

Adverse Health Effects of Climate Change on Pregnant Women Working Outdoors

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Abstract

Climate change is the biggest public health threat that imposes increased adverse health effect on pregnant women such as pregnancy loss, restricted fetal growth, low birth weight, preterm, eclampsia and placenta previa. **The Aim** of this study was to assess the Adverse Health Effects of climate change on Pregnant women working outdoors. **Design:** A descriptive research design was utilized in this study. **Setting:** The study was conducted at out-patient and inpatient departments in a university hospital in Fayoum governorate, Egypt. **Sample:** A purposive sample of all pregnant women working outdoors during the period of study. **Tools:** Two tools for data collection were used, 1) A structured interviewing questionnaire for assessing demographic characteristics of pregnant women, obstetric history, assessing pregnant women's knowledge regarding climate change, pregnant women's reported practice regarding heat stress. Adverse health effects of climate change (as heat stress) on pregnant women. 2). Observation checklist for heat stress risk assessment. **Results:** The current study revealed that 80% of pregnant women were exposed to sun burn and 90% of them were exposed to sun stroke in the last twelve months. Also, 60% of studied sample had poor knowledge regarding climate changes as heat stress and effect of heat stress, 60% of pregnant women had unsatisfactory reported practice regarding climate change as heat stress, On the other hand, 60% of pregnant women were exposed to personal parameters that cause heat stress and 40% of them were exposed to environmental parameters that lead to adverse health effects on pregnant women, 80.0% of pregnant women in the study sample complained from severe lower abdominal pain, 25.0% of them complained from post-traumatic stress disorders, 22.0% of them complained from anemia and 20.0% of them complained from vaginal bleeding. **Conclusion:** there was a correlation between pregnant women's knowledge, total reported practices and total score of observational checklist for heat stress risk exposure with highly statistical significance difference ($p < 0.001$). **Recommendations:** Implementation of health education programs about hazards of climate change and impact on pregnant women's health and pregnancy outcomes.

Key words: Pregnant women, adverse health effects, & climate change.

1. Introduction

Climate change is one of defining issues of our time and the major global health threats to the world's population. It is brought on by global warming due in large part to increasing levels of greenhouse gases resulting from human activity, including burning fossil fuels (carbon dioxide), animal husbandry (methane from manure) industry emissions (ozone, nitrogen oxides, sulfur dioxide), vehicle/factory exhaust, and chlorofluorocarbon aerosols that trap extra heat in the earth's atmosphere. Resulting extremes of weather give rise to wildfires, air pollution, and changes in ecology, and floods. Asghari, et al. (2017).

Climate change is considered one of the biggest threats to achieving the millennium development goals (MDG) to maternal health caused by Generating electricity and heat by burning fossil fuels causes a large chunk of global emissions. Most

electricity is still generated by burning coal, oil, or gas, which produces carbon dioxide and nitrous oxide – powerful greenhouse gases that blanket the Earth and trap the sun's heat. Globally, a bit more than a quarter of electricity comes from wind, solar and other renewable sources which, as opposed to fossil fuels, emit little to no greenhouse gases or pollutants into the air. Bonafede, et al. (2022).

Climate change is caused by multiple causes including, manufacturing and industry produce emissions, mostly from burning fossil fuels to produce energy for making things like cement, iron, steel, electronics, plastics, clothes, and other goods. Mining and other industrial processes also release gases, as does the construction industry. Cutting down forests to create farms or pastures, or for other reasons, causes emissions, since trees, when they are cut, release the carbon they have been storing. Each year approximately 12 million hectares of forest are destroyed. Since forests absorb carbon dioxide,

destroying them also limits nature's ability to keep emissions out of the atmosphere. Deforestation, together with agriculture and other land use changes, is responsible for roughly a quarter of global greenhouse gas emissions. Buzan, (2018).

Using transportation, most cars, trucks, ships, and planes run on fossil fuels. That makes transportation a major contributor of greenhouse gases, especially carbon-dioxide emissions. Producing food causes emissions of carbon dioxide, methane, and other greenhouse gases in various ways, including deforestation and clearing of land for agriculture and grazing, digestion by cows and sheep, the production and use of fertilizers and manure for growing crops, and the use of energy to run farm equipment or fishing boats, usually with fossil fuels. All this makes food production a major contributor to climate change and greenhouse gas emissions also come from packaging and distributing food. Adams, et al. (2021).

Powering residential and commercial buildings consume over half of all electricity. As they continue to draw on coal, oil, and natural gas for heating and cooling, they emit significant quantities of greenhouse gas emissions. Growing energy demand for heating and cooling, with rising air-conditioner ownership, as well as increased electricity consumption for lighting, appliances, and connected devices, has contributed to a rise in energy-related carbon-dioxide emissions from buildings in recent years. Borg, et al. (2021).

Climate change impacts on pregnancy health can be conceptualized to involve (a) direct impacts via discrete environmental disasters, (b) indirect impacts through changes in the natural environment, and (c) indirect impacts through changes in the social environment. It is important to note that although direct and indirect impacts are commonly evaluated separately, they often occur simultaneously and have a synergistic and cascading impact on pregnancy. Dumas, et al. (2019).

Climate change is expected to cause more frequent and intense climate-related environmental disasters such as heat waves; wildfires; and extreme weather events such as drought, hurricane, and flood. Accumulating evidence suggests positive associations between prenatal exposures to these events and adverse pregnancy outcomes. More importantly, populations who have the least access to the world's resources and contribute least to climate change bear a disproportionately higher burden. Glaser, et al. (2022).

The average annual number of heat waves, defined as a series of unusually hot days, in the USA increased from two in the 1960s to six in the 2010s. The length and average temperature of individual heat waves have also increased significantly in recent decades. Pregnant women are more prone to heat stress than non-pregnant women due to their compromised thermoregulation and homeostasis ability. Climate change also has direct impacts on human health and well-being. Particularly vulnerable

populations are affected, including women, pregnant women, children, the disabled, and the elderly. Haynes, et al. (2022).

Recent meta-analysis of 70 studies across 27 countries examines the impact of high temperature on preterm birth, low birth weight, and stillbirth. Summary estimates suggest a 16% higher risk of preterm birth during heat wave days compared to non-heat wave days. Furthermore, each additional degree Fahrenheit (0.56 °C) was associated with a 5% increased risk. Potential susceptible exposure windows for preterm birth include 1 month preconception, the month of conception, first trimester, second trimester, and last week of pregnancy, suggesting both acute and chronic exposures are relevant. The meta-analysis also showed that the low-birth-weight rate was 9% higher during periods with hotter than usual temperature, with babies on average 26 g lighter. Additionally, stillbirth risk was 46% higher during heat wave compared to non-heat wave days, with risk increment of 5% for each additional degree Fahrenheit. Early pregnancy appears to be the most susceptible window of exposure for stillbirth. Meanwhile, high temperatures have also been linked to other serious pregnancy outcomes such as premature rupture of membranes, gestational cardiovascular events, gestational hypertension and preeclampsia, birth defects, and neonatal mortality. Krishnamurthy, et al. (2017).

