Climate Changes program and its Effect on Knowledge and Health Related Behaviors of Patients with Respiratory Allergic Diseases

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Abstract

Context: Climate change is an unavoidable issue that poses a significant risk to human health on global scale exacerbating respiratory allergic diseases and refers to long-term changes in average weather patterns over time. **Aim:** To evaluate the effect of climate changes program on knowledge and health related behaviors of patients with respiratory allergic diseases. **Method:** The study used a quasi- experimental design, specifically employing a pre/post-test methodology on a purposive sample of (80) patients with respiratory allergic diseases visited the allergy and immunology outpatient clinic through four months at Benha University Hospital, Qualubyia Governorate, Egypt. **Tools:** Three tools were utilized for data collection: Structured interview questionnaire, patients' knowledge assessment and patients' climate changes health-related behaviors scale. **Results** showed a statistically significant increase in the total patients' knowledge level both immediately and post 3 months of climate changes program implementation (P= ≤0.05). There was a statistically significant enhancement in the total patients' health related behaviors level**,** whereas 86.2% of the studied patients had unsatisfactory health-related behaviors preprogram implementation, but improved to be satisfactory as observed in 72.3% & 68.8% of them immediately post and post 3 months of program implementation, respectively (P= ≤0.05). Besides, a positive significant correlation between patients' total knowledge score and total health related behaviors pre and post 3 months of program implementation, as well as a highly significant correlation immediately post program implementation ($P<0.001^{**}$). **Conclusion:** The implementation of climate changes program resulted in a significant and positive effect on the knowledge and health related behaviors of patients with respiratory allergic diseases. **Recommendations:** Further researches and studies are needed to focus on identifying new approaches of climate changes program among patients with respiratory allergic diseases to enhance their health-related behaviors.

Keywords: Climate Changes, Knowledge, Health Related Behaviors, Respiratory Allergic Diseases.

Introduction

Climate change (CC) refers to ongoing alterations in the climate system across extensive areas and timeframes, primarily induced by human activities,

with a lesser impact from natural processes. This intricate environmental threat has global repercussions on public health, developmental aspects, agriculture, water resources and energy generation **(Portela et al. 2023).**

Climate change is the largest global health threat in 21st century, affecting earth's physical, biological, and human systems for public health, and these have been summarized in global terms by the World Health Organization (WHO) as threats to safe drinking water, adequate shelter, air quality and stable food source **(World Health Organization, 2021).**

Increased concentrations of greenhouse gases, especially CO_2, in the earth's atmosphere have already warmed the planet substantially, causing more severe and prolonged heat waves, temperature variability, air pollution, forest fires, droughts and floods, all of which put respiratory health at risk and increase frequency of acute cardio-respiratory events impacting not only on the morbidity but also on the mortality for respiratory diseases and allergic disorders **(Chang et al. 2022).**

Genetic susceptibility and environmental factors such as foods, dust mites, pollens, fungi and animal dander, additionally to high concentrations of ground-level ozone and some infectious disease vectors have been linked to both allergic respiratory diseases as rhinitis and asthma and non-allergic respiratory diseases as chronic obstructive pulmonary disease, stroke and myocardial infarction **(Singh & Kumar, 2022).**

Patients who are more susceptible to extreme weather events as occupational agents, indoor pollution from cooking fuel and tobacco smoke, environmental exposure to high temperatures and air pollutants from traffic and fossil fuel burning and bio-particulates such as aeroallergens (pollen, fungal spores, insects and biological debris) are more vulnerable to respiratory allergic diseases **(Tran et al. 2023).**

Respiratory allergic diseases are a significant public health issue which is expected to reach 4 billion in the 2050s. According to WHO estimates, 3 million people die prematurely every year as a result of air pollution, especially in the major cities of Asia, Africa, and Latin America. These chronic conditions cause discomfort, sneezing, nasal congestion and difficulty breathing due to overreaction to foreign. Climate change can prevent or minimize health outcomes through social factors, improved weather forecasting and research on patient's impact **(Ray & Ming, 2020; Andersen et al. 2023).**

Education and raising awareness particularly in educational institutions are crucial in the fight against climate change, as they help patients understand its causes and effects, encourage sustainable behaviors, develop knowledge and skills **(Soliman, Saleh & Eldeep, 2023)**, inform policy decisions and build global cooperation by educating patients about sustainable practices and technologies such as reducing waste, conserving energy and using sustainable transportation options (**Mohammed, Fahmy& Megahed, 2024).**

Significance of the study

Respiratory allergic diseases are a significant public health concern worldwide, affecting both developed and developing countries. Globally, they affect more than 400 million people, with prevalence rates between 10% and 30% among adults and over 40% among children **(Almatroudi et al., 2021).** In Egypt, the prevalence of allergic rhinitis, bronchitis and asthma were 13.5%, 11.2% and 4.1% respectively, which underscores the importance of awareness, early diagnosis and effective management strategies **(Ishak, Abd El Sayed & Wahba, 2020).**

The negative effects of climate changes on environmental sustainability have an adverse impact on human health by altering aeroallergen distribution, increasing ozone pollution and deteriorating air quality and is expected to cause an additional 250,000 deaths year between 2030 and 2050. This adverse impact exacerbates the risk of diseases, reduces quality of life and places a heavy strain on hospitals to care for those who are suffering from these effects **(Pereira, Fogelbach & Sole, 2022).**

Nurses should actively educate patients and families about climate change and its effect on health behaviors. Improved public health strategies as adequate humidity control, building resilience against climate effects, optimum air filtration and ventilation will be critical to adaptation **(Mekawy, 2023).** From the clinical experience, observation of actual situations and according to increased number of patients with respiratory allergic diseases, the researchers noticed that climate changes cause adverse effects on daily health behaviors among these patients at Benha university hospital. A retrospective analysis of statistical records indicated that the number of patients who visited the allergy and immunology outpatient clinic at Benha University Hospital over the year (2023) was approximately 200 patients (**Benha University Hospital Statistical Office, 2023**).

