Mobile Intervention to Enhance Adolescents' Awareness about Climate Change and Its Adverse Effect

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Abstract

Background: Identifying adolescent awareness regarding climate change, is essential preliminary step in determining gaps and paving the way for awareness campaigns that address climate change causes and counteraction mitigation measures. **Aim:** This study aim to determine the effect of mobile intervention to enhance adolescents' awareness about climate change and its adverse effect. **Design:** A quasi-experimental research design was used. **Setting:** This study was carried in three secondary schools namely Fatima AlZahra, Hoda Shaarawy and 25 January official Languages, affiliated to El-Massara Administration, Helwan, Cairo Governorate, Egypt. **Sample:** A multi-stage random sample was used. **Sample size:** 377 adolescents from both gender. **Tools:** Four tools were used in this study: **First**: Structured interview questionnaire which consisted of the following parts: **Part 1**: Characteristics data of studied adolescents, **Part 2:** Knowledge of studied adolescents about climate change. **Second:** Studied adolescents 'daily life reported practice. **Third**: Studied adolescents' attitude Likert scale toward climate change. **Fourth:** Studied adolescents' awareness. **Results:** The current study revealed that, 54.4% and 62.3% of studied adolescents had poor knowledge and inadequate reported practices about climate change respectively at pre-intervention, which improved to 80.4% and 76.1% at post-intervention respectively had good knowledge and adequate reported practices. As well 69.5% of them had a negative attitude and 59.4% of them had low awareness about climate change at pre-intervention, which improved to 78.8% and 75.3% at post-intervention had a positive attitude and high awareness respectively toward climate change. The differences between pre and post-interventions revealed highly statistically significant differences. **Conclusion:** Mobile intervention had been positive effect in achieving significant improvements in adolescents' knowledge, reported practices, attitudes, and awareness regarding climate change and its adverse effect. Also, there was a positive correlation between their total knowledge, reported practices, attitudes and awareness. **Recommendation:** Educational programs should be designed to increase climate literacy and awareness about climate change and its adverse effect, as well as to empower adolescents to move towards sustainability.

Key words: Adolescents' Awareness, Climate change, Mobile intervention.

Introduction

Adolescence is the period of life begin from the ages of 10 and 19 years, between childhood and adulthood. It is a distinct period in human development and a crucial time for establishing the foundations of good health. Teenagers grow quickly in terms of their physical, cognitive, and emotional development. This may have an impact on how they see the world, form judgments, feel, and act. The five most prominent traits of adolescence are increasing physical and mental development, an unclear status, increased pressures, increased decision making, and thesearch for self **(Dolgin, 2021).**

Climate change (CC) is known as a change in the climate that can be directly or indirectly linked to human activities and that modifies the global atmosphere's chemical composition. The long-term regional or worldwide average of temperature, humidity, and rainfall patterns over seasons, years, or decades is referred to as climate change. Climate change is the significant alteration in weather patterns over several decades or longer, such as becoming wetter, warmer, or drier. It is the longer-term trend that differentiates CC from natural weather variability **(Ayanlade et al.,2020).**

Climate change is an urgent public health issue which is impacting health locally and across the world. The most significant threat facing human health is CC, "a health emergency", and a "code red for humanity". Evidence points to a multitude of climate related impacts, including heat-related illnesses, respiratory illnesses, zoonotic and vector-borne diseases, water and food-borne diseases, impaired mental health, well-being and death related to severe weather event **(WHO, 2021)a.**

The wellbeing of adolescents is one of the effects of CC. Adolescents are in a state of well-being when they have the resources, self-assurance, and support they need to thrive and exercise all of their legal and human rights. The four other domains of connectedness, positive values, and contributions to society; safety and supportive environments; learning, education, employability, and resilience as well as optimal health and nutrition are recognized as being crucial for adolescent wellbeing **(Ross et al., 2020).**

The leading cause of CC is human activity and the release of greenhouse gases. Activities of humans, especially the burning of fossil fuels like coal, gas, and oil to power vehicles, factories, and homes; result in the release of greenhouse gas and different gases into the atmosphere. Different activities, such as deforestation (cutting down trees) and raising livestock, conjointly emit greenhouse gases. Rising sea levels, raised transmission of infecti0us diseases, shortage of water and foods, mass migrati0n, political tr0uble, and financial loss for governments and people are all effects of CC that are detrimental to people's physical, mental, and social well-being **(Álvarez et al., 2021).**