Pregnant women and their fetuses are more vulnerable than the general population to the health impacts of climate change because climate related hazards, including extreme heat, flooding and wildfires have been linked to certain health problems, such as anemia, eclampsia, low birth weight, preterm birth, and even miscarriage. There are many biological and behavioral changes that occur during pregnancy and the postpartum period that can make women more prone to insect-, food-, and water-related illnesses. Some of these illnesses, which may increase due to climate change, can also threaten maternal and fetal health. Pregnant and postpartum women can be at increased risk of experiencing post-traumatic stress disorder (PTSD) and depression after natural disasters and extreme weather event. Cheng & MacDonald, (2019).

Nurses are trusted health professionals to inform the society about dangerous impact of climate changes on pregnant women's health. Nurses must raise awareness of the impact of climate changes on the pregnant women's as well as empower pregnant women to make healthy lifestyle choices such as active transportation, use green energy and dietary changes. Nurses must be involved in supporting the development of heat action plans play vital role in helping communities adapt to climate changes and prevent adverse health effects on pregnant women. As such, nurses must assess the way in which climate changes may affect the health of pregnant women within their environment and inform the community on how best to prepare for climate induced events.

Foster, et al. (2021).

Community health nurses increasingly face the adverse health effects of climate change as heat stress, thus they have an exclusive capability to help for prevention and decrease of related health problems for high risk groups. As such, this review underscores the effects of these environmental factors on maternal and children's health, as the most vulnerable groups to climate change and heat stress. Irani, et al. (2021).

Community health nurses should instruct pregnant women about the importance of reducing exposure to air pollution, advocate for a healthy environmental. instruct pregnant women about the importance of respecting and protecting green spaces because it absorbs carbon dioxide and is associated with lowering levels of air pollutions. Han, et al. (2021).

Significance of the study:

The incidence of climate change and heat-related deaths is increasing with climate change, particularly for those who perform vigorous work pregnant women outdoors during summer. During 2014–2020 in the United States, an average of 702 pregnant heat-related deaths occurred annually. High heat exposure was a contributing cause of death in addition to chronic medical conditions, Between July 2020 and July 2021, the maximal and minimal temperatures throughout Japan reached unusual highs accompanied by extreme humidity, leading to a notable surge in pregnant women of heat-related death that reach 401 deaths. From 1998–2021, more than 166,000 pregnant women died due to heat-related illness, including more than 70,000 who died during the 2003 heat wave in Europe. Vaidyanathan et al., (2020), & Toosty et., (2021).

"Climate change" were associated with various adverse health effects pregnancy outcomes, all studies that fit the study criteria reported a significant relationship between climate change-related exposures and several adverse pregnancy outcomes: eclampsia, preeclampsia, low birth weight, preterm birth, hypertension, sex ratio, and length. The estimation is that 25,000 infants per year between 1969 and 1988 were born earlier than normal (39–40 weeks' gestation) as a result of heat exposure, with a total loss of 150,000 gestational days per year¹⁰. Without intervention, the estimate is that by the end of the century there will be an additional loss of 250,000 days of gestation per year¹⁰ In 2010. Pouliot et al. (2019)

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

Community health nurses play important role on

training pregnant women's for identifying the climate change such as signs and symptoms of heat stress, the importance of hydration before, during and after the working shift, importance of intake of balanced healthy diet and fluids, time of breaks, observed the sign of hydration levels, wearing of PPEs in addition to wearing protective cloths, cotton clothes, and important to ask medical advice. Abo khashabah et al., (2020).

Aim of the study

This study aims to assess the adverse health effects of climate change on pregnant women working outdoors through:

- 1- Assessing the pregnant women's knowledge about climate change
- 2- Assessing the pregnant women's reported practices regarding climate change as heat stress .
- 3- Assessing the adverse health effects regarding climate change as heat stress on pregnant women's health.

Research Questions

Q1-Do pregnant women have adequate knowledge about climate change?

Q2- What are pregnant women's reported practices regarding prevention of heat stress?

Q3- What are the adverse health effects of climate change, as heat stress, on pregnant women?

Q 4- Is there a relationship between pregnant women's knowledge, reported practices and the adverse health effects they are exposed to as a result of climate change?

Subjects and Method

Methodology

Study design: A descriptive research design was used to achieve the aim of the present study.

The study setting.

The study was conducted in maternity out patient and inpatient departments in the university hospital in Fayoum Governorate. Egypt.

A purposive sample of all pregnant women who were admitted to previously mentioned setting through a 6 months period, only pregnant women working outdoors were included in the study.

Sample size: The subjects of the current study included 100 pregnant women working as street sales representatives and street sales representative and street venders.

Tools for data collection: Data was collected throughout using two tools:

Tool I: A structural interviewing questionnaire: this tool is divided into 4 parts:

Part I: Demographic characteristics of pregnant women. It includes: age, level of educational, residence, monthly income, time of heat exposure, history of sun burn (last 12 months), and history of heat stroke (last 12 months).

Part II: Pregnant women obstetric history such as : duration of marriage, number of pregnancies, age at pregnancy, previous birth type, problems during last

labor, and recent pregnancy outcome.

Part III: Pregnant women's knowledge about climate change such as: meaning of climate change, types of climate change, hazards of climate change, knowledge about effect of sun waves and how to protect from sun light

Scoring system: The answers to these questions were scored as "2" for the correct answers, "1" for the incomplete answer, and "0" for wrong or I don't know answer. The score of each item stumped up and then converted into percent score.

Poor knowledge ≥ 50%

Average 50-70%

Good knowledge <70%

Part VI: Pregnant women's reported practice about climate change as heat stress work and breaks, shade, hydration, clothes, hat, gloves, sun glasses and sun screen.

Scoring system: for assessment of pregnant women's reported practice about climate change as heat stress designed to be answered by done, not done, and not applicable. Scores of each item ranged from three to one (done 2, not done 1, not applicable 0).

The total score of each item was summed up and then converted into percentage score. Unsatisfactory practice > 60%

Satisfactory practice < 60%

Tool II: - Observation checklist for heat stress risk assessment. It was developed by Bethea & Parsons, (2002), which includes: air temperature, thermal radiation, air velocity, and humidity, the black squares indicate that the score is not available for a particular category.

Scoring system: A score higher than 1 indicate greater heat stress risk. As the scores increase (also shown by color shading from light red to dark red) so the risk of that parameter contributing to heat stress increases. If three or more of scores are greater than 1, there may be a risk of heat stress. Bethea & Parsons, (2002). Cronbach Alpha reliability of this tool is 0,89.

