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Health Risks Associated with Climate Change among Children: Mothers' Awareness and Practices

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Abstract

Background: Climate change has been described as a fundamental threat to human health. It has a far-reaching impact and has been identified as a global threat to humanity, especially among vulnerable groups such as children. **Aim:** This study aimed to assess mother's awareness and practices about health risks associated with climate change among children. **Research Design: A** cross-sectional descriptive study design was used. **Setting**: study conducted at three maternal and child health centers located in Fayoum city: Alhadka, Keman Fares and Elsad Elaly. Subjects: A convenience sample was used, it consisted of 382 mothers, and their children less than five years. **Tool**: two tools were used for data collection; **Tool I:** A structured interviewing questionnaire including **1st part**: the Socio-demographic data of the mothers and their children. **2nd part**: the child's medical history. **3rd part**: mother's awareness regarding climate changes. Tool II: The mother's self-reported practice checklist regarding climate change. **Results**: The study results revealed that the studied children experienced various health problems, including malnutrition and infectious diseases, associated with climate change, with 79.8% of them exposed to anemia and 41.9% to hepatitis. Additionally, 46% had poor knowledge about climate change and its preventive measures, about two-thirds of them showed an inadequate level of practices regarding climate change. There was a strong positive correlation with high statistical significance between mother's knowledge and practice ($r= 0.784$ at $p<0.001$).**Conclusion**: the study reported a lack of knowledge among studied mothers about climate change and its associated preventive measures. **Recommendation**: Offer educational programs for mothers with children under five, focusing on adapting to climate change and mitigating its potential adverse health consequences

Keywords: *Children under five, Climate changes, Health risks, Mother awareness and practices*

Introduction:

The Earth's climate has changed more significantly than at any point in the previous 650,000 years, therefore climate change recognized as the foremost health peril of the twenty-first century **(Anderko et al., 2020).** The term climate change refers to long-term shifts in global or regional weather patterns and average temperatures, primarily driven by human activities such as the release of greenhouse gases into the atmosphere **(Wulandari et al., 2023).** Climate change is caused by both natural processes and human activity, with greenhouse gas emissions being the most significant contribution. These emissions generate considerable environmental changes, such as droughts, rising temperatures, and severe disasters, as well as long-term changes in physical environments and geographies **(Naz et al., 2022).** Due to it impacts air quality, food security, water availability, and the frequency of natural disasters, climate change is a grave threat to public health **(Costa et al., 2023).**

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Climate change significantly impacts human health and well-being by altering the frequency and intensity of extreme weather events and promoting the spread of certain diseases and pests, these changes lead to both direct, and indirect health risks, including increased morbidity and mortality, exposure to infectious diseases, air pollution, aeroallergens, malnutrition, and mental health disorders **(Saad et al., 2023).**Notably, early-life exposure to these environmental stressors can have enduring adverse effects on both physical and psychological health **(Zangerl et al., 2024).**

According to **UNICEF (2023)**, children under the age of five year nearly 90 percent of the global burden of disease linked to climate change, they are especially susceptible to the adverse effects of climate change, including pollution, life-threatening illnesses, and extreme weather events. **Anderko et al (2020)** added that climate change's health effects are disproportionately affecting children due to their physical, physiological, and cognitive immaturity. Additionally, the **Environmental Protection Agency, (2024) EPA (2024)**, reported that children's developing bodies increase their vulnerability to climate-related risks due to faster breathing, exposure to harmful pollutants, and increased exposure to weather conditions, allergies, and bug bites compared to adults, as well as reliance of young children's on adults for protection and basic needs increases their vulnerability during climate-related emergencies.

Mothers play a crucial role in mitigating climate change by promoting sustainable lifestyle choices, advocacy, and education for their children, providing them with the necessary knowledge and skills to combat climate change **(Abera, 2023).** During extreme heat, they safeguard their children's health by promoting hydration, appropriate clothing, and scheduling outdoor activities during cooler times, while emphasizing the use of shaded areas for protection **(Kayode, 2024).** Moreover, in response to poor air quality, **Cheng et al. (2022**) added that mothers often protect their children by restricting children's outdoor activities, particularly following wildfires or smoke exposure, to minimize respiratory illness

Nursing is a crucial profession in climate action, assisting communities in adapting to health risks posed by climate change. Nurses act as connectors between patients, families, and health care systems, promoting climate-resilient practices and sustainability measures **(Vold et al., 2021).**Community Health Nurses (CHNs), particularity play a crucial role in the health care system as educators, advocates, and change agents, they enhance resilience, foster coping mechanisms, and foster future-focused behaviors, CHNs also identify climate change concerns and assessing local health effects of climate change-related disasters on children **(Abdelaziz et al., 2024; Williams et al., 2021)**.

