.967, $p = 0.001$), indicating that the intervention had a substantial positive impact on the participants' overall understanding and perception of air pollution risks and the need for action.

Table 6 presents the total high scores for different dimensions of the health beliefs model (HBM) regarding air pollution and pregnant women, pre- and post-intervention. The intervention significantly improved the pregnant women's perceptions of vulnerability, severity, and the benefits of preventing air pollution exposure. It also reduced perceived barriers, increased cues to action, and enhanced self-efficacy. All the changes were statistically highly significant with p -values < 0.01 , demonstrating the effectiveness of the health beliefs model in raising awareness and motivating behavior change regarding air pollution and pregnancy health.

Table 7 shows a highly statistically significant ($p < 0.001$) of the of health beliefs model for pregnant women about climate change throughout study phases. There was 86.70% of the studied women have low score about health beliefs model at pre intervention, and decreased to become was 15% at post intervention phase. Furthermore, Mean $\pm$ SD was 115.16 ± 25.18 at pre intervention phase compared with 203.16 ± 13.51 at post intervention phase.

Table 8 shows that there statistically significant relation between the total satisfactory knowledge level of women and the occupation in post-intervention at ($p < 0.05$).

Table 9 reflects a positive correlation coefficient, with a statistically significant between knowledge and Preventive behavior in pre& post intervention with ($r = 0.275$), p (0.033*) and ($r = 0.549$), p (0.001**), respectively. In addition, there was a positive correlation between the knowledge and the health beliefs in post-intervention at ($r = 0.658$), $P(0.001^{**})$, moreover the table illustrates a positive correlation coefficient ($r = 0.770$) between health beliefs with the preventive behavior in post-intervention at $P(0.001^{**})$.

Table 10 illustrates the predicting factors which affect knowledge score, Heath beliefs score, and preventive behavior score. As regards predicting factors which affect knowledge score, it indicates that heath beliefs score and educational level were a significant independent positive predictor. The model explains 50% of the variation in knowledge scores. In addition, the preventive behavior score and knowledge score were considered the predicting factors that affect the health beliefs score, as the model explains 67% of the variation in the health beliefs score. As regards predicting factors that affect the preventive behavior score, it indicates that health beliefs score and age were significant independent positive predictors. The model explains 62% of the variation in preventive behavior scores.

Discussion:

Climate change represents a significant global health issue that has rapidly moved to the forefront of the worldwide health agenda, especially in the poorest countries with the least capacity to adapt to climate change It has become one of the most important issues in Egypt and worldwide *Shalaby et al., 2023*). As pregnant women are vulnerable to climate impacts, there is mounting epidemiological evidence that high ambient temperatures are associated with pregnancy complications and adverse fetal and neonatal complications and outcomes *Wright et al., 2023*).

This study was conducted in light of the hypotheses of study: knowledge, health beliefs, and protective behaviors of pregnant women towards climate change will be improved after applying narrative information. The study findings indicated improvement of the women's knowledge, health beliefs, and protective behaviors, which led to the study hypothesis's acceptability.

In terms of demographic traits, the current research displayed that two-thirds of the studied women were 25-<35 years and the mean of age was 26.74 ± 3.93 years. It is the same with *Afifi et al. (2024)* Quazi experimental study which reported that it was about two third of the pregnant women aged between 25 - < 35 with a mean age of 25.80 ± 3.43 years. This finding was inconsistent with *(Verweij et al., 2020)* who noticed that 35 % of the women's mean age was 36.8 ± 12.6 . in addition, this result was not completely comparable to the finding of *Eltelt et al. (2023)* who brought up that the studied pregnant women were < 20 years old, with a mean age (of 19.8 ± 7.3 years. The researcher explained the variation of the women's age between the studies because the sample was selected randomly and the age isn't considered inclusion criteria.

Concerning occupation and residence, the majority of studied women were housewives in the current study and half of them belonged to rural areas it may be due to the study siting provide unaffordable medical services so many rural women do their antenatal visits there. This finding is in agreement with the results reported by *Afifi et al. (2024)*. This research was conducted at obstetrics and gynecological outpatient clinic at Benha University Hospital in Qaliobya governorate, Egypt, which concluded that about half of the studied women lived in rural areas.

As regards obstetrical history, in terms of the number of gravidities, the findings of current research indicated that more than one-third was prim gravida and approximately two-thirds was multigravida, this result agrees with *Afifi et al. (2024)* which reflects that one-third of the study group were prim gravida and two third were multi para.