Ethical considerations: An official permission to conduct the proposed study was obtained from the Scientific Research Ethics Committee, in the Faculty

of Nursing, Fayoum University. Subjects were given complete full information about the study and their role before signing the informed consent. They were assured that participation is voluntary and they can withdraw any time. They were also assured about confidentiality of the information where it was not be accessed by any other party without taking permission of the participants. Ethics, values, culture and beliefs was respected.

Pilot study: Pilot study has been conducted to test the clarity, applicability and understandability of the tool. It has been conducted on a sample of 10% (10) pregnant women. The participants of the pilot were included in the main study sample since no major changes were required.

Field work: A written approval letter was obtained from Dean of Faculty of Nursing, Fayoum University. to all pregnant women participate in conducting the study. The aim of the study and its procedure was explained to them to get their consent and cooperation. Interviewing questionnaire sheet was completed by the investigator from each pregnant women. Data was collected 3 days/week during the three months of the academic year 2021-2022 till the needed sample was completed.

III- Administrative Item: Approval to carry out this study was obtained from the dean of the faculty of nursing and to all pregnant women participate in conducting the study was explained to them to get their consent and cooperation.

IV-Statistical Item: Upon completion of data collection, data was computed and analyzed using Statistical Package for the Social Science (SPSS), version 24 for analysis. The P value was less than 0.05. Descriptive statistics tests as numbers, percentage, mean standard deviation (SD), was used to describe the results. Appropriate inferential statistics such as t test was used. Results, the collected data was organized, analyzed, tabulated.

2. Results

Table (1): Frequency distribution of pregnant women regarding to demographic characteristics (n=100).

Characteristics	No.	%
Age		
- <20 – years	40	40.0
- 20 < 40 years	35	35.0
- >40 years	25	25.0
Mean ± SD 19,83± 7. 34 Rang (20-40)		
Level of education		
Don't read &write.	30	30.0
- Read and write	40	40.0
- Basic education	20	20.0
-Diploma / Secondary education	10	10.0
Residence		
-Urban	75	75.0
-Rural	25	25.0
Monthly income		
-Enough	2	2.0
-Not enough	98	98.0
-Enough and saved	0	0.0
Type of clothes worn during work:		
-Cotton	20	20.0
-Polyvester	35	35.0
-Cotton and polyester	45	45.0
Time of heat exposure		
Not exposed-	0	0.0
-<10 am	30	30.0
-Between 10am-3pm	45	45.0
-After 3pm	25	25.0
History of sun burn (last 12 months):	80	80.0
History of heat stroke (last 12 months):	90	90.0

Table (1): Showed that the mean age of studied

sample was 19.83± 7.34. Regarding their level of educational 40.0% of them could read& write.

Regarding residence, 75.0% them resided in urban area. Regarding exposure to heat, 45% of them were exposed to heat between 10 am – 3 pm. This table revealed that all the pregnant women didn't take

training program about hazards of climate change. Regarding sun burn, 80% of them had history of sun burn (last 12 months) and, 90% of them had history of heat stroke (last 12 months) .

Table (2): Frequency distribution of pregnant women regarding obstetric history (n=100).

Obstetric history	No.	%
Duration of marriage:		
<5 years	65	65.0
6-10 years	30	30.0
>10 years	5	5.0
Number of pregnancies:		
One	15	15.0
Two	60	60.0
Three and more	25	25.0
Age at pregnancy:		
< 20 years	30	30.0
20< 30 years	60	60.0
>30 years	10	10.0
Previous birth type		
Normal	20	20.0
Cesarean section	80	80.0
Problems during last labor:		
Yes	80	80.0
No	20	20.0
Recent pregnancy outcomes:		
Early loss only (no births)	10	10.0
Only one live birth	40	40.0
More than one live birth	50	50.0

Table (2) : Shows that, 65.0% of pregnant women in the study sample had duration of marriage <5 years, 60.0% of them the two pregnancies, 60.0% of them had age at pregnancy 20< 30 years,60.0% of them complained of problems before & during pregnancy,80.0% of them previous birth .by cesarean section Also, 80.0% of them suffered from problems during last labor,and 50.0% of them had more than one live births.

Figure (1): Frequency distribution of total score of pregnant women's knowledge about climate change

as heat stress (n=100).

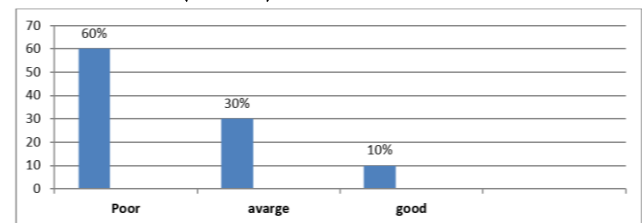


Figure (1): illustrates that 60% of studied sample had poor knowledge, 30.0% had average knowledge, while 10% of had good knowledge regarding climate change as heat stress

Table (3): Frequency distribution of the pregnant women's reported practice about climate change as heat stress (n=100).

Pregnant working women's reported Practice about heat stress						Items
Not applicable		Not done		Done		
%	No	%	No	%	No	
Work and breaks						
0.0	0	45.0	45	55.0	55	1) I schedule outdoor work tasks to occur when levels of solar UV radiation are less intense as early in the morning or later in the afternoon
0.0	0	50.0	50	50.0	50	2) I rotate between indoor, shaded and outdoor tasks to avoid exposure to solar UV radiation for long periods of time.
0.0	0	40.0	40	60.0	60	3) I take rest breaks periodically to allow my body to cool down.
Shade						
0.0	0	30.0	30	70.0	70	4) I seek shade where possible.
0.0	0	55.0	55	45.0	45	5) I seek indoor areas or shaded outdoor areas for rest and meal breaks.
Hydration						
0.0	0	65.0	65	35.0	35	6) During the work, I drink 1 cup of water every 15-20 min. and drink before I feel thirsty.
0.0	0	50.0	50	50.0	50	7) I frequently drink tea, coffee, and soft drinks
0.0	0	45.0	45	55.0	55	8) I drink cool water as a preventive measure to adapt in the workplace during hot weather.
Hat						
60.0	60	40.0	40	0.0	0	12) I wear a hat with a broad brim (10-12 cm) or a flap at the back to shade both the face and back of the neck and a close weave.
Gloves						
25.0	25	30.0	30	45.0	45	13) I wear gloves
Sun glasses						
100.0	100	0.0	0	0.0	0	14) I wear a sunglasses
Sun screen						
100.0	100	0.0	0	0.0	0	15) I use broad-spectrum, sun protection factor (SPF) of 30+ water resistant sunscreen. I apply liberally to clean, dry skin at least 20 minutes before going outside.
100.0	100	0.0	0	0.0	0	16) I reapply sunscreen at least every two hours.