Promoting children's health is a fundamental responsibility for community health nurses, particularly in regard to climate change. They advocate political action, teach mothers about healthy nutritional habits, and adapt their lifestyles to climate change. Additionally, they offer care to vulnerable groups, especially youngsters, during severe weather events **(Singer et al., 2022)**. By assessing the health risks that climate change poses to children, community health nurses can enhance the effectiveness of their work. This enables them to create targeted emergency preparedness strategies and respond promptly to excessive heat and air pollution events **(Costa et al., 2023)**.

Significance of the study:

Climate change is predicted to impact 325 million people annually, causing 300,000 fatalities. Between 2030 and 2050, 250,000 deaths are expected due to malnutrition, malaria, diarrhea, and heat stress. It is estimated that 155 million children under the age of five will be stunted, and 52 million will be wasted **(UNICEF/WHO/World Bank Group, 2017).**

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According to the United Nations International Children's Emergency Fund (UNICEF), half of the world's children are 'extremely high risk' of climate change impacts due to exposure to many climate hazards and a lack of access to essential health care and other services that can assist children, families, and communities in mitigating and recovering from climate-related disasters **(Proulx et al., 2024)**.Moreover rising temperatures and extreme weather events are threatening children, with children under the age of five account for over 90% of the globally disease burden **.**

According to the **UNICE, (2022), c**limate change poses a serious threat to children's survival, development, and well-being, particularly in low- and middle-income nations. Egypt, is increasingly affected by extreme weather events due to its arid desert climate and dependence on the Nile River (**Global Carbon Project, 2021),** with over 100 million people. The nation's heavy reliance on the Nile makes it exceptionally vulnerable to climate-related threats such as heatwaves and sea level rise, moreover, Egypt ranks 63rd globally in climate change preparedness and 83rd in vulnerability, highlighting its limited capacity to adapt to environmental challenges **(Universiy of Notre Dame, 2020),** as a developing nation, Egypt's children face significant risk, in particular due to the country's lack of climate change awareness **(El Sakka, 2017).** Consequently, conducting this study will enable community health nurses to generate data base on climate change-related health risks affecting children under five, as perceived by their mothers, and may aid in developing targeted interventions to mitigate these health impacts on children.

Aim of study:

This study aimed to assess mother's awareness and practices about health risks associated with climate change among children.

Research questions:

1. What are the perceived changes in children's health that mothers attribute to climate change?
2. What is the level of mothers' awareness of climate change-related health risks among children under five?
3. What are the reported practices that mothers have adopted to protect their children from climate change-related health risks?

Subjects and method:

I. Technical Design:

Research design:

A cross-sectional descriptive design was utilized in this study.

Setting:

The current study was conducted at three maternal and child health centers located in Fayoum city, which are the main institutions that offer comprehensive healthcare services to mothers and children and are strategically located in different districts in Fayoum city.

Sample:

convenient sample was consisted of 382 mothers, and their children aged less than five years according to this power analysis equation.

$$n = \frac{N \times p(1-p)}{\left[\left[N-1\times\left(d^2 \div z^2\right)\right]+ p(1-p)\right]}$$

N: population target

z: The standard score corresponding to the significance level 0.95 is equal to 1.96

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d: The error rate is equal to 0.05

p: Property availability and neutral ratio = 0.50

n: sample

$$n = \frac{60720 \times 0.50(1-0.50)}{[[60720-1\times(0.05^2 \div 1.96^2)]+0.50(1-0.50)]}$$ =382 mothers, and their children

Tools for data collection:

Two tools were developed by the researcher based on a review of related literature.

Tool I: A structured interviewing questionnaire It was self - administered questionnaire, developed by the researcher which classified into three parts, including:

Part 1: The Socio-demographic data of the mothers and their children, such as age, marital status, educational level, current occupation, residence, family income, number of children, age of children, sex, weight of the child and ranking.