A main objective of the current study was to assess pregnant women's knowledge of climate change. Regarding the total satisfactory score, the current study revealed that most women had unsatisfactory scores about knowledge and its domains in the pre-intervention phase. This result might be due to the nature of the women's life as two-thirds of them were unemployed which made them unable to exchange information and knowledge about the existing global events with other knowledgeable and updated colleges like climate change, also, being unemployed helped them to be away somewhat from the heat, sunburn and other bad effects of climate changes that made them uninterested in the climate issues.

It is in line with *El-Kurdy et al. (2024)*, a study about the effect of motivational interviewing on pregnant women's health awareness and risk perception regarding climate change. Showed that post-intervention, most of the pregnant women exhibited good knowledge regarding climate change, compared to the majority exhibiting poor knowledge pre-intervention. Moreover, this agreed with the finding of a study done by *Morris et al. (2019)* a study about stories vs. facts: triggering emotion and action-taking on climate change who stated that more than half of the sample had an unsatisfactory knowledge level about climate change pre-intervention.

However, these results contradicted with *Ngwenya & Mukwada (2024)* who reported that the majority of the studied sample had a satisfactory knowledge level about climate change while the minority had an unsatisfactory knowledge level

Additionally, the current study showed statistically highly significant differences between the pre and post-intervention results of all the items of knowledge regarding climate change and its effect on pregnant women at ($p < 0.001$). From the perspective of the researcher this is due to the usage of the useage of the narrative method in teaching the women, which make the information easy in comprehension and recalling.

The same in the study of *Abd-Elhamed et al. (2023)* which about impact of narrative versus didactic information on pregnant women's knowledge, attitude and perception regarding climate change, which discovered that material with a narrative focus performed much better than material with a didactic focus which influencing pregnant women's actual information as well as increasing women's knowledge; this could be observed through the results post intervention implementation, as more than half of the women in narrative group had satisfactory knowledge level about climate changes with significant differences between both the narrative and deductive groups.

Regarding the response of research hypotheses to the health beliefs model for pregnant women about climate change, the present study found that most of the pregnant women had high health belief levels in-post-intervention phase. This showed that pregnant women were truly think that climate change is a major concern, and that quick action is needed to take, this might be explained by gaining information via a dramatic way through attractive methods that helped more to increase a woman's perception, activity and to develop a positive attitude toward such issues. As according to the theory, when someone experiences a narrative teaching, their attention, emotions, and visuals combine, causing them to mentally travel through the story.

The research result presents a statistically highly significant difference ($p < 0.001$) in the total score of the health beliefs model about heat waves and its domains including perceived vulnerability and self-efficacy, similarly, in *Adybo et al. (2020)* a study which examined the effectiveness of traditional didactic information versus narrative information on pregnant women's perceptions of climate change, reported that participants in the narrative condition had significantly higher perceived risk and had significantly higher self-efficacy.

The current study illustrated that the majority of pregnant women had positive scores for protective behaviors related to mitigating the risks of climate change. This may be due to narrative structure influencing engagement with climate change through emotional arousal, to maximize the likelihood of action-taking.

According to *Adebayo et al. (2020)* their study discovered that narratively based information significantly influenced pregnant women's subsequent real information-seeking activity and increased their intentions to adopt risk-reducing behavior more effectively than didactic information. This finding is consistent with *Morris et al. (2019)* study about stories versus facts: evoking feelings and adopting climate change action. It shown that the majority of the pro-environmental behaviors following stimuli were impacted by story form. According to the findings, individuals in the tale condition were consistently more likely than those in the knowledge condition to act in a way that was environmentally friendly.

In addition, the research result presents a statistically highly significant difference ($p < 0.001$) in the total score of the health beliefs model about heat waves and its domains including perceived vulnerability and self-efficacy, similarly, in *Adybo et al. (2020)* a study which examined the effectiveness of traditional didactic information versus narrative information on pregnant women's perceptions of climate change, reported that participants in the narrative condition had significantly higher perceived risk and had significantly higher self-efficacy.