Table (3):. showed that, 60% of studied sample took rest breaks periodically to allow body to cool down, and 70% of them sought shade where possible. Only 35% of them drank 1 cup of water every 15-20 min., and drink before feeling thirsty. However, none of the women in the study sample wore sunglasses that comply with standards, or use broad-spectrum, sun protection factor (SPF) of 30+ water resistant sunscreen or reapply sunscreen at least every two hours. They thought that all these were not applicable.

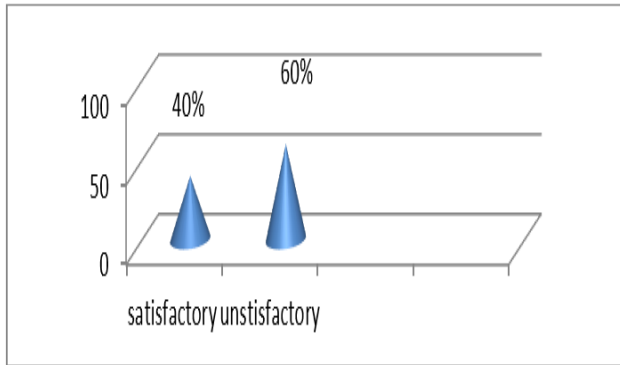


Figure (2): Frequency distribution of total score of pregnant women's reported practice about climate change as heat stress, (n=100).

Figure (2): Illustrated that 60% of pregnant women reported unsatisfactory practice, while 40% of them reported satisfactory practice regarding climate change as heat stress.

Observational checklist to assess pregnant women heat stress risk exposure

Figure (3): shows that, 60.0% of pregnant women were exposed to the risk of heat stress (air temperature), 30.0% of them were exposed to the risk of heat stress (air temperature and 10.0% of them were exposed to neutral heat stress.

Pregnant Women Heat Stress Risk Exposure (Air Temperature

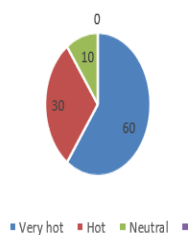


Figure (3): Observational checklist to assess pregnant women heat stress risk exposure (Air Temperature), (n=100)

Assess of pregnant women Heat Stress Risk Exposure (Work Rate or Metabolic Rate

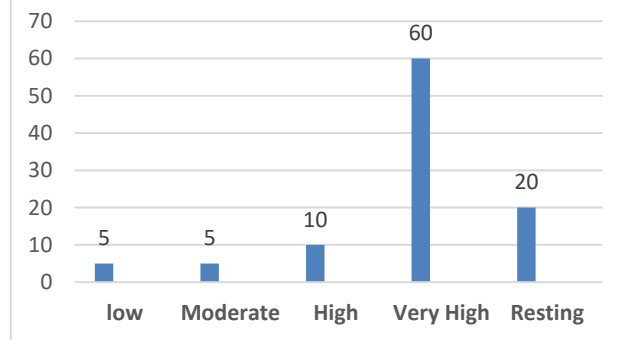


Figure (4): Observational checklist to assess pregnant women's heat stress risk exposure (Work Rate or Metabolic Rate), (n= 100).

Figure (4): shows that 60% of pregnant women were exposed to very high metabolic rate, while 20% of them were resting as part of a work/rest schedule or is awaiting instructions.

Table (4): Observational checklist to assess of pregnant women's heat stress risk exposure (Thermal Radiation), (n= 100).

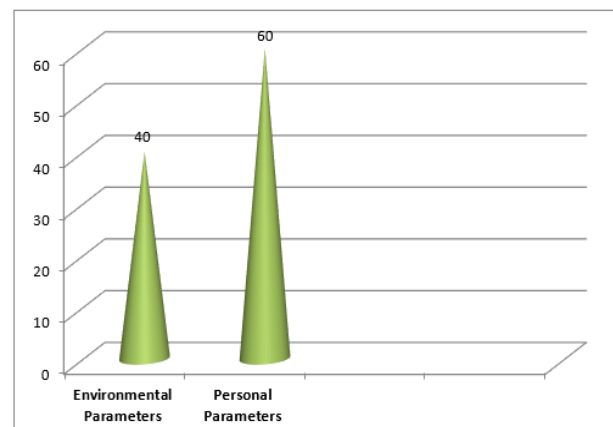


Figure (5): : Frequency distribution of total pregnant women's risk exposure about climate change as heat stress, (n=100)

Figure(5): Illustrated that 60% of pregnant women were exposed to personal parameters that cause heat stress and 40% of them were exposed to environmental parameters that lead to adverse health effects of pregnant women.

2) Thermal Radiation

It's the heat that is given off from a warmer to a colder object.

Radiant heat may be present if there are heat sources in an environment as the sun, hot surfaces...etc.

%	No	Description and things to look out for
0.0	0	* Objects colder than the surrounding air are near to worker
0.0	0	* There are no heat sources in the environment
0.0	0	* Heat source is present in the environment but the workers aren't working in close to it.
30.0	30	* Worker is working in close proximity to the heat source
35.0	35	* Workers cannot work in close proximity to the heat source for more than 10 minute
35.0	35	* Workers cannot work in close proximity to the heat source for more than 5 minutes.
0.0	0	* Workers are not permitted to work in the environment without PPE to protect them from the radiant heat in that environment.

Table (4): shows that, 35.0% of pregnant women cannot work in close proximity to the heat source for more than 5-10 minutes.

Table (5): Observational checklist to assess pregnant women’s heat stress risk exposure (**Air velocity**) (n= 100).

Air velocity		
It's the speed at which air moves across the pregnant women		
%	No	Description and things to look out for
40.0	40	* Cold air at a high air speed
2.0	2	* Cold air at a moderate or a high speed
3.0	3	* Cold air & low movement
5.0	5	* Still air movement in a neutral environment.
5.0	5	* Warm air & low movement
5.0	5	* Still air movement in a warm environment.
3.0	3	* Still air movement in a hot environment.
2.0	2	* Warm air at a moderate speed, still air movement in a very hot environment Hot air and moderate air movement
35.0	35	* Very hot air at a high speed.

Table (5): shows that, regarding air velocity, 40.0% of studied sample indicated that the air movement that they were exposed to was cold air at a high

speed, while, 35.0% of them were exposed to very hot air at a high speed.

Table (6): Observational checklist to assess pregnant women’s heat stress risk exposure (**Humidity**), (n= 100).

Humidity		
If water is heated and it evaporates to the surrounding environment, the resultant amount of water in the air of that environment will provide humidity. If workers are wearing high protection PPE that is vapor impermeable the humidity within the microclimate of the garment may be high.		
%	No	Description and things to look out for
0.02	20	* No humidity. Air is dry, with no drying processes or other mechanisms for increasing the humidity in the workplace
10.0	10	* Humidity seems to be somewhere between very humid and very dry.
.070	70	* Air is very humid. Examples may be near drying machines, laundry machines, chemical processes where steam is given off.
0.0	0	* Vapor impermeable PPE is worn

Table (6): shows that, 70.0% of studied samples were working in a very humid air, while 20% of them

worked in dry air areas.