Part 2 : children health risk appraisal; to assess the children's health changes that mothers attribute to climate change, including: **malnutrition** which included (5 items): stunting, wasting, anemia, weight loss and overweight and obesity , **respiratory** which including (5 items): chest allergy, sinusitis, cold and runny nose, pneumonia and narrowing of the bronchi , **waterborne diseases** which including (3 items): typhoid fever, cholera and hepatitis A, **heat-related illnesses** which including (4 items): sunstroke, fainting, skin rash and heat stress, **digestive system** which including (6 items): loss of appetite, indigestion, diarrhea, constipation, nausea or vomiting and dehydration, **nervous system problems** which including (5 items): headache, fever, depression, stress and insomnia.

Part 3: Mother's awareness regarding climate changes: It was used to assess the mother's knowledge regarding climate changes. This questionnaire was covered **9** main items of mothers' knowledge regarding climate change-related health risks among children under the age of five. **44** questions and statements were included in this tool; Awareness items covered in this tool were as the following:

1. The mother's knowledge about climate change. It included: definition, causes, general impact of climate changes and effect of climate changes on child's health (It includes **4** items).
2. The mother's knowledge about the health risks of climate changes on children. It included: Transmission of infectious diseases, the spread of respiratory diseases, the spread of digestive system diseases, heat exhaustion when exposed to intense sunlight, sunstroke from long exposure to intense sunlight, the spread of insect-borne diseases, malnutrition diseases (It includes **7** items).
3. The mothers' knowledge of preventive measures to reduce the effect of climate changes on children. It included: preventive measures taken during high weather temperatures, severe heat and cold waves, improving air quality at home, limiting disease spread by insects and polluted water, maintaining food safety and child nutrition, and improving children's mental health in relation to climate change (It includes 8 items).

The scoring system:

The knowledge level was categorized into three levels:

Total scores of knowledges were 44 points, one mark awarded for each correct response, and zero for incorrect answer and classify as the following:

1. Poor = scores less than 60% of total scores (less than 38 marks)
2. Average = scores between 60% to less than 75% of total scores (38 - <48marks)
3. Good = scores equal or more than 75% of total scores (48-63 marks)

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Tool II: The mother's self-reported practice checklist, it was modified from **(Cook et al., 2019)**: to assess the mothers' practices to protect their children from climate change-related health risks, such as temperature impacts (heat temperature), extreme events including severe heat waves and severe cold waves, air quality improvement, vector-borne disease, water-related illness prevention, food safety and nutrition, and mental health promotion.

Scoring system

This checklist was classified into 8 categories; all of these categories composed of 59 statements. These statements requiring a response on 3 points Liker- rating scale with 3 continua (never, sometimes and always). Each step was given a score in SPSS as (always= 3 marks, sometimes= 2 marks and never= 1 mark)

The total score levels were categorized as:

- Adequate practice: equal or more than 70% of total scores (133 to 177 marks).
- In adequate practice: less than ٧٠٪ of total scores (<١٣٣ marks).

Content Validity:

The data collection tools were reviewed by a panel of three experts in community health nursing and pediatric health nursing staff, to review the tools for clarity, relevance, comprehensiveness, understanding and applicability, and the necessary modifications were done accordingly based on the comments.

Content Reliability:

The tool's reliability was assessed using Cronbach's alpha test, revealing that the tool's items are closely related. The Cronbach's alpha test results were as follows.

Reliability of the tools was done by Cronbach's Alpha Analysis Test to determine questionnaire items related to each other.

Items	Alpha Cronbach	F	P-value
Total knowledge	0.792	28.210	<0.001*
Total practice	0.813	19.471	<0.001*

Ethical consideration:

The study was approved by Fayoum University's scientific research ethical committee, and the researcher, prior to the study, clarified its objectives to mothers to gain their trust. The researcher ensured data anonymity and confidentiality of subjects' data, and mothers were informed they could choose to participate or withdraw from in the study at any time.

II. Operational Design:

Preparatory phase:

Includes reviewing of related literature and theoretical knowledge of various aspects of the study using books, articles, internet, periodicals, scientific journals, and magazines to develop tools for data collection, the tools were reviewed by jury doctors, then tools were tested for being feasible and applicable through a pilot study.

Pilot Study:

A pilot study was carried out on 10% (38) of the study sample. To evaluate the clarity and applicability of the research tools, as well as to estimate the time required for data collection. There were no modifications found after the pilot study. Consequently, the subjects who participated in the pilot study were included in the final sample for the main study.