In terms of perceived vulnerability, the result revealed a significant increase in the perception of pregnant women at (Mean $\pm$ SD 16.93 $\pm$ 1.92, $p < 0.001^{**}$) after the intervention. The same in the study conducted by *Kaya et al. (2024)* in which the findings revealed a significant increase in the perception of pregnant women (Mean $\pm$ SD 15.48 $\pm$ 4.54, $p < 0.001$) following climate change education. In addition, it is in line with *El-Kurdy et al. (2024)*, the study about effect of motivational interviewing on pregnant women's health awareness and risk perception regarding climate change, which showed that the risk perception score significantly improved post-intervention compared to pre-intervention.

In the same context, *Farg et al. (2024)* illustrated that the overall score of women's knowledge regarding climate change and how it affects their pregnancy was significantly correlated with their employment, degree of education, and place of residence.

The same in *Ahmed Abd-Elhamed et al. (2023)* study about the impact of narrative versus didactic information on pregnant women's knowledge, attitude, and perception regarding climate change, showed that there are significant statistical differences between participants' demographic and their knowledge.

This result is not as the finding of the study done by *Lopez & Malay (2019)* who indicated no significant age- or gender-related disparities regarding the respondents' knowledge or attitudes towards climate change. This contradiction may be due to the differences in the study subjects and site, as this study was conducted on university students in the Philippines.

Regarding the total high scores of the health beliefs model about air pollution and its domains, the study represents significantly improved in the pregnant women's perceptions of vulnerability, severity, and the benefits of preventing air pollution exposure. It also reduced perceived barriers, increased cues to action, and enhanced self-efficacy. All the changes were statistically highly significant with p-values < 0.01 , demonstrating the effectiveness of the health beliefs model in raising awareness and motivating behavior change regarding air pollution and pregnancy health.

This is in the same vein with (*Pormosayebi, et al.(2018)*), the study which investigate the effect of educational program based on the health belief model on preventing behaviors exposure to polluted air among pregnant women. The results of this study showed that the mean awareness score of mothers in the intervention group increased significantly from 43.18 ± 15.50 before the intervention to 71.39 ± 16.68 after the intervention, in addition, the implementation of training program based on Health Belief Model with emphasis on predictive behaviors can be effective in reducing exposure to air pollution in pregnant women.

Considering the Correlation between study variables, the current study illustrated that there is a positive correlation coefficient ($r = 0.549$), with a statistically significant p (0.001^{**}) between knowledge and Preventive behavior.

A similar finding was reported in *Afifi et al. (2024)* the research results clarified that there was a highly positive statistical correlation between total knowledge and total health-related behaviors scores of studied women in both groups before and after intervention ($p \leq 0.001$). This means that; with an increase in knowledge, there is a concurrent increase in health-related behaviors, and vice versa.

This finding demonstrated consistency with the findings of (*Mahmoud et al. (2023)*), who revealed that knowledge and practices were positively correlated. A statistically significant difference was found between the overall knowledge score and overall practices score ($r = 0.220$, $P = < 0.001$ between the post-program total knowledge score level and total daily life practices & attitudes.

As regards predicting factors that affect knowledge score, it indicates that health beliefs score and educational level were significant independent positive predictors. The model explains 50% of the variation in knowledge scores. The same in *Adybo et al. (2020)* which reflects that self-efficacy and risk perception were predicting factors that affected knowledge scores.

As regarding to stepwise multiple linear regression for preventive behavior, the current study revealed that the most predicting factors which affect the preventive behavior score, are the health beliefs score and age. The model explains 62% of the variation in preventive behavior scores. It is explained as the health belief model (HBM) and the knowledge, attitude, and practice (KAP) model are the most often applied theories. KAP makes the assumption that knowledge may result in a shift in perspective, which in turn can lead to changes in behavior connected to health. HBM predicts health-related behavior using a number of factors, including perceived suspicion, severity, benefit, and obstacles. A combination of KAP and HBM may fully show the behavioral circuits since attitude and risk perception differ and coexist *La Torre et al. (2023)*.

This is in the same vein as *Mirzaei-Alavijeh et al. (2020)*, a study about a psychometric assessment of self-care practices in relation to the air pollution prevention questionnaire have revealed that the explanation of health-related activities can be significantly influenced by perceived severity. showed that the strongest indicator of discomfort caused by the environment was perceived health risk.

Additionally *Ullah et al. (2024)* a review that use the health belief model in the context of heatwave research: further supported the value of the HBM in heat wave behavior modification programs by revealing that perceived benefit and "cues to action" were important predictors of adaptive actions.