Table (7): Observational checklist to assess pregnant women’s heat stress risk exposure (**Clothing**), (n= 100).

Clothing		
Clothing interferes with our ability to lose heat to the environment. Heat stress is a risk in situations where workers may be wearing PPE, even if the environment is not warm or hot.		
%	No	Description of clothing
0.0	0	* Shorts and a T-shirt. No protective or work clothing worn.
20.0	20	* Light work clothing.
80.0	80	* Cotton coverall, jacket.
0.0	0	* Winter work clothing, double cloth coveralls, water barrier materials.
0.0	0	* Light weight vapor barrier suits.
0.0	0	* Fully enclosed suit with hood and gloves

Table (7): shows that 80% of the pregnant women reported wearing cotton coverall, jacket, and 20.0%

of them reported wearing light work clothing.

Table (8): Adverse health effect of pregnant women’s regarding climate change as heat stress (100).

%	NO	Adverse health effect
20.0	20	Vaginal bleeding
5.0	5	Preeclampsia / eclampsia
80.0	80	Severe lower abdominal pain
10.0	10	Abruptio placenta.
5.0	5	Placenta previa,
22.0	22	Anemia
10.0	10	Urinary tract infection
25.0	25	Post-traumatic stress disorders
15.0	15	Depression

Table (8) : Table (8) : Illustrated that,80.0% of pregnant women in the study sample complained from severe lower abdominal pain,25.0% of them complained of post traumatic stress disorders, 22.0% of them complained of anemia and 20.0% of them complained of vaginal bleeding .

Table (9) : Relation between pregnant women demographic characteristics and total knowledge about climate change as heat stress, (n=100).

Demographic data		Total Knowledge						T-test or ANOVA		
		Poor N=60		Average N=30		N _o	Good N=10		T	P-value
		No	%	No	%		No	%		
Age	< 20 years	25	41.6	10	33.3	5	50.0	22.761	<0.001*	
	20<40 years	20	33.3	10	33.3	5	50.0			
	> 40 years	15	25.1	10	33.3	0	0.0			
Place of residence	Urban	55	91.6	20	66.7	0	0.0	22.761	<0.001*	
	Rural	5	8.4	10	33.4	10	100.0			
Monthly income	Enough	1	1.7	1	3.3	0	0.0	21.396	<0.001*	
	Not enough	59	98.3	29	96.6	10	100.0			
Level of education	Don't read & write	15	25.0	13	43.3	2	20.0	20.350	<0.001*	
	Read and write	38	63.3	0	0.0	2	20.0			
	Basic education	5	8.3	10	33.4	5	50.0			
	Diploma / secondary education	2	3.4	7	23.3	1	10.0			
Training program about hazards of climate change as heat stress	Yes	0	0.0	0	0.0	0	0.0	20.655	<0.001*	
	No	60	100.0	30	100.0	10	100.0			
Types of clothes worn during work	Cotton	10	16.6	5	16.6	5	50.0	21.433	<0.001*	
	Polyester	15	25.0	15	50.0	5	50.0			
	Cotton and polyester	35	58.4	10	33.4	0	0.00			
Time of heat exposure	<10 am	10	16.6	10	33.3	5	50.0	20.965	<0.001*	
	10am -3 pm	30	50.0	10	33.3	5	50.0			
	After 3 pm	20	33.4	10	33.4	0	0.0			
History of sun burn (last 12 months)		40	66.6	30	100.0	10	100.0	19.563	<0.001*	
History of heat stroke (last 12 months)		50	83.4	30	100.0	10	100.0	21.655	<0.001*	

Table (9): It was observed from this table that there was highly statistically significant relation between age, educational level, place of residence, monthly income, types of clothes worn during work, training program about climate change, time of heat exposure and pregnant women's total knowledge (p<0.001)

Table (10): Relation between pregnant women's demographic characteristics and total reported practice about climate change as heat stress. (n=100).

Demographic data		Total reported practice				T-test or ANOVA	
		Satisfactory N=40		Unsatisfactory N= 60		T	P-value
		No	%	No	%		
Age	< 20 years	15	37.5	25	41.7	20.443	<0.001*
	20<40 years	10	25.0	25	41.7		
	> 40 years	15	37.5	10	16.6		
Place of residence	Urban	30	75.0	45	75.0	20.753	<0.001*
	Rural	10	25.0	15	25.0		
Monthly income	Enough	0	0.0	2	3.4	21.123	<0.001*
	Not enough	40	100.0	58	96.6		
Level of education	Don't read & write	5	12.5	25	41.6	19.376	<0.001*
	Read and write	15	37.5	25	41.6		
	Basic education	15	37.5	5	8.4		
	Diploma / secondary education	5	12.5	5	8.4		
Types of clothes worn during work	Cotton	25	62.5	20	33.3	20.441	<0.001*
	Polyester	15	37.5	40	66.7		
	Cotton / polyester						
Training program about hazards of heat stress	Yes	0	0.00	0	0.00	19.870	<0.001*
	No	40	100.0	60	100.0		
Time of heat exposure	<10 am	10	25.0	20	33.3	20.944	<0.001*
	10 am -3pm	10	25.0	35	58.3		
	After 3 pm	20	50.0	5	8.4		
History of sun burn (last 12 months)		20	50.0	60	100.0	21.455	<0.001*
History of heat stroke (last 12 months)		30	75.0	60	100.0	20.657	<0.001*

Table (10): shows that, there was highly statistically significant relation between age, educational level, place of residence, monthly income, types of clothes worn during work, training program about climate change, time of heat exposure and pregnant women's total reported practice ($p < 0.001^*$)

Table (11) : Relation between total knowledge and total reported practice, (n=100).

Variable	Total knowledge (N=100)	
	R	P value
Total reported practice	0.49	<0.001**

Table (11): illustrates that there was relation between pregnant women's total knowledge and total reported practice regarding heat stress with highly statistical significance difference ($p < 0.001^*$)

Table (12): : Correlation between total knowledge, total reported practice and observational checklist for heat stress risk exposure, (n=100).

Variable	Observational checklist for heat stress risk exposure (N=100)			
	Environmental Parameters		Personal Parameters	
	R	P value	r	P value
Total knowledge	0.88	<0.001**	0.67	<0.001**
Total reported practice	0.76	<0.001**	0.85	<0.001**

Table (12): illustrates that there was correlation between pregnant women's knowledge, total reported practice and observational checklist for heat stress risk exposure with highly statistical significance difference ($p < 0.001^*$).