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Field work:

The approval to conduct the study was obtained written from participant mothers after explaining the aim of the study. Voluntary participation and confidentiality were assured by the investigator for each mother through clarifying to them that all information will be used for scientific research only. Data collection was started and finished at 6 months from mid- November 2023 to mid - May 2024.The sample was collected from 3 maternal and child health care centers, one day for each center every week (from Tuesday to Thursday) during the work hours from 09:00 a.m. to 2:00 pm , The investigator met 382 mothers and their children who agreed to be involved in the study sample, The investigator started the interview with each mother individually using the data collection tools, every mother took about 20-30 minutes. The structured interviewing questionnaire sheet was read, explained and choices were recorded by the investigator from each participant in the study individually and some mothers were filling out the questionnaire alone.

III. Administrative Design:

An approval to carry out this study was obtained from the directorate of health at Fayoum Governorate and was directed to the head of maternity and child health care centers for conducting the study.

IV- Statistical Design:

The data was analyzed and presented in numbers, percentages, in the form of tables, figures and diagrams as required. using the mean and standard Deviation, chi-square test was used to compare between groups in qualitative, linear correlation coefficient was used for detection of correlation between two quantitative variables in one group, the data was analyzed with the program statistical package for social science (IBM SPSS Windows, Version 20.0. Armonk, NY: IBM Corp.)., and the following values were used to determine degrees of statistical significance: P Value< 0.05 significant (S), P-Value > 0.05 Not significant (NS), and P-value < 0.001 High significant (HS).

Results:

Table (1): shows the distribution of the studied mothers according to their socio- demographic characteristics. It was found that 56.5% of studied mothers were from 15 <30 age ranges with a mean of 29.54±4.68 years, and the majority (79.8%) of them were married related to the educational level, 31.9% of studied mothers attained education at the university or institute level. Additionally, 77.7% of them were not currently employed and around 52.6% lived in urban areas, with 46.9% reporting sufficient income. Moreover, a substantial portion 77.2% of mothers has a family size ranging from 1 to 3 children.

Table (2): portrays distribution of children according to their Personal characteristics. It was noticed that the studied children's ages were distributed across various stages, with 36.6% falling within the 3 to less than 5 years age range. On average, the children's age is 2.06±1.48 years. The gender distribution of the children shows 56.5% male and 43.5% female. Regarding child rank, the majority 37.7% of them were the first-born. In terms of children's weight/age, 53.4% of studied sample classified as appropriate, while 46.6% are deemed not appropriate.

Table (3): shows that during severe heat waves, 77% of the studied children were suffered from skin rach, 72.3% of them suffered from heat stress, 70.9% of children suffered from fever, 64.1% of children suffered from nausea and vomiting, 63.1% of children suffered from anxiety and stress, 50.3% of children suffered from cold and runny nose, 42.1% of children suffered from Chest allergy. 52.1% of children suffered from loss of appetite and 58.1% of children suffered from diarrhea.

Figure (1): shows that the overall knowledge level among mothers shows that 22 % have good knowledge, 32% have average knowledge, and 46% have poor knowledge regarding climate change and related preventive measures.

Figure (2): shows that the overall practice of preventive measures among mothers indicates that 30% have implemented adequate practices, while 70% have implemented in adequate practices.

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Table (4): shows that asignificant associations between Total Practice scores and various demographic factors. Key findings include higher rates of practice completion among individuals aged 15-30 years, married individuals, those with higher education levels (especially Secondary and University), urban residents, and those with sufficient monthly family income ($p < 0.001^*$ in each case). Current job status, working hours per day, and number of children did not show significant associations with Total Practice.

Table (5): clarifies that there was a strong positive correlation with highly statistically significant ($r = 0.784$, $p < 0.001^*$) between Total Knowledge and Total Practice.

Table (1): Number and percentage distribution of mothers according to their Socio-demographic characteristics (N=382).

Items	No	%
Age by years		
15-30	216	56.5
31-40	120	31.4
41- or more	46	12.1
Mean ±SD	29.54±4.68	
Marital status		
Married	305	79.8
Absolute	49	12.8
Widow	28	7.4
Education		
not read and write	61	16
Primary	45	11.8
Preparatory	47	12.3
Secondary	107	28
University or institute	122	31.9
Current job		
Working	85	22.3
does not work	297	77.7
Place of residence		
Urban	201	52.6
Rural	181	47.4
Monthly family income		
Sufficient	179	46.9
Insufficient	203	53.1
Number of children		
1-3	295	77.2
4-6	79	20.7
7 or more	8	2.1

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Table (2): Number and percentage distribution of children according to their Personal Characteristics (N=382).