Aim of the study

The aim of this research was to evaluate the effect of climate changes program on knowledge and health related behaviors of patients with respiratory allergic diseases.

Research hypotheses

H1- Patients' knowledge score regarding respiratory allergic diseases and climate changes could be statistically improved after implementing the climate changes program.

H2 - Patients' health related behaviors could be statistically improved after implementing the climate changes program.

H3- After implementing the climate changes program, there could be a significant correlation between total patients' knowledge score and their total health related behaviors score.

Subjects and method

Research design: To accomplish the aim of the current research, a quasi-experimental pre- and post-intervention research design was used. This type of

empirical research assesses the causal effect of an intervention on its target population **(Sefidkar & Madadizadeh, 2022).**

Setting: The study was implemented in the allergy and immunology outpatient clinic located in the underground floor at Benha University Hospital, Qualubyia Governorate, Egypt.

Subjects: A purposive sample of (80) patients with respiratory allergic diseases who visited the aforementioned setting within the past four months were recruited for this study. The sample size was calculated using the following equation **(Fearon et al., 2017):**

$$n = \frac{N \times p\,(1-p)}{\left(\left(N-1 \times \left(d^2 \div z^2\right)\right) + p\,(1-p)\right)} = 80$$

N = Population size is 200
p = Ratio provides a neutral property is equal to 0.12
d = the error rate is equal to 0.05
z = Class standard responding to the level of significance equal to 1.96

Inclusion criteria: Conscious adult patients aged 20-60 years old from both sexes who were aware and committed to participate in the research with confirmed diagnosis of respiratory allergic diseases including (asthma, allergic rhinitis, bronchitis, or bronchiolitis). **While excluded** patients who diagnosed with psychosis or currently undergoing antipsychotic treatment with verbal disability.

Tools of data collection:

Tool I: Structured interview questionnaire: The researchers prepared this Arabic- language questionnaire after reviewing pertinent and related recent literatures based on **(Abdallah & Farag, 2022; Mahmoud & Mahmoud, 2023)** It divided into two main parts as follow:

Part I: Patients' personal data: It involved the evaluation of patients' age, sex, occupation, educational level, residence and marital status.

Part II: Patients' clinical data: It designed by the researchers to assess patients' complaints, severity, type of respiratory allergic disease, season that make patients' symptoms become worsen, triggers (Indoor and outdoor allergens), climate factors affecting patients' health and frequency of follow- up visits. As well as presence of chronic diseases and family history regarding respiratory allergic diseases, smoking, history of medication, receiving regular therapy for respiratory allergy, use of corticosteroids and O2 therapy or inhaler. It is composed of twelve multiple-choice multiple-choice questions (MCQs).

Tool II: Patients' knowledge assessment: It was designed by the researchers to evaluate the patients' knowledge about respiratory allergic diseases and climate changes. It consisted of 20 multiple-choice questions (MCQs), each of which had four responses. It was divided into two sections:

Section 1: Patients' knowledge about respiratory allergic diseases. It consisted of (9 MCQs) about the definition, types, causes, risk factors, manifestations, complications, diagnostic tests, treatment methods and prevention of respiratory allergic diseases.

Section 2: Patients' knowledge about climate changes. It included 11 multiple-choice questions (MCQs) that addressed the following topics: the definition, natural and human causes, the risky people to climate change, indicators and signs of climatic changes, effects of climate changes on daily lives and human health, ways to reduce climate change and to protect ourselves from climate changes, allergic diseases and its relationship with climate changes, as well as methods of adaptation to climate changes.

Scoring system: - Each question was evaluated by a score of 0 or 1. Each correct answer was given one score, while all incorrect answers were assigned zero score. Overall, the total score of all questions was 20. The scores were aggregated and converted to a percentage. The knowledge level was classified as satisfactory if the score was ≥75 % (≥15 marks) or unsatisfactory if the score was <75% (<15 marks).

Tool III: Patients' climate changes health-related behaviors scale:

The researchers developed it after reviewing the pertinent literatures **(Badawy et al. 2023)** to assess patients' indoor and outdoor daily behaviors related to climate changes. The scale encompassed the following topics: Indoor behaviors (11 items) and outdoor behaviors (8 items)

Scoring system: - Patients were directed to assign numerical values ranging from 0 to 2 corresponding to "never," "sometimes," and "always" when responding to items. The total score was 38 marks. These scores were converted into a percent and categorized as satisfactory level of behavior at ≥65% (24 marks or more) and unsatisfactory level of behavior at <65% (less than 24 marks).

Method

Administrative design: Official approvals were obtained from the dean of the nursing faculty and the director of the allergy and immunology outpatient clinics at Benha University Hospital. The purpose and method of data collection were explained by the researchers.