3. Discussion

Results of the current study reveals that pregnant women age was <20 years, and the mean age was 19.83 ± 7.34 years. About two fifth of them can only read and write. This result disagrees with **Verweij et al., (2019)** who studied "epidemiological evidence from south Indian female pregnant working the heat exposure and health linkage" and found that 35% had an age of 36.8 ± 12.6 years. And 65% of them had university education or more. However, this study result agrees with **Shih et al., (2022)** who conducted a study in Nigeria about "perceived climate change impacts and adaptive behaviors in different socio-demographic groups in the subtropics" and found that, the mean age of participants was 20.63 ± 6.42 years and 45% of them could only read and write.

The study finding indicated that, the majority of pregnant women live in urban areas and the majority of them their monthly income was not enough. The study findings agree with **Graham et al. (2021)**. They conducted a study in sub-Saharan Africa about "Diversity and climate change: the dynamic burden of poor maternal health." The study found that 75% of participants live in urban areas and 80% of them had monthly income that was not enough.

Regarding pregnant women's types of clothes wear

during work, the current study revealed that, less than half of them wear cotton and polyester during work. The study agree with **Costello, et al (2019)** the study conducted in London about "Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission". and revealed that, all study sample wear 65% polyester, 35% cotton.,

Regarding to study sample participation in training programs about climate change, the current study showed that, the majority of pregnant women, did not participate in any training programs about hazards of climate change. This result agrees with **Chersich et al. (2020)** who conducted a study in USA About "Associations between high temperatures in pregnancy and risk of preterm birth, low birth weight, and stillbirths: systematic review and meta-analysis" and revealed that, 90% of study sample did not participate in any training program about climate change. From the investigator point of view, the phenomenon of climate change is a new phenomenon in Egypt, and training programs are still few for all groups of people.

Regarding to study sample time of heat exposure during work, the current study revealed that, less than half of them were exposed to heat between 10 am – 3 pm. This finding disagrees with **Rother et al (2019)**. This study was conducted in South Africa about "Perceptions of occupational heat, sun exposure, and health risk prevention: a qualitative study of forestry workers in South Africa" and found that, 70% of them were exposed to heat between 6 am –12pm. From the investigator's point of view, there is a difference in temperatures between South Africa and Egypt, which leads to different results.

Regarding to history of sun burn (last 12 months) the current study revealed that, the majority of pregnant women in the study sample were exposure to the sun burn (last 12 months) .This finding disagrees with **Bekkar et al (2020)** who conducted a study in USA titled " Association of air pollution and heat exposure with preterm birth, low birth weight, and stillbirth in the USA: a systematic review" and found that, 75% of pregnant women were not exposed the sun burn (last 12 months).

Regarding to history of heat stoke (last 12 months) the current study revealed that, the majority of women in the study sample were exposure to heat stoke (last 12 months). This finding agrees with **McCormick (2021)** who conducted a study in Iran about, "The contribution of low birth weight to infant mortality and childhood morbidity" and found that, the 80% of pregnant women were exposed to heat stoke (last 12 months).

Regarding pregnant women's obstetric history, the current study revealed that, more than two thirds of them their duration of marriage was <5 years, more than half of them had two pregnancies, less than two thirds of them their age at pregnancy was $20 < 30$ years, less than two thirds of them complained of problems before & during pregnancy, the majority of

them their previous birth type was cesarean section. Also, the majority of them suffered from problems during last labor, and more than half of them had more than one live birth in the last three years. These findings agree with **Malley et al (2019)** who conducted a study in Pakistan titled "Preterm of birth associated with maternal particulate matter exposure: a global, regional and national assessment" and found that, 60.0% of these women the duration of marriage was <5 years and the majority of them their previous birth type was cesarean section.

Concerning the pregnant women's knowledge about climate change, the current study revealed that, more than half of them had poor knowledge about meaning, types, and hazards of climate change. While one quarter of them had average knowledge regarding climate change. The minority of them had good knowledge about climate change. These results disagree with **Ngwenya et al., (2018)** who conducted a study in Bulawayo, Zimbabwe about "Studied climate change and adaptation strategies of outdoors workers in the city of Bulawayo, Zimbabwe. and revealed that the majority of study sample had good knowledge about climate change, and the minority of them had poor knowledge regarding climate change. However, results of the current study agree with **Morris et al., (2021)** who conducted a study about "Studied occupational climate change and heat stress across multiple European industries and stated that 65.0% of the participants had poor knowledge regarding climate change, while, 20.0% of them had good knowledge about climate change. Results of the current study also agree with **Jacklitsch, (2017)** who conducted a study in "Assessing heat-related knowledge, perceptions, and needs among emergency oil spill cleanup responders" and found that more than half of the participants had poor knowledge about meaning, types, and hazards of climate change while, one quarter of them had average knowledge regarding climate change and the minority of them had good knowledge about climate change. From the investigator's point of view, the majority of the sample had poor knowledge about climate change and heat stress because not all of them did not participate in any training program regarding climate change and heat stress. This section answers the first research question.

Regarding the pregnant women reported practice regarding climate change as heat stress about **work and breaks**, the current study revealed that, less than two thirds of them did practices regarding taking rest breaks periodically to allow body to cool down. Also, more than half of them did not do practice regarding rotating between indoor, shaded and outdoor tasks to avoid exposure to solar UV radiation for long periods of time. The study finding agrees with **Field, et al (2019)** who conducted a study in USA about "Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fifth Assessment Report

of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA". They found that 60.0% of study sample did practices regarding taking rest breaks periodically to allow body to cool down. Also, 55.0% of them did not do practices regarding rotating between indoor, shaded and outdoor tasks to avoid exposure to solar UV radiation for long periods of time. From the investigator's point of view, the nature of pregnant women work in the street for long periods does not give them the opportunity to take enough rest to avoid exposure to sunlight and heat stress.

Regarding the pregnant women's reported practice regarding climate change as heat stress about **Shade**, the current study revealed that, more than two thirds of them did practice regarding seeking shade where possible. The study agrees with **Gamble, et al. (2019)** who conducted a study in Washington U.S about "The impacts of climate change on human health in the United States " and found that, 70.0% of study sample did practice regarding seeking shade where possible. From the investigator's point of view, most expectant pregnant women are looking for shaded places to work in to avoid heat stress, especially during pregnancy, because it is a difficult stage for women.

Regarding the pregnant women's reported practice regarding climate change as heat stress about **hydration**, the current study revealed that, more than two thirds of them did not do practice regarding seeking hydration during the work, drinking 1 cup of water every 15-20 min. and drinking before feeling thirsty. The study disagrees with **Lajinian et al (2018)** who conducted a study in Pakistan titled "An association between the heat-humidity index and preterm labor and delivery: a preliminary analysis". They found that, the majority of study sample did practice regarding seeking hydration during the work, drinking 1 cup of water every 15-20 min. and drinking before feeling thirsty. From the investigator's point of view, most Egyptian - pregnant women drink water only when they feel thirsty.