Personal characteristics	Number	Percent %
Age of children		
≤ one year	79	20.7
More than 1 - <3 years	163	42.7
3- <5 years	140	36.6
Mean ±SD	2.06±1.48	
Gender		
Male	216	56.5
Female	166	43.5
Child rank		
The first	144	37.7
The second	127	33.2
The third	107	28
The fourth	3	0.8
The fifth	1	0.3
Children weight / age		
appropriate	204	53.4
not appropriate	178	46.6

Table (3): Number and percentage distribution of children according to their exposure to health problems related to climate change during severe heat waves (N=382).

Exposure to health problems during severe heat waves	Yes		No	
	No	%	No	%
Respiratory problems				
Chest allergy	161	42.1	221	57.9
Sinusitis	122	31.9	260	68.1
Cold and runny nose	192	50.3	190	49.7
Pneumonia	63	16.5	319	83.5
Narrowing of the bronchi	98	25.7	284	74.3
Digestive system problems				
Loss of appetite	199	52.1	183	47.9
Indigestion	171	44.8	211	55.2
Diarrhea	222	58.1	160	41.9
Constipation	172	45.0	210	55.0
Nausea or vomiting	245	64.1	137	35.9
Dehydration	189	49.5	193	50.5
Nervous system problems				

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Headache	**211**	**55.2**	**171**	**44.8**
Fever	**271**	**70.9**	**111**	**29.1**
Depression	**168**	**44.0**	**214**	**56.0**
Anxiety and Stress	**241**	**63.1**	**141**	**36.9**
Insomnia	**219**	**57.3**	**163**	**42.7**
Heat-related illnesses				
Sunstroke	**192**	**50.3**	**190**	**49.7**
Fainting	**218**	**57.1**	**164**	**42.9**
Skin rash	**294**	**77.0**	**88**	**23.0**
Heat stress	**276**	**72.3**	**106**	**27.7**

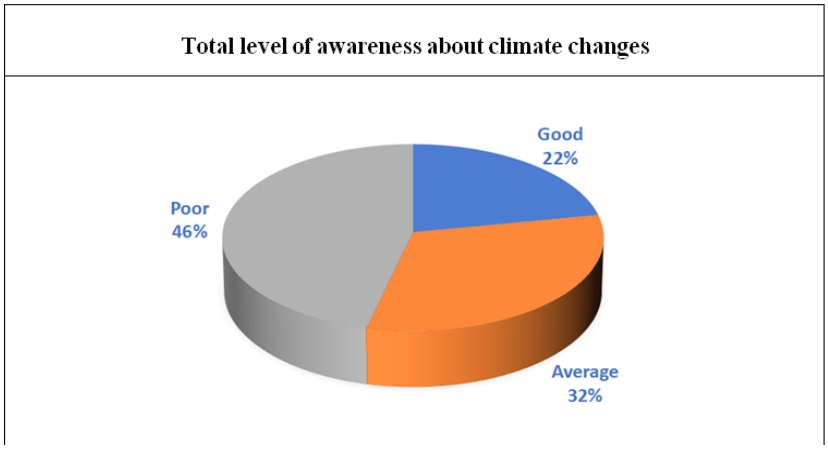

Figure (1): Percentage distribution of mothers regarding their total level of awareness related to climate changes (N=382).

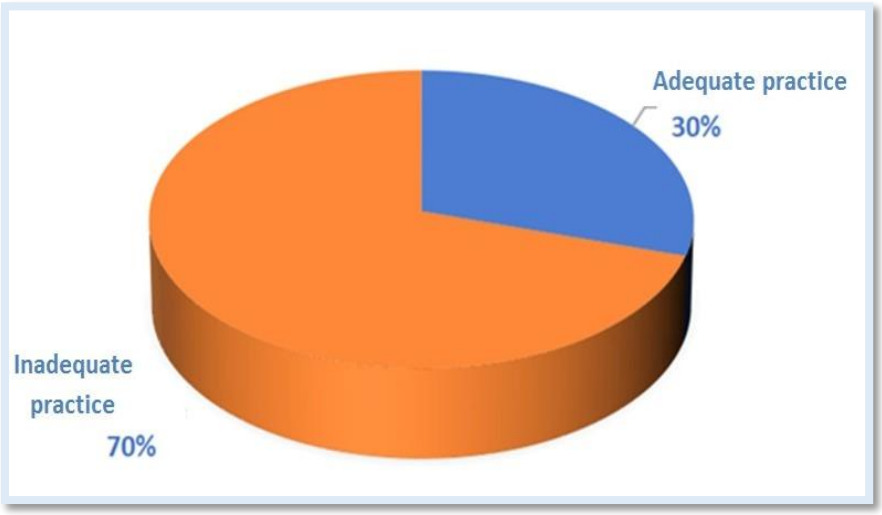

Figure (2): percentage distribution of mothers regarding their total self-reported practices related to climate changes (N=382).