Conclusion:

In the light of the results of the current study and verified research hypothesis, it was concluded that There was a highly statistically significant improvement regarding the studied pregnant women's total knowledge, health beliefs, and protective behaviors towards climate change at pre and post-intervention of narrative information. Moreover, there was a positive correlation between knowledge and health beliefs with preventive behavior in post-intervention at ($r = 0.658$), $P(0.001^{**})$ and ($r = 0.770$), $P(0.001^{**})$, respectively. As regards predicting factors which affect knowledge score, it indicates that health beliefs score and educational level were a significant independent positive predictor.

❖ **Recommendation:**

1. Educational training and communication activities about climate change and its effect on pregnancy should be conducted for pregnant women using narrative messages. To increase their level of information which will be reflected in their level of knowledge, perception, and healthy attitude to lessen the detrimental health effects induced by climate change on pregnancy.
2. Nurses should provide counseling for pregnant women about climate change and its effect on pregnancy outcomes.
3. Apply antenatal motivational interviewing sessions to enlighten pregnant women on how to mitigate the harmful effects of climate change.

❖ **Further research**

1. Further research is needed to increase expectant mothers' understanding of how climate change and its environmental consequences affect the health of pregnancy and fetus.
2. Future studies should be done to evaluate the effect of the application of this narrative information on the pregnancy outcome.
3. Future studies should be done to explore the long-term health effects of climate change on pregnant women and their fetuses.

Limitation of the study

1. The participants were experiencing time constraints and anxiety that may have limited their attention span.
2. Deficient in the resources about this research.

Table (1): Demographic Characteristics of the studied pregnant women (n=60).

Characteristics	No.	%
Age		
20-<25	23	38.3
25-<30	27	45.0
30-35	10	16.7
Mean± SD	26.74±3.93	
Educational level		
Primary school	1	1.7
Preparatory school	3	5.0
Secondary school	32	53.3
University	24	40.0
Occupation		
Worker	20	33.3
Housewife	40	66.7
Residence		
Rural	30	50.0
Urban	30	50.0

Table (2): Present and past obstetric history of the studied pregnant women (n=60).

History	No.	%
Gestational age		
≤24	33	55.0
>24	27	45.0
Mean± SD	23.38±5.44	

No. of Gravidity		
Primigravida	21	35.0
Multigravida	39	65.0
No. of parity		
Nullipara	21	35.0
Primipara	26	43.3
Multipara	13	21.7
Mode of last delivery		
None	21	35.0
NVD	17	28.3
C.S	22	36.7

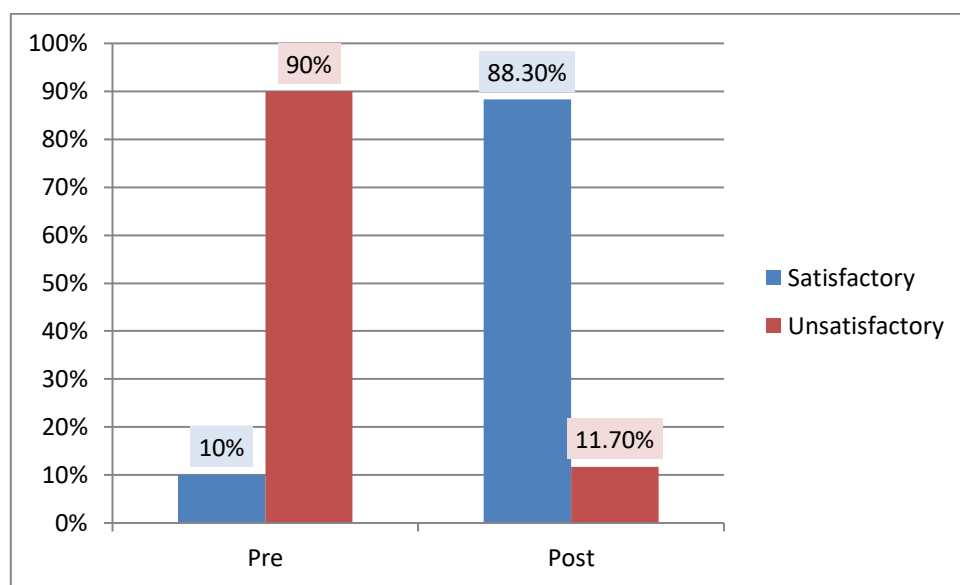


Figure (I): Total score of knowledge as reported by studied pregnant women throughout study phases.