Regarding the pregnant women's reported practice regarding climate change as heat stress about wearing **Hat**, the current study revealed that, less than two thirds of them thought that it was not applicable to wear a hat with a broad brim (10-12 cm) or a flap at the back to shade both the face and back of the neck. This finding agrees with **Riyad et al., (2019)**. They conducted a study in Egypt titled "Women's health-related vulnerabilities in natural disasters as climate change: a systematic review protocol. " and found that, 60.0% of the study sample thought that it was not applicable to wear a hat with a broad brim (10-12 cm) or a flap at the back to shade both the face and back of the neck. From the investigator's point of view, these hats are expensive in Egypt, and most mothers cannot buy

them.,

Regarding the pregnant women's reported practice regarding climate change as heat stress about wearing **Gloves**, the current study revealed that, less than half of them wore gloves during work. The study agrees with **Watts, et al. (2019)**. They conducted a study in Singapore about "The report of the Lancet Countdown on health and climate change: ensuring that the health of a child born today is not defined by a changing climate". They found that, 50.0% of the study sample wore gloves during work.

Regarding the pregnant women's reported practice regarding climate change as heat stress about wearing **Sun glasses**, the current study revealed that, the majority of them thought that it was not applicable to wear sun glasses that comply with the standards. The study agrees with **Sillmann, et al (2019)**, who conducted a study in Turkey about "Intergovernmental Program for Climate Change (IPCC) Sixth Assessment Report". They found that, the majority of women thought that it was not applicable to wear sunglasses that comply with the standards., From the investigator's point of view, most pregnant mothers in Egypt cannot buy good and appropriate sunglasses due to their high price and they are not financially able to buy them.

Regarding the pregnant women's reported practice regarding climate change as heat stress about using **Sunscreen**, the current study revealed that, the majority of them thought that it was not applicable to use broad-spectrum, sun protection factor (SPF) of 30+ water resistant sunscreen, apply liberally to clean, dry skin at least 20 minutes before going outside. and reapply sunscreen at least every two hours. This study finding agrees with **Cook, et al (2018)**. They conducted a study in Iran about 'Quantifying the consensus on anthropogenic global warming in the scientific literature', Environmental Research Letters". They found that, 90.0% of study sample thought that it was not applicable to use broad-spectrum, sun protection factor (SPF) of 30+ water resistant sunscreen, apply liberally to clean, dry skin at least 20 minutes before going outside, and reapply sunscreen at least every two hours. From the investigator's point of view most pregnant mothers in Egypt cannot buy good and appropriate sun screen due to their high price and they are not financially able to buy them.

Regarding the reported practice, more than half of studied samples had unsatisfactory practice regarding climate change such as heat stress. Our study pointed that all of the women in the study sample never used sun screen and all of them didn't wear sunglasses at all. This finding agrees with a study carried out in Helwan by **El-Maksoud et al., (2020)**. They conducted a study in Egypt about "Health Promotion about Sun Protection among Outdoor Workers at Helwan University" and found that, more than half of studied sample had unsatisfactory practice regarding sun protection in which only 36.2% of respondents who had good practice regarding sun protection. This finding

agrees with another study carried out in Dubai by **Alawad et al., (2017)** about, "Studied the assessment of sun health awareness levels among medical sciences pregnant women's at Ajman University" and found that the majority of studied sample had unsatisfactory practice regarding sun protection in which only 8.1% of respondents had good practice regarding sun protection. From the investigator's point of view, most pregnant women in Egypt do not use sunscreen due to its high price, and that most pregnant women monthly income is not sufficient for the basic requirements of daily life.

This section answers the research question (Q3)- What are the adverse health effects on pregnant women regarding climate change?

Regarding pregnant women's adverse health effects of climate change as heat stress, the current study revealed that, the majority of them complain of severe lower abdominal pain, one quarter of them complained of vaginal bleeding, anemia, post traumatic stress disorders and the minority of them complained of abruptio placenta. The study results agree with **Ajanga et al (2016)** who conducted a study in northwest Tanzania about "Effect of climate change on pregnancy and associations with anemia in northwest Tanzania" and found that, 80.0% of pregnant mothers complained of severe lower abdominal pain, 30.0% complained of vaginal bleeding, anemia, post traumatic stress disorders and the minority of them complained of abruptio placenta. Also, the study agrees with **Anda et al (2018)** conducted a study in Russia about "Implementation, quality control and selected pregnancy working in outdoor outcomes of the Murmansk County birth registry in Russia. "And found that, 84.0% of pregnant mothers complained of severe lower abdominal pain, 16.0% complained of vaginal bleeding, anemia, post traumatic stress disorders and the minority of them complained of abruptio placenta. Also, the study agrees with **Black, et al (2019)** who conducted a study in Bangladesh about "Maternal and child undernutrition: global and regional exposures and health consequences" and found that, 75.0% of pregnant mothers complained of severe lower abdominal pain, 25.0% complained of vaginal bleeding, anemia, post traumatic stress disorders and the minority of them complained of abruptio placenta. From the investigator's point of view, pregnant women who work in the street are exposed to general stress and suffer one of the many problems of pregnancy due to hard effort and exposure to heat stress for long periods of the day.

Part IV: The assessment of worker's risk regarding heat stress exposure.

Regarding pregnant women's heat stress risk exposure (**air temperature**) the current study revealed that, more than half of pregnant women were exposed to the risk of high heat stress (air temperature), while, one third of them were exposed to the risk of high heat stress (air temperature) and the minority of them were exposed

to neutral heat stress. But the results were in disagreement with **Humphrys et al., 2022**, who conducted a study in Australia titled "climate change and heat stress at work". They stated that the majority of workers were not exposed to high temperature during time of work. This study was in with a study by **Vega-Arroyo et al., (2018)**, in California. This study was titled "Evaluating the Main Modifiable Factors Contributing to Heat-Related Illness in pregnant women" and mentioned that more than half of study subjects were exposed to very hot temperatures during time of work.

Regarding assessment of pregnant women's heat stress risk exposure (**Work Rate or Metabolic Rate**), the current study revealed that, more than half of pregnant women were exposed to very high metabolic rate, while one quarter of them reported resting as part of a work/rest schedule or is awaiting instructions. This result disagrees with **Fischer et al (2019)** who conducted a study in London about "Socio-economic and climate change impact on pregnant women" and found that, 20% of pregnant women were exposed to very high metabolic rate, while 80% of them reported resting as part of a work/rest schedule or is awaiting instructions. From the investigator's point of view, the nature of the work of pregnant women between the two countries is different, and the places of study are different, as well as the laws of work for pregnant women in Egypt are different. In addition, in Egypt, many pregnant women need to work for long periods to provide the basic requirements for families.

Regarding, assessment of pregnant women heat stress risk exposure (**Thermal Radiation**), the current study revealed that, one third of pregnant women worked in close proximity to the heat source for more than 5-10 minutes i.e. exposed to radiant heat. Findings of this study agrees with **Akachi et al (2019)** who conducted a study in Pakistan about "Global climate change and maternal and child health: a review of pathways, impacts and measures to improve the evidence base". They found that 35.0% of pregnant women worked in close proximity to the heat source for more than 5-10 minutes i.e. exposed to radiant heat. From the investigator's point of view, most of the pregnant mothers in the study worked outdoors for long periods of time, which exposed them to radiant heat.