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Table (4): Relation between socio-demographic characteristics of mothers and total practice related to climate change (N= 382).

Items	Total practice				Statistical test	
	Done		Not done		Chi-square	
	No	%	No	%	X^2	P-value
Age						
15-30 years	83	72.8	133	49.6	17.775	<0.001*
31-40 years	21	18.4	99	36.9		
41- or more	10	8.8	36	13.4		
Marital status						
Married	105	92.1	200	74.6	15.323	<0.001*
Absolute	5	4.4	44	16.4		
Widow	4	3.5	24	9.0		
Education						
not read and write	2	1.8	59	22.0	207.447	<0.001*
Primary	8	7.0	37	13.8		
Preparatory	3	2.6	44	16.4		
Secondary	5	4.4	102	38.1		
University or institute	96	84.2	26	9.7		
Current job						
Working	19	16.7	66	24.6	2.929	0.087
does not work	95	83.3	202	75.4		
Place of residence						
Urban	86	75.4	115	42.9	33.943	<0.001*
Rural	28	24.6	153	57.1		
Monthly family income						
Sufficient	82	71.9	97	36.2	41.017	<0.001*
Insufficient	32	28.1	171	63.8		
Number of children						
(1-3)	101	88.6	194	72.4	14.088	<0.001*
(4-6)	10	8.8	69	25.7		
7 or more	3	2.6	5	1.9		

>0.05 Non significant <0.05* significant <0.001** High significant

Table (5): Correlation between mothers' total knowledge and practice scores

Items	Total Knowledge score	
	R	P-value
Total practice score	0.508	<0.001*

>0.05 Non significant <0.05* significant <0.001** High significant

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Discussion:

Climate change (CC) is an unavoidable issue that poses a significant risk to human health on a global scale **(Dinku et al., 2022).** Consequences of climate change such as increasing temperatures and more extreme weather events are impacting human health **(Rocque et al., 2022).** In Egypt is significantly prone to be impacted by the consequences of climate change, the intensity of warming, with average annual temperatures rising by 0.53 °C per decade. The younger generations will be particularly affected by the country's climate-related hazards according to Conference of Parties **(COP 27, 2022)**. Including health consequences which are classified as direct or indirect effects as a result of climate change **(Khan et al., 2024).** This study was aimed to assess mother's awareness and practices about health risks associated with climate change among children under the age of five years.

The current results reveal that more than half of the studied mothers' aged were 15 years and more with a mean ± SD of 29.54±4.68. This finding in the same line with **Abd Elhamed, Ahmed & Mohamed, (2023)**, who studied that "Mothers' Awareness about the Effect of Climate Changes on Health of Their Children Under 5 Years" and reported that more than half of the study subjects their age were ≤ 20 - < 30 years. In the respect of mothers' educational level, it was found that more than one third of the studied mothers had university or institute education, this inconsistent with **Maged et al. (2024),** who reported that more than two thirds of them had university education.

Concerning the marital status, the current study results found that the majority of the studied mothers were married. This result congruent with **Maged et al. (2024)**, who conducted a study in Egypt entitled "Mother's Awareness Regarding Health Consequences of Heat Stress Related to Climate Change among their Preschool Children " and reported that most of studied mothers were married. These results were reinforced by the study conducted by **Mouse et al. (2021)**, and demonstrated that three quarter of the studied sample were married.

In terms mothers' occupations, the present study showed that the majority of the studied mothers were not employed. This result in disagreement with a study conducted in Germany by **Filho et al. (2022)**, titeled "An analysis of climate change and health hazards ", and proved that the majority of mothers were working. In the context of the place of residence, the present study indicated that more than half of the studied mothers from urban area. This result agrees with previous study done by **Maged et al. (2024),** who revealed that more than half of the studied sample lived in urban areas. In addition, these results go in line with a study conducted by **Filho et al. (2022)**, who reported that the majority of mothers were lived in urban areas.