Ethical considerations:

On 4/9/2024 the study approval was obtained from the Scientific Research and Ethics Committee of the Faculty of Nursing at Benha University ***(Code no. REC-MSN-P75)***. Throughout the research process, all ethical guidelines were strictly adhered to. Each patient was informed of the aim and objectives of the research prior to data collection and their consent was obtained. They were also informed of their right to withdraw from the research at any time. The researchers assured maintaining privacy, anonymity of their participants and confidentiality of data.

Preparation of the tool: Included reviewing of literature of various aspects for this study in order to develop the appropriate tools for data collection according to supervisors' guidance and experts' opinions. The researchers developed the program according to the patient's initial assessment and translated it into the Arabic language. During this phase, the researchers also visited the

study setting to be acquainted with the personnel and the setting, the tools were tested by the following: -

Tools validity and reliability:

The face and content validity of the tools were checked through a jury consisting of five experts from the Medical and Nursing fields. Three professors of medical surgical nursing from Faculty of Nursing, Benha University and two professors of allergy and immunology from Faculty of Medicine, Benha University to ensure the comprehensiveness, clarity, consistency, appropriateness, relevance, accuracy, simplicity, applicability and the proposed suitability of tools' content. Cronbach alpha test was used to assess the reliability of tolls resulting in values of 0.755 for the knowledge questionnaire and 0.710 for the health-related behaviors scale.

Pilot study: A pilot study was conducted on 10% of the study subjects (8 patients). It was carried out to assess the usefulness, applicability, clarity and execution time of the tools, as well as to evaluate the feasibility of fieldwork and identify any potential difficulties that the researchers could encounter and impede the collection of data. Required modifications were done. So, the pilot sample was excluded from the study sample and substituted with others.

Field work:

Data collection of the current study was carried out through four months period (from the beginning of October 2024 to the end of January 2025). It was collected according to the policy of the study setting. The researchers visited the setting three days (Sunday, Tuesday and Thursday) per week during morning shift. Before data collection, the researchers welcomed each patient and informed them about the title, aims, tools, the study technique and the outcomes of the study to obtain their approval and cooperation which is needed for conducting this study.

The study was conducted through four phases:

Assessment phase:

After the researchers obtained patients' consent for the study, data was collected in this phase. The researchers filled the structured interview questionnaire (Tool I) to all patients individually to assess their personal and clinical data, then they assessed patients' knowledge using (Tool II) and patients' health-related behaviors using (Tool III). Each patient took about 20–30 minutes. Around (6:8) patients were organized daily by the researchers.

Planning phase: Following the conclusion of the initial assessment, the researchers designed climate changes program based on recent literatures and produced a hand out booklet featuring illustrations in a simple Arabic language that were pertinent to the requirements of patients with respiratory allergic diseases. A teaching plan was established by the researchers to address the program's general and specific objectives. In addition, the instructional media, various teaching strategies, the number of sessions, their duration and contents were determined. In an effort to improve knowledge and health related behaviors regarding climate changes of patients with respiratory allergic diseases, the

climate changes program was implemented.

Climate changes program:

It was designed by the researchers after an extensive literature review based on **(Andersen, et al. 2023; Tran et al. 2023).** In accordance with the educational requirements of the patients that were identified during the pretest phase, the program was designed in a simple Arabic language with colorful illustrations that addressed all theoretical and health related behaviors aspects in order to enhance their learning abilities. It contained the definition, types, causes, risk factors, manifestations, complications, diagnostic tests, treatment methods and prevention of respiratory allergic diseases. In addition to the definition, natural and human causes, the risky people to climate change and its effects on daily lives and human health, ways to reduce climate change and to protect ourselves from climate changes, allergic diseases and its relationship with climate changes, as well as methods of adaptation to climate changes either indoors or outdoors:

- Indoor health-related behaviors concerning their health and climate changes as; maintaining indoor air quality by using air purifiers to minimize indoor allergens, avoiding indoor tobacco exposure, adhering to prescribed allergy medications as directed by healthcare professionals, consuming adequate amount of water, consuming a healthy diet, dispose of waste properly, limit exposure to domestic animals, avoid exposure to insects killing aerosol, avoid household cleaning products, get adequate sleeping hours and seek medical help for abnormal symptoms.

- Outdoor health-related behaviors concerning their health and climate changes as; avoiding exposure to extreme heat especially in summer, reducing time spent outdoors during peak allergen seasons, avoiding physical activities outdoors during periods of high temperature, increasing hydration during exercise and outdoor activities, wearing mask during extreme weather, reducing consumption of packaged and fast foods, track symptoms written notes anywhere and carry allergy medication while outdoor as prescribed.

Implementation phase: Each respiratory allergic diseased patient was planned to two theoretical "present three sessions of "sessions and one practical session climate changes program that included face to face group, each session lasted between thirty and forty minutes. The proposed climate changes program was implemented in the examination room of the allergy and immunology outpatient clinic at the end of patients' follow-up visits. To obtain pertinent data, patients were divided into ten groups, each of which contained eight patients based on their agreement on a suitable date for them. This phase was implemented through four sessions.

Contents of each session: -

- The researchers initiated the sessions by greeting the patients, introducing themselves and discussing the climate changes program, its objectives,

importance and components. As well as asking the patients to cooperate for their benefit.

1st session: Covered the definition, types, causes, risk factors, manifestations, complications, diagnostic tests, treatment methods and prevention of respiratory allergic diseases.

2nd session: Cleared the definition, natural and human causes, the risky people to climate change, indicators and signs of climatic changes, effects of climate changes on daily lives and human health.