Table (3): Total mean scores of knowledge and its domains as reported by studied pregnant women throughout study phases (n=60).

Scores	Pre	Post	W	p-value
	Mean± SD			
Heat waves	0.48±.72	2.51±.77	-6.536	0.001**
Air pollution	0.38±.66	2.51±.62	-6.693	0.001**
Climate change	2.86±1.56	5.36±1.17	-6.072	0.001**
Total	3.73±2.39	10.40±2.01	-6.665	0.001**

W: Wilcoxon Signed Ranks Test, **: statistically highly significant (p<0.01).

Table (4): Total mean scores of health beliefs model about heat waves and its domains as reported by studied pregnant women throughout study phases (n=60).

Health Beliefs Model about Heat waves	Pre	Post	Paired t-test	p-value
	Mean± SD			
Perceived vulnerability	9.75±3.06	16.93±1.92	-14.634	0.001**
Perceived severity	15.03±4.20	26.43±1.94	-18.809	0.001**
Perceived benefit	9.70±3.45	18.11±6.69	-8.452	0.001**
Perceived barriers	8.48±3.00	17.53±3.99	-9.554	0.001**
Cues to action	7.75±3.07	16.46±2.31	-18.176	0.001**
Self-Efficacy	8.65±2.20	13.56±1.29	-15.035	0.001**
Total	59.36±13.78	101.05±9.00	-20.388	0.001**

Non significant (p>0.05), **: statistically highly significant (p<0.01).

Table (5): Total mean scores of health beliefs model about air pollution and its domains as reported by studied pregnant women throughout study phases (n=60).

Air pollution	Pre	Post	Paired t-test	p-value
	Mean± SD			
Perceived vulnerability	7.13±2.44	13.06±1.02	-16.951	0.001**
Perceived severity	9.48±2.89	17.65±2.08	-18.656	0.001**
Perceived benefit	8.98±2.75	13.33±1.41	-11.267	0.001**
Perceived barriers	10.08±3.59	19.16±4.65	-11.312	0.001**
Cues to action	7.91±3.37	16.65±2.58	-17.304	0.001**
Self-Efficacy	12.20±3.89	22.25±2.07	-17.734	0.001**
Total	55.80±13.23	102.11±8.33	-22.967	0.001**

**: statistically highly significant (p<0.01).

Table (6): Total high scores of health beliefs model about air pollution and its domains as reported by studied pregnant women throughout study phases (n=60).

Air pollution	Pre		Post		MCp-value
	No.	%	No.	%	
Perceived vulnerability	12	20.0	52	86.7	0.001**
Perceived severity	14	23.3	59	98.3	0.001**
Perceived benefit	25	41.7	54	90.0	0.001**
Perceived barriers	5	8.3	49	81.7	0.001**
Cues to action	7	11.7	55	91.7	0.001**
Self-Efficacy	13	21.7	53	88.3	0.001**
Total	8	13.3	51	85.0	0.001**

MC: McNemar test, **: statistically highly significant (p<0.01).

Table (7): Total score of health beliefs model for pregnant women about climate change throughout study phases (n=60).

Health beliefs score	Pre		Post		MCp-value
	No.	%	No.	%	
High	8	13.3	51	85.0	0.001**
Low	52	86.7	9	15.0	

Mean± SD	115.16±25.18	203.16±13.51	
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MC: McNemar test, **: statistically highly significant ($p < 0.01$).