Concerning monthly family income, the present study indicated that more than half of the studied mothers have insufficient monthly family income. These findings were agreed with **Abd Elhamed, Ahmed & Mohamed, (2023)**, who illustrated that less than two thirds of the study subject had insufficiently monthly income. Moreover, this result is contradicted with the study done with **El-sharkawy, Elsheikh & Refaat, (2023)**, who mentioned that the most of mothers had enough income.

Regarding number of children in the family, the current study found that more than three quarter of the studied mothers had 1 to 3 children (Table 1). This finding incongruent with the results done by **Abd Elhamed, Ahmed & Mohamed, (2023),** who declared that about half of the studied mothers had one child. In relation to the age of the children, the current study clarified that more than one third of the studied children their aged were more than 1 - <3 years. This study disagrees with the study done by **Maged et al. (2024),** who stated that more than half of studied children their aged from 3 to <4 years old. These finding contrast with the study done by **Malmquist et al. (2021)**, on" Vulnerability and Adaptation to Heat Waves in Preschools " in Sweden, and reported that the most of young children were the age from 3 to 4 years.

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According to the children gender the present study viewed that more than half of the studied children were male. This finding was in a harmony with **Xu et al. (2020)**, who study titled "The impact of heat waves on children's health" in united states, and concluded that, two thirds of children were young male children. In the context of the child rank the current study found that more than one third considered in the first rank. This result not corresponding with **Maged et al. (2024),** who mentioned that nearly half of the studied children were in the second rank.

Regarding respiratory problems during severe heat waves, the results of the current study verified that half of the studied children were exposed to cold and runny nose during severe heat waves. This finding aligns with **Zeng, Lu & Deng, (2017),** study titled "Prenatal Exposure to Diurnal Temperature Variation and Early Childhood Pneumonia" and found that direct morbidity from heat waves includes respiratory diseases running nose, from the investigator's perspective, these findings may be associated with the weakness of children's immunity during this age, and also due to the anticipated increase in frequency and duration of heat waves owing to ongoing climate change. Concerning digestive system problems during severe heat waves, the present study showed that about more than half of the studied children had nausea or vomiting. This finding in accordance with the results of study done by **Smith, (2024)**, titled "Pediatric Thermoregulation: Considerations in the Face of Global Climate Change" and concluded that illness most common among participants involving gastrointestinal distress (particularly nausea, vomiting and diarrhea). From the investigator's point of view, these results might be because more than half of the study participants were not aware that spread of digestive system diseases is a health risk as a result of climate changes.

Concerning nervous system problems during severe heat waves, the present study reported that nearly three quarters of the studied children exposed to fever. This result in the same line with **Abd Elhamed, Ahmed & Mohamed, (2023)**, who showed that more than three quarters of the studied mothers had incorrect answers regarding the effect of climate changes on the psychological and mental health of their children. As well, this finding contradicted with **Barkin et al. (2021)**, who study entitled "Effects of extreme weather events on child mood and behavior. Developmental Medicine and Child Neurology" and reported that most of participants complain of a feeling of fear and helpless, resulting in psychological trauma and post-traumatic stress.

According to heat related illness of children due to severe heat waves, the current study results verified that more than half of the studied children had skin rash. This result comes in contrary with an Egyptian study done by **Maged et al. (2024)**, who found that more than one third of studied children had skin rash as a result of heat rash. This finding was supported by **Hyndman, (2019),** who found that about half of students had symptoms of heat rash, such as skin rash and painful red skin. From the investigator's point of view, this might be due to extreme heat than average conditions which affect the body's ability to regulate temperature and can result in skin rash.

Regarding respiratory problems during severe cold waves, the results of the present study showed that the majority of the studied children were exposed to cold and runny nose. These findings align with a study done by **Weeda et al. (2024)**, titled " How Climate Change Degrades Child Health: A Systematic Review and Meta-Analysis " and who reported that Forty-three studies investigated the impact of diverse climate variables on children respiratory health, specifically focusing on emergency department visits, asthma incidence, and the risk of infectious respiratory diseases such as colds, rhinorrhea, rhinitis, and sinusitis. Comparable effects were observed in Beijing, China, where cold extremes heightened children respiratory presentations in the emergency department; however, the effects on respiratory health persisted for an extended duration in children (**Ma et al., 2019**). From the investigator's point of view, these results might be related to weakness of children's immunity during this age.