3rd session: Discussed the ways to reduce climate change and to protect ourselves from climate changes, allergic diseases and its relationship with climate changes, as well as methods of adaptation to climate changes.

4th session: Contained health related behaviors related to indoor and outdoor behaviors.

- Every session began with a summary of the previous one and the objectives of the new one taking into consideration the use of simple Arabic language to accommodate the patients' educational level.

- During sessions, patients were motivated, encouraged and reinforced to to enhance their active engagement in the study.

- During sessions, every patient had an opportunity to ask any question and share information. Also, the session ended by a summary of its contents and feedback was obtained from the patients to ensure that they got the maximum benefit.

- Different teaching and learning methods were used as: Lecture of simplified instruction followed by discussion, media for teaching included booklet and pictures.

- The colored booklet was given to each patient to help them reviewing and support teaching.

- At the end of sessions, the researchers informed the patients that they were evaluated by the researcher.

Evaluation phase: Using the same data collection tools of the pretest, this phase aimed to evaluate the effect of climate changes program on knowledge and health related behaviors of patients with respiratory allergic diseases. Each patient was evaluated two times; immediately and post three months of the program implementation by using (tool II & tool III) to compare changes in knowledge and health related behaviors among studied patients. To evaluate each patient during this phase, either a follow-up appointment was scheduled on the same day or telephone calls were made.

Statistical analysis of the data:

Version 25 of the statistical package for social science (SPSS) was used to analyse the data. Numerical data were expressed as mean, standard deviation (SD) and range. Qualitative data were expressed as frequency and percentage. To examine the difference of qualitative variables between two different periods within the same group, the chi-square test was employed. The pearson product-moment correlation coefficient and spearman correlation for categorical variables were used to test correlation

between different numerical variables. Significance levels were determined as highly significant for $p \leq 0.001$, significant for $p \leq 0.05$, and not significant for $p > 0.05$.

Results:

Table (1) displays personal data of the studied patients showing that 53.8 % of patients were between the age of 20-<30 years with a mean age of 29.61 ± 7.68, as well as 48.8% & 66.2% were married males, respectively, whereas, 71.3% were educated and 78.8 % were working as farmers (52.4%). Moreover 66.2% stated that their time of work was at morning and 73.8 % were residing in rural area and housing near air pollution area among 56.2% of patients.

Table (2) shows that 33.8% of the studied patients were complaining from nasal congestion, and 57.5% were diagnosed for 1-3 years with mild degree of severity among 67.5% and 41.2% of them had bronchitis followed by asthma in 40%, which worsen during spring among 72.5% also 57.5% had reported that humidity affects their health. Regarding smoking habit 76.5%, 42.5% & 88.2% of patients were cigarettes smokers for < 5 years, respectively. Moreover 71.3% had chronic diseases and 52.6% of them had hypertension. Concerning family history 90.0% of patients stated positive history of allergic diseases and 71.3%. were frequently comply with follow up visits.

Figure (1) illustrates that domestic pets were of the highest indoor allergens among 46.3% of patients, while irritants in air was the highest outdoor allergens among 43.8%.

Table (3) reveals that 76.2% of the studied patients were receiving regular therapy for respiratory allergy, and 78.8% were receiving corticosteroids and using O2 therapy or inhaler, which was used daily or almost daily among 73.8%.

Table (4) indicates that there was a statistically significant difference in the studied patients' knowledge level regarding allergic diseases and climate changes pre and post climate changes program implementation ($p= \leq 0.05$).

Figure (2) illustrates that 73.8% and 68.8% of the studied patients had a satisfactory level of knowledge immediately post and post 3 months of program implementation, respectively, whereas 87.5% of them had an unsatisfactory level of knowledge preprogram implementation.

Table (5) reveals that the patients' health related behaviors pre and post program implementation were statistically significant different ($P= \leq 0.05$). Where 91.2% had unsatisfactory indoor activity behavior level preprogram implementation but improved to a satisfactory level among 67.5% and 65% immediately and post 3 months of program implementation, respectively.

Figure (3) illustrates that 86.2% of the studied patients had unsatisfactory health-related behaviors preprogram implementation, but improved to be satisfactory as observed in 72.3% & 68.8% of them immediately post and post 3 months of program implementation, respectively with a statistically

significant difference pre and post program implementation (P= ≤0.05).

Table (6) displays a positive significant correlation between patients' total knowledge score and total health related behaviors pre and post 3 months of program implementation, as well as a highly significant correlation immediately post program implementation (P<0.001**).

Table 1. Frequency distribution of the studied patients according to their personal data (n= 80).

Patients' personal data	No.=80	
	(No.)	%
Age		
- 20-<30	43	53.8
- 30- < 40	19	23.8
- 40-<50	8	10.0
- 50-60	10	12.4
Mean ± SD	**29.61 ± 7.68**	
Sex		
-Male	53	66.2
-Female	27	33.8
Marital status		
-Single	23	28.7
-Married	39	48.8
-Divorced	18	22.5
Level of education		
- Educated	57	71.3
- Un educated	23	28.7
Occupation		
-Working	63	78.8
-Not working	8	10.0
-Housewife	9	11.3
Nature of work (n=63)		
-Farmer	42	52.4
-Rancher	9	11.3
-Hairdresser	4	5.0
-Chemical worker	4	5.0
-Builder	12	15.0
-Florist	9	11.3
Time of work		
- At morning	53	66.2
- At afternoon	19	23.8
- at night	8	10.0
Residence		
-Urban	21	26.2
-Rural	59	73.8
Housing near air pollution		
-Yes	45	56.2
-No	35	43.8

Table 2. Frequency distribution of the studied patients regarding their clinical data (n=80).