Climate change awareness is insistent to attain sustainability in developing nations. Decreasing awareness of adolescent is important impediment to CC adaptability in developing nations. Since CC impacts are increasing the frequency and severity of disasters, so increasing local awareness of CC is essential. Building the knowledge, abilities, attitudes, and behaviors all are necessary to combat the effects of CC, participate in and develop climate policies, support the green and promote individual environmental responsibility all depended on education **(Abbas, 2020).**

Environmental education effectively improves attitudes toward public environmental policies, as well as individuals' willingness to participate in pro-environmental behaviors. However, adults tend to have more stabilize behavior patterns, consumer habits, and value orientations. In contrast, adolescents are more easily guided and subject to intervention. Adolescents begin to form early environmental affection, values, and attitudes in high school, and these have a long term impact on the affective environmental attitudes and value orientation of the whole society **(Eugene et al., 2021).**

Mobile phone health interventions are a new, quickly developing technique that have been utilized to enhance the provision of healthcare services in various nations throughout the world. Mobile phones can be a cheap way to spread health information. It offers consumers of distant learning numerous chances and advantages. Increasing students' knowledge, abilities, and skills, ensuring educational equality and allowing each student the chance to learn at their own pace, and encouraging autonomous and lifelong learning opportunities **(Lee et al., 2021).**

In reducing the impact of CC on the healthcare sector and adjusting to the phenomena, nurses are play crucial role. For adolescents to be able to serve as leaders and take initiative to create climate safe health systems, the idea of sustainability in practice and knowledge related to CC must be integrated into education, in both theoretical and practical courses. As a result, it is important to state that, adolescence students need to be ready for a new career while keeping CC in mind **(International Council of Nurses, 2021).**

Significance of the study

Egypt is the most populous nation in Africa and ranks as the 87th most vulnerable nation to the threat of CC. But when it comes to being unprepared to deal with CC, it ranks at number 73rd in the world. Water supplies are under severe strain due to the high population growth, rapid urbanization, and impacts of CC. Threats to human health, biodiversity, and food security follow from this, with the CC forecast, Egypt's rapidly growing urban centers will struggle to provide essential services like health care, housing, sanitation, education, and energy **(Climate Change Profile, 2020).**

Changes in climate patterns can put lives at risk. One of the most lethal meteorological phenomena is heat. Hurricanes are becoming more intense and wetter as ocean temperatures rise, which can result in both direct and indirect fatalities. More flames are caused by dry weather, which pose significant health hazards. By influencing the food we eat, the water we drink, the air we breathe, and the weather we face, these influences pose a threat to our health. Adolescents that study CC will be better able to comprehend why global temperatures are rising, how their environment affects them, and how to address this issue before it gets worse **(Abutaleb et al., 2019).**

Aim of the study

This study aimed to evaluate the effect of mobile intervention to enhance adolescents' awareness about climate change and its adverse effect.

Research Hypotheses

H_1: Implementation of mobile intervention will improve studied adolescents' knowledge about climate changes and its adverseeffects at posttest than pretest.

H_2: Implementation of mobile intervention will improve studied adolescents' daily life reported practices about climate changes and its adverse effects at posttest than pretest.

H_3: Implementation of mobile intervention will improve studied adolescents' attitude about climate changes and its adverse effects at posttest than pretest.

H4: Implementation of mobile intervention will improve studied adolescents' awareness about climate changes and its adverse effects at posttest than pretest.

H_5: There will be a significant correlation between studied adolescents' knowledge, attitudes, reported practices and awareness about climate changes and its adverse effects at posttest.

Subjects and Methods

I. Technical Design

Research design

A quasi-experimental research design was utilized in this study with pre and post mobile intervention. A quasi-experimental research design is a style that aims to prove a causal connection between an dependent and independent variable. A quasi-experimental design is a useful tool in situations where true experiments cannot be used for ethical or practical reasons and demonstrate causality between an intervention and an outcome.

Setting

The study was carried out in three secondary schools namely Fatima AlZahra Official Languages, Hoda Shaarawy Official Languages (in Hadayek Helwan) and 25 January Official Languages (in El-Massara) affiliated to El-Massara Administration in the Egyptian Governorate of Cairo.

Sampling

Sample technique: A multi-stage random sample was used for the selection of adolescent from the secondary school according to the following stages:

First stage: Three secondary schools were selected