Regarding pregnant women's heat stress risk exposure (**air velocity**), the current study revealed that, about two fifths of studied sample the air movement that they were exposed to was cold air at a high speed, while, one third of them were exposed to very hot air at a high speed. The study agrees with **Homer et al (2019)** who conducted a study in Iran about "Climate change threatens the achievement of the millennium development goal for maternal health" and found that, 40.0% of studied sample the air movement that they were exposed to was cold air at a high speed, while, 35.0% of them were exposed to very hot air at a high speed. From the investigator's point of view, the work of a pregnant

woman in the open air makes her vulnerable to climate change throughout the year.

Regarding pregnant women's heat stress risk exposure (**humidity**), the current study revealed that, more than two thirds of studied sample were working in a very humid air, while 20% of them worked in dry air, with no drying processes or other mechanisms for increasing the humidity in the workplace. The study agrees with **Hartman et al (2018)** who conducted a study in Iran about "The impact climate change of maternal and newborn newborns" and found that, 70.0% of studied sample were working in very humid air, while 20% of them worked in dry air, with no drying processes or other mechanisms for increasing the humidity in the workplace. From the investigator's point of view, exposure of a pregnant women to moisture has a negative impact on the women's health during pregnancy.

Regarding pregnant women's heat stress risk exposure (**clothing**), the current study revealed that, the majority of the pregnant women wore cotton coverall, jacket and one fourth of them wore light working cloth. This study agrees with **Hyatt et al (2018)** who conducted a study in Egypt about "Regional maps of occupational heat exposure about pregnant women: past, present, and potential future" and found that, 80% of the pregnant women wore cotton coverall, jacket and 20.0% of them wore light working cloth. From the investigator point of view, most pregnant women wear light clothes while working to feel comfortable while working all day in open spaces.

Regarding to total pregnant women's risk exposure about climate change as heat stress, the current study revealed that, more than half of pregnant women were exposed to personal parameters that cause heat stress and about two fifths of them were exposed to environmental parameters that led to adverse health effects on pregnant women. The study agrees with **IPCC (2017)** who conducted a study in Cambridge University about "Climate change 2017. Impacts, adaptation and vulnerability. Contribution of working group to the fourth assessment report of the Intergovernmental Panel on Climate Change" and found that, 60.0% of pregnant women were exposed to personal parameters that cause heat stress and 40.0% of them were exposed to environmental parameters that led to adverse health effects on pregnant women. From the investigator's point of view, the work of a pregnant woman in the open air exposes her to many health problems associated with climate change, especially high temperatures.

Regarding the relation between pregnant women's demographic characteristics and total knowledge about climate change as heat stress, the current study revealed that, there was highly statistical significant relation between age, educational level, place of residence, monthly income, types of clothes worn during work, training program about climate change, time of heat exposure and pregnant women's total knowledge $p < 0.001$. The study

agrees with **Kjellstrom(2019)** who conducted a study in Pakistan about "Climate change, direct heat exposure, health and well-being in low and middle-income countries. Glob Health Action" and found that, there was highly statistically significant relation between age, educational level, place of residence, monthly income, types of clothes worn during work, training program about climate change, time of heat exposure and pregnant women's total knowledge $p < 0.001$.

Regarding the relation between pregnant women's demographic characteristics and total reported practices about climate change as heat stress, the current study revealed that, there was highly statistical significant relation between age, educational level, place of residence, monthly income, types of clothes worn during work, training program about climate change, time of heat exposure and pregnant women's total reported practices $p < 0.001$. The study agrees with **Parsons(2019)** who conducted a study in London about "Human thermal environments: the effects of hot, moderate, and cold environments on human health, comfort, and performance in pregnant women" and found that, there was highly statistical significant relation between age, educational level, place of residence, monthly income, types of clothes worn during work, training program about climate change, time of heat exposure and pregnant women's total reported practice $p < 0.001$. From the investigator's point of view, this result emphasizes the importance of education programs to raise pregnant women's awareness about effects of heat stress and to highlight the significance of using all protective measures during sun exposure.

Regarding the relation between total knowledge and total reported practice, the current study revealed that, there was relation between pregnant women's total knowledge and total reported practice regarding heat stress with highly statistical significant difference ($p < 0.001$). The study agrees with **Poursafa & Kelishadi (2019)** who conducted a study in Iran about "What health professionals should know about the health effects of air pollution and climate change on children and pregnant mothers." They found that, there was relation between pregnant women's total knowledge and total reported practice regarding heat stress with highly statistical significance difference ($p < 0.001$). From the investigator's point of view, when pregnant women's knowledge increases, their practices to deal with climate changes and heat stress will be improved.

Regarding to correlation between total knowledge, total reported practice and observational checklist for heat stress risk exposure, the current study revealed that, there was correlation between pregnant women's knowledge, total reported practice and observational checklist for heat stress risk exposure with highly statistical significance difference ($p < 0.001$). The study agrees with **Rylander et al (2018)** who conducted a study in Denmark about "Climate change and environmental

impacts on maternal and newborn health with focus on Arctic populations". " They found that there was correlation between pregnant women's knowledge, total reported practice and observational checklist for heat stress risk exposure with highly statistical significance difference ($p < 0.001$). From the investigator's point of view, pregnant women need to attend training programs on the risks associated with climate change on their health and the health of the fetus.

4. Conclusion

Based on the study finding and research hypothesis it can be concluded that: The current study revealed that 80% of pregnant women were exposed to sun burn and 90% of them were exposed to sun stroke in the last twelve months. Also, 60% of studied sample had poor knowledge, about climate change as heat stress, Also, 60% of pregnant women's unsatisfactory done practice, about climate change as heat stress, while, 60% of pregnant women's exposed to personal parameters that cause heat stress and 40% of them exposed to environmental parameters lead to adverse health effect of pregnant women's and regarding adverse health effect of pregnant women regarding climate change, 80.0% of them complain severe lower abdominal pain, 25.0% of them complain post-traumatic stress disorders, 22.0% of them complain of anemia and 20.0% of them complain of vaginal bleeding . There was correlation between pregnant women's knowledge, total reported practice and observational checklist for heat stress risk exposure with highly statistical significance difference ($p < 0.001^{**}$).

5. Recommendations

On the light of the results of the current study findings, the following recommendations are suggested:

- 1-Implementation of health education program for pregnant women regarding climate change and prevention and control of heat stress
- 2-Dissemination of health education booklets about climate change to improved pregnant women's awareness about heat stress and how to protective themselves
- 3-Further research on a large sample size and other settings is recommended.

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