Patients' clinical data	(No.)	%
Patients' complaints		
- Shortness of breath	19	23.8
- Sneezing	21	26.2
-Nasal congestion	27	33.8
-Nasal itchy or burning	13	16.2
Time since diagnosis		
-1-3 years	46	57.5
->3 years	34	42.5
Disease severity		
-Mild	54	67.5
-Moderate	26	32.5
Type of respiratory allergic disease		
- Asthma	32	40.0
- Rhinitis	15	18.8
- Bronchitis	33	41.2
Season that make patients' symptoms become worsen		
- Spring	58	72.5
-Fall	22	27.5
Climate factors affecting patients' health		
- Temperature	4	5.0
- Humidity	46	57.5
- Air contaminants	30	37.5
Smoking		
-Smoker	34	42.5
-Passive smoker	26	32.5
- stopped smoking	4	5.0
-Non smoker	16	20.0
Years of smoking		
-<5years	30	88.2
-5-10 years	4	11.8
Type of smoking #		
-Cigarettes	26	76.5
-Shesha	5	14.7
-Cigarettes and Shesha	6	17.5
Presence of chronic diseases		
-Yes	57	71.3
-No	23	28.7
If yes, chronic diseases		
-Liver disease	7	12.3
-Renal disease	20	35.1
-Hypertension	30	52.6
Family history regarding respiratory allergic diseases		
-Yes	72	90.0
-No	8	10.0
Frequency of follow up visits		
- Every two weeks	57	71.3
- Every one month	23	28.7

 # Not mutually conclusive

Figure 1. Frequency distribution of the studied patients according to allergic triggers (n=80).

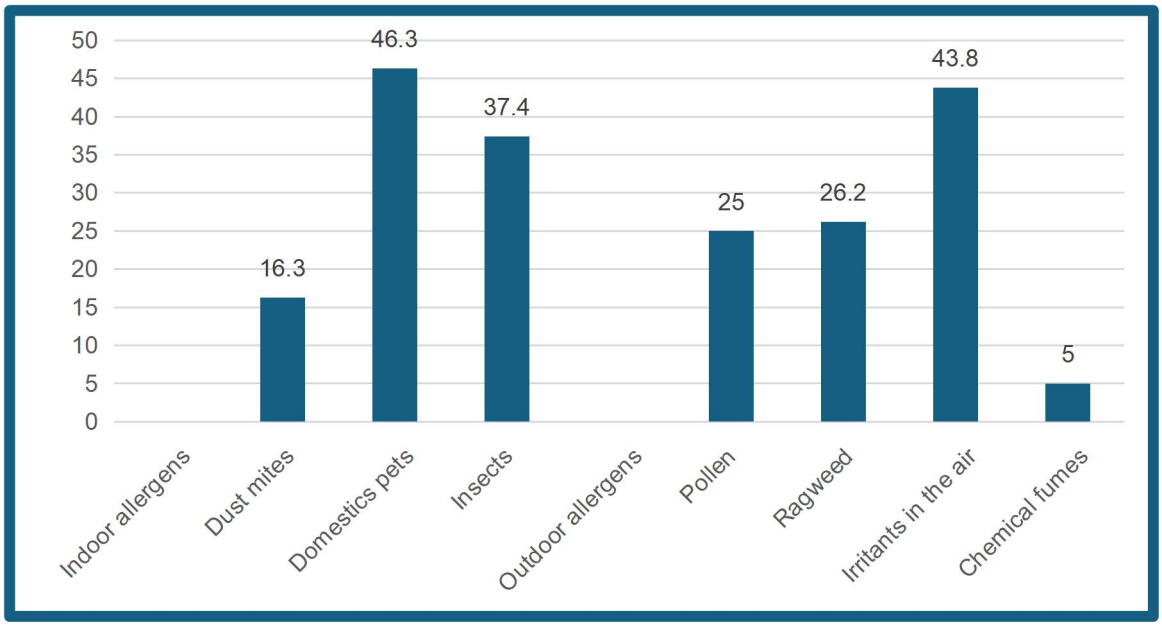


Table 3. Frequency distribution of the studied patients regarding their history of medication (n=80).

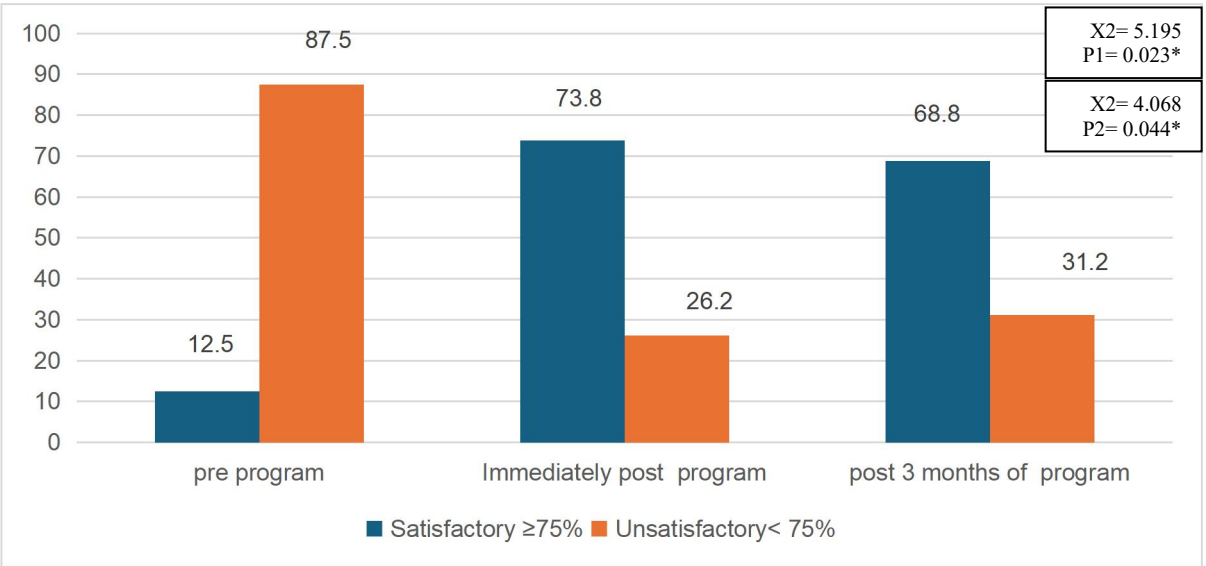
Patients' history of medication	(No.)	%
Receive regular therapy for respiratory allergy		
- Yes	61	76.2
- No	19	23.8
Use of corticosteroids		
- Yes	63	78.8
- No	17	21.2
Use of O2 therapy or inhaler		
- Yes	63	78.8
- No	17	21.2
Frequency of using inhaler		
- Daily or almost daily	59	73.8
-2-3 times weekly	21	26.2

Table 4. Frequency distribution and significant difference of the studied patients' knowledge level regarding allergic diseases and climate changes pre and post program implementation (n=80).

Total knowledge	Pre-program		Immediately post Program		Post 3 months of program		X^2 (p value) (1)	X^2 (p value) (2)
	No.	%	No.	%	No.	%		
Patients' knowledge about allergic diseases								
Satisfactory level ≥ 75%	12	15.0	60	75.0	57	71.3	5.697	4.706
Unsatisfactory level < 75%	68	85.0	20	25.0	23	28.7	0.017*	0.030*
Regarding climate changes								
Satisfactory level ≥ 75%	15	18.8	66	82.5	65	81.2	4.260	3.916
Unsatisfactory level < 75%	65	81.2	14	17.5	15	18.8	0.039*	0.048*
Total knowledge level								
Satisfactory level ≥ 75%	10	12.5	59	73.8	55	68.8	5.195	4.068
Unsatisfactory level < 75%	70	87.5	21	26.2	25	31.2	0.023*	0.044*

(*) Statistically Significant at ≤0.05
Difference between pre and immediate post periods of program
Difference between pre and post 3 months periods of program

Figure 2. Level of patients' total knowledge related to allergic diseases and climate changes pre and post program implementation (n=80).



(*) Statistically Significant at ≤0.05
(1)Difference between pre and immediate post periods of program
(2)Difference between pre and post 3 months periods of program

Table 5. Frequency distribution and significant difference of the studied patients' health related behaviors regarding allergic diseases pre and post program implementation (n=80).

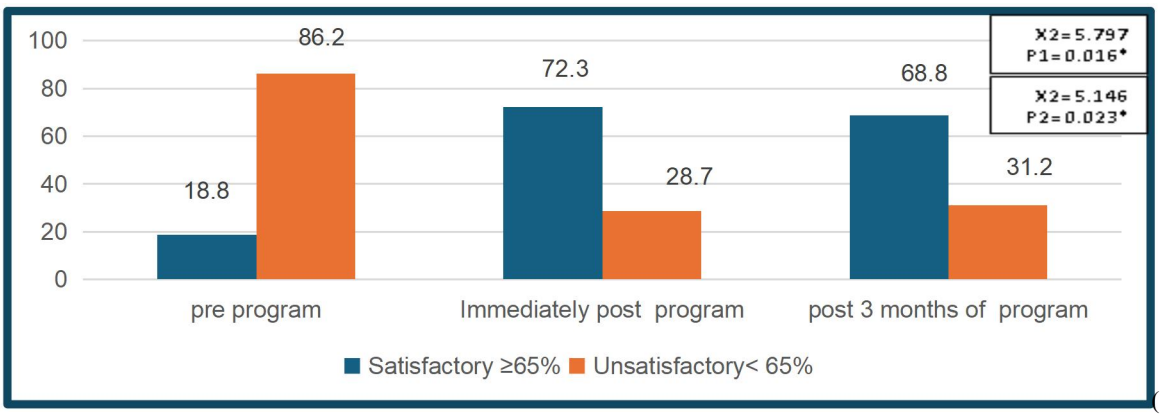
Health -related behaviors	Pre- program (n=80)		Immediately post Program (n=80)		Post 3 months of program (n=80)		X^2 (p value) (1)	X^2 (p value) (2)
	Satisfactory ≥ 65%	Un satisfactory < 65%	Satisfactory ≥ 65%	Un Satisfactory < 65%	Satisfactory ≥ 65%	Un satisfactory < 65%		
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)		
Patients' indoor health -related behaviors	7(8.0)	73(91.2)	54(67.5)	26(32.5)	52(65.0)	28(35.0)	5.299 0.021*	4.131 0.042*
Patients' outdoor health -related behaviors	13(16.2)	67(83.8)	56(70.0)	24(30.0)	53(66.2)	27(33.8)	6.652 0.010*	4.714 0.030*
Total	11(13.8)	69(86.2)	57(72.3)	23(28.7)	55(68.8)	25(31.2)	5.797 0.016*	5.146 0.023*

(*) Statistically Significant at ≤0.05

Difference between pre and immediate post periods of program

Difference between pre and post 3 months periods of program

Figure 3. Level of patients' total health related behaviors regarding allergic diseases pre and post program implementation (n=80).



*) Statistically Significant at ≤0.05

(1)Difference between pre and immediate post periods of program

(2)Difference between pre and post 3 months periods of program

Table 6. Correlation coefficient between patients' total knowledge and total health-related behaviors pre and post program implementation (n=80).

Variable	Study periods	Total knowledge	
		r	P value
Total health related behaviors	Pre program	0.256	0.028*
	Immediately post	0.499	<0.001**
	Post 3 months	0.278	0.012*

* Statistically significant p ≤ 0.05 ** Highly statistically significant p ≤ 0.001

Discussion:

Climate change is an unavoidable issue that poses a significant risk to human health on a global scale and refers to long-term changes in average weather patterns over time **(Yadav & Upadhyay, 2023).** It could affect human health, plants, animals as well as governmental economies which lead to many negative consequences include respiratory disorders, malnutrition, different heat disorders as heat stress and stroke, infectious diseases like vector-borne and waterborne diseases including gastrointestinal problems and mental health disorders as stress disorders and depression, which associated with natural disasters **(Abdallah & Farag, 2022).**

Improving the patients' knowledge and own health behaviors related to climate change causes, effects and its related potential solutions could be reflected on many positive daily life practices for minimizing the great environmental and health consequences **(Peters et al. 2022).**

Regarding the personal data of the patients, the current study's results demonstrated that slightly more than half of the participants were between the age of 20-<30 years with a mean age of 29.61 ± 7.68, whereas nearly half and two thirds were married males. Additionally, less than three quarters of them were educated and were resided in rural areas. These findings are consistent with what was reported by **Ibrahim, Abd Elmawla & Ali (2023)** who studied climate change and health: effect of awareness program on knowledge, attitudes and practices of community dwelling elderly that the Mean ± SD age of the patients was 66.86± 4.86 years, with most of them being over the age of 60, less than two thirds were married and more than half of them had secondary education. Conversely, they contradicted the notion that more than half of them were females and the majority lived in urban areas.

Furthermore, these findings are aligned with **Mulugeta et al. (2023)** who studied knowledge towards the health impacts of climate change and its associated factors among community of amhara sayint district, northeastern Ethiopia, 2022. Their study revealed that the majority of participants were married males and resided in rural regions. Additionally, most of them were farmers and more than half had elementary education. While, contradicted regarding age as they indicated that more than two thirds of the participants were aged between 25-34 years old.

On the other hand these findings disagree with those of **Amin, Eldeeb & Elbialy (2023)** in a study titled predictors of climate change knowledge and risk perception among the adults in El- Beheira governorate, demonstrated that more than half of the patients were single females, the age of more than one quarter of them ranged from 30 <40 years old and less than half were unemployed. However, the educational level and residence of the patients were compatible, as more than two-thirds of the participants had a

university education and more than half of them were rural residents.

As for patients' complaints, disease severity and season that make patients' symptoms become worsen, the current study revealed that one third of the studied patients were complaining from nasal congestion, slightly more than two thirds had mild degree of disease severity which worsen during spring among nearly three quarters of them. Similarly, **Tikhe & Khare (2023)** documented that the majority of patients were suffering from mild form of respiratory disease in a retrospective cohort study on ambient air quality and respiratory morbidities. However, there was a discrepancy in terms of both patients' complaints and season that make patients' symptoms become worsen, as they indicated that most of patients were suffering from cough and breathlessness during summer as respiratory infections result from the long-term exposure to substances such as dust and fumes, vapors and air pollution that can irritate lungs and may result in bronchitis.

This might be referred to that patients with an already impaired lung function due to asthma or interstitial lung disease are considered especially vulnerable to weather changes and extreme conditions, with increased risks of exacerbations as coughing, wheeze, shortness of breath, nasal congestion and difficult breathing

In pertinent to type of respiratory allergic disease, the study results showed that bronchitis followed by asthma constitutes the most prevalent respiratory allergic diseases. This finding is consistent with **Abir et al. (2024)** who studied impact of climate change on health and drug demand and **Sinha & Basu (2022)** who conducted a study about perceived impact of climate change on health: reflections from Kolkata and its suburbs, they stated that asthma and bronchitis are the highest respiratory allergic disease affect participants as an effect of climate change.

Moreover, this result disagrees with **Singh & Kuma (2022)** who mentioned that allergic rhinitis and inhalant sensitization have been described as the first wave of allergic disorders in a study titled climate change and allergic diseases: an overview. This finding reflected at the light of the scientific fact that the alterations in air quality and climate change exposures may adversely affect lung function, increase allergic responses and trigger onset of asthma, bronchitis, chronic obstructive pulmonary disease and also lung cancer.

Regarding climate factors affecting patients' health, the present study results stated that more than half of the studied patients had reported that humidity is the climate factor affects their health. Conversely, a study done by **Toor, Chaudhary & Randhawa (2021)** entitled review article related to knowledge about impact of global warming on health, they mentioned that the vast majority of respondents had illness conditions resulting from poor air quality, heat stress and

extreme weather events as potential climate changes effect.

In relation to allergic triggers, the current study found that domestic pets were of the highest indoor allergens, while irritants in air was the highest outdoor allergens. This result is consistent with **Bayram et al. (2023)** who conducted a study about impact of global climate change on pulmonary health: susceptible and vulnerable populations and **Covert et al. (2023)** who studied climate change impacts on respiratory health: exposure, vulnerability and risk, they stated that hotter temperatures lead to higher amounts of irritants and particles, causing the exacerbation of chronic respiratory diseases. While this result differs from that of **Agache et al. (2024)** in a study about climate change and allergic diseases: a scoping review who mentioned that house dust mites is from the highest indoor allergens

About patients' history of medication, the present study showed that more than three quarters of the studied patients were receiving regular therapy for respiratory allergy, corticosteroids and using O2 therapy or inhaler. This result is consistent with **Andersen et al. (2023)** who conducted a study titled climate change and respiratory disease: clinical guidance for healthcare professionals and reported that exposure to high temperatures or extreme heat, especially in the summer can trigger respiratory symptoms that may require extra use of rescue medication, healthcare visits to the general practitioner or emergency room, hospital admission or even intensive care with respiratory support. This may be due to extreme effect of climate changes on patients with respiratory allergic diseases with increased risks of exacerbations of symptoms and emergency room visits or hospitalizations.

Considering the studied patients' knowledge, the current study revealed that most of the studied patients had an unsatisfactory level of knowledge pre climate changes program implementation, while nearly three quarters and more than two thirds of them had a satisfactory level of knowledge immediately post and post 3 months of program implementation respectively with a statistically significant difference pre and post program ($P= \leq 0.05$). This result is supported by **El-afandy et al. (2024)** who studied the effect of climate changes educational program on asthmatic women's health knowledge and practices in outpatient chest clinic and reported that less than three quarters of studied women had poor knowledge about climate change pre-education program implementation, which improved to good knowledge among most of them after the program implementation with a statistically significant difference between pre and post education program scores (9.71 ± 3.75 to 21.21 ± 3.06) respectively at ($p \leq 0.05$).

From researchers' point of view, this result may be related to patients' low educational level and socioeconomic status, living in rural areas and working as farmers that

mainly effect on their knowledge level and desire to acquire and update knowledge. These results validate the first research hypothesis, demonstrating the efficacy of the program and showing that patients' knowledge increased when information is presented in an understandable manner.

Concerning level of patients' total health related behaviors regarding allergic diseases, the results of the present study indicated that most of the studied patients had unsatisfactory health-related behaviors preprogram implementation, but improved to be satisfactory as observed in nearly three quarters and more than two thirds of them immediately post and post 3 months of program implementation, respectively with a statistically significant difference pre and post program (P= ≤0.05). This might be referred to that the program helped patient to recognize the causes, effect of climate changes and improved their health-related behaviors toward these changes. This finding is supporting the second research hypothesis.

This result is in harmony with **Badawy et al. (2023)** who revealed that participant's health-related behaviors related to climate change pre- educational intervention were unsatisfactory, while post application of the educational intervention improved to somewhat satisfactory in their research on the effect of climate change educational intervention on knowledge and health-related behaviors of children with respiratory allergic diseases. Moreover, this result agrees with **Edmondson et al. (2022)** in a study about climate change, behavior change and health: a multidisciplinary, translational and multilevel perspective and **Turzakova et al. (2024)** who studied association between climate change and patient health outcomes: a mixed-methods systematic review, they recorded that health-related behaviors are critically important in preventing or delaying chronic diseases, promoting optimal health and well-being as well as in adaptation to and mitigation of climate change that encourage healthy lifestyles. Additionally, **Chevance et al. (2023)** who mentioned that there are deep interconnections between each of the potential effects of climate change and associated health behaviors in their study which entitled thinking health-related behaviors in a climate change context: a narrative review.

In relation to correlation between patients' total knowledge and total health-related behaviors, the current research indicated a positive significant correlation between patients' total knowledge score and total health related behaviors pre and post 3 months of program implementation, as well as a highly significant correlation immediately post program implementation ($P<0.001^{**}$). It served to validate the third research hypothesis. The study conducted by **Pizzulli, Telesca & Covatariu (2021)** entitled analysis of correlation between climate change and human health based on a machine learning approach provides support for this result, as they concluded that climate change is strongly correlated with human health

behaviors. Also, this result agrees with **Badawy et al. (2023)** who revealed that there was a positive correlation between knowledge and behaviors pre and post educational intervention.

Conclusion:

The present study concluded that climate changes program showed a statistically significant increase in the total patients' knowledge level both immediately and 3 months after program implementation, also it had a positive and significant enhancement in the total patients' health related behaviors level. Additionally, a positive significant correlation between patients' total knowledge score and total health related behaviors pre and post 3 months of program implementation, as well as a highly significant correlation immediately post program implementation ($P<0.001^{**}$) that confermed the research hypotheses.

Recommendations:

The current research recommended the following:

- Replicating the current study on a larger probability sample from different geographical distribution to achieve wider generalization of the results.

- Hold an ongoing educational program about climate changes and its effect on quality of life for patients with respiratory allergic diseases to enhance their understanding of the disease and its management, as well as coping with climate changes.

- Develop immersive and interactive learning experiences and new approaches that educate patients on the core principles of climate change and how to decrease this change.

- Organize regular workshops and follow- up visits on sustainable practices, where professionals in sustainability offer educational sessionson ecofriendly habits and practices.

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