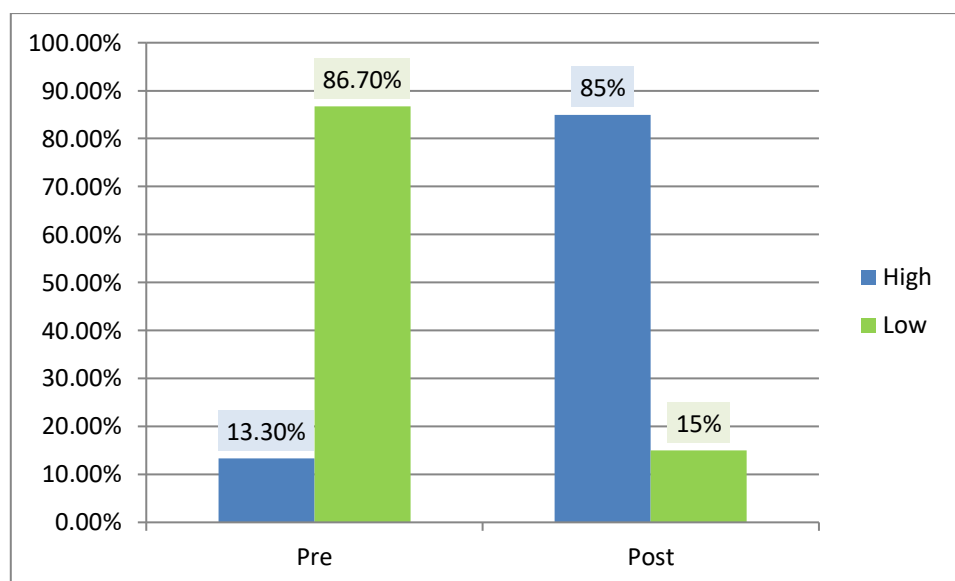


Figure (II) : Total score of health beliefs model for pregnant women about climate change throughout study phases

Table (8): Relation between demographic characteristics of the studied pregnant women and their knowledge score throughout study phases.

Characteristics	Total satisfactory knowledge score (>60%)				χ^2 (¹ p-value)	χ^2 (2p-value)
	Pre=6		Post=53			
	No.	%	No.	%		
Age						
20-<25	1	16.7	21	39.6	1.512 (0.470)	3.934 (0.140)
25-<30	4	66.7	25	47.2		
30-35	1	16.7	7	13.2		
Educational level						
Primary school	0	0.0	1	1.9	0.566 (0.904)	10.000 (0.019*)
Preparatory school	0	0.0	3	5.7		
Secondary school	0	0.0	28	52.8		
University	6	100.0	21	39.6		
Occupation						
Worker	5	83.3	16	30.2	FET (0.208)	FET (0.013*)
Housewife	1	16.7	37	69.8		
Residence						
Rural	3	50.0	27	50.9	FET (0.99)	FET (0.99)
Urban	3	50.0	26	49.1		

χ^2 : Chi square test FET: Fisher exact test non-significant ($p > 0.05$), *: statistically significant ($p < 0.05$), p^1 : for pre-intervention, p^2 : for post-intervention

Table (9): Correlation matrix between study variables throughout study phases.

Pre	Knowledge		Heath beliefs		post	Knowledge		Heath beliefs	
	R	P	r	p		r	P	r	P
Knowledge									
Heath beliefs	0.181	0.167				0.658	0.001**		
Preventive behavior	0.275	0.033*	0.052	0.694		0.549	0.001**	0.770	0.001**

r: correlation coefficient, non significant($p>0.05$), *: statistically significant ($p<0.05$), **: statistically highly significant ($p<0.01$).

Table (10): Stepwise multiple linear regression for predicting factors that affect total scores of knowledge, health beliefs, and preventive behavior.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
knowledge score ^a							
(Constant)	-5.418	1.283		-4.223	.000	-7.986	-2.849
Heath beliefs score	.049	.010	.514	4.736	.000	.028	.069
Educational level	1.065	.399	.290	2.672	.010	.267	1.863
Heath beliefs score ^b							
(Constant)	-13.866	16.386		-.846	.401	-46.679	18.947
preventive behavior score	2.364	.367	.585	6.449	.000	1.630	3.098
knowledge score	3.542	.955	.337	3.708	.000	1.630	5.455
preventive behavior score ^c							
(Constant)	33.740	4.065		8.301	.000	25.600	41.879
Heath beliefs score	.195	.020	.787	9.592	.000	.154	.236
Age	-.270	.133	-.167	-2.035	.047	-.536	-.004

^aR-square=0.496, ANOVA: $F= 27.998$, $P<0.001$, variables entered and excluded: age, occupation, residence, gestational age, no. of gravidity, no. of parity, mode of last delivery and preventive behavior score. ^bR-square=0.672, ANOVA: $F= 58.349$, $P<0.001$, variables entered and excluded: age, educational level, occupation, residence, gestational age, no. of gravidity, no. of parity, and mode of last delivery. ^cR-square=0.620, ANOVA: $F= 46.550$, $P<0.001$, variables entered and excluded: educational level, occupation, residence, gestational age, no. of gravidity, no. of parity, mode of last delivery and knowledge score.

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