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Concerning nervous system problems during severe cold waves, the present study reported that less than half of the studied children were suffered from fever during severe cold waves. This result is in agreement with **Mohammed Abdullah et al., (2022)**, who reported that more than one-quarter of the study sample had a fever related to climate change effects. Regarding to heat related illness of children related to severe cold waves, the current study results showed that about the minority of the studied children had sunstroke. The findings align with a study done by **Mohammed Abdullah et al., (2022)**, who mentioned that half a quarter of the study participants were suffered from heatstroke related to climate change. According children exposure to malnutrition problems resulting from climate change, the current study clarified that more than three quarters of the studied children suffered from anemia. This is consistent with the findings of **Xiao Fan, & Deng, (2016)**, who found that climate change presents hazards to human health and wellbeing resulting in severe anemia. From the investigator's point of view, this might be due to poor health habits and rising food prices.

Concerning the exposure of children to waterborne diseases, these study findings found that nearly half of the studied children suffered from waterborne diseases as hepatitis A. So, this study in harmony with the study done by **Hathaway & Maibach, (2018)**, on a study titled "Health Implications of Climate Change: A Review of the Literature About the Perception of the Public and Health Professionals", who demonstrated that the impact of inadequate drinking water in Egypt is equally stark, with patients spending an average of 2,8 billion days in hospitals due to water-related diseases.

According to the current study findings, more than one quarter of mothers had good knowledge, about third of them had average knowledge and nearly half of them had poor knowledge. This result was in the same line with study carried out by **Mohammed Abdullah et al., (2022)**, which performed at Egypt, who mentioned that about more than half a quarter of the studied participants had good knowledge; more than one-third of them had moderate and poor knowledge.

As regards overall practice of preventive measures among of the studied mothers this current study indicated that one third have implemented adequate practices, while more than two third have implemented in adequate practices. This result in same line with **Abdallah & Farag, (2022),** which found that the overall practice level was insufficient among the study participants. As regards relations between total practice scores and socio-demographic characteristics the current study revealed that a significant association between total knowledge score of the mothers and their age in which higher practice increase among those aged 15-30 years. This study in same line with the results of **Abd Elhamed, Ahmed & Mohamed, (2023),** who mentioned that good practice about climate change was associated with young mothers.

Also, the current study demonstrated that there is a statistically significant relations between total practice score of the studied mothers and their educational level in which higher practice increase among those with higher education levels (especially secondary and university. This result in same line with the results done by **Maged et al. (2024),** who mentioned that good practice about climate change was associated with high level educated mothers. Moreover, the current study demonstrated that there is a statistically significant relations between total practice score of the mothers and their educational level in which higher practice increase among those with sufficient monthly family income)**.** This result contradicted with the results done by **Abd Elhamed, Ahmed & Mohamed, (2023),** who demonstrated that there was no significant relation found in mothers' total practice and monthly income. On other hand, the current study demonstrated not significant associations between total practice and current job status, and number of children. This result in same line with the results done by **Maged et al., (2024),** who mentioned that there was no significant relation found in mothers' total practice and occupation.

As regard to correlation between total knowledge and total practice among the studied mothers, the current study showed that there was a strong positive correlation with highly statistically significant between total knowledge and total

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practice. This result in the same line with study done by **Abd Elhamed, Ahmed & Mohamed, (2023),** and showed that there was a strong positive correlation with highly statistically significant between total knowledge and total practice regarding global climate change.

Conclusion:

According to the present study findings, the study found that around one quarter of the total mothers' level of knowledge regarding health risks associated with climate change and related preventive measures among children, while less than one-third have moderate knowledge level and less than half have poor knowledge. Additionally, less than three-quarters of mothers reported inadequate practices regarding health risks associated with climate change and related preventive measures.

The study concluded that there was a highly statistically significant relation between socio-demographic characteristics and total level of knowledge of mothers regarding climate change-associated health risks among children under the age of five. Also, there was a strong positive correlation with a highly statistically significant between the total level of knowledge and practice among mothers.

Recommendations:

1. Develop target educational programs for mothers focusing on preventives measures to safe guarded their children health against climate change effect.

2. Integrate climate change awareness into maternity and child health care services, particularly for mothers with children under five, aimed to educate mothers about climate -related health risks and adaptive practices.

3. Conducting long-term research on climate change, and health of children under the age of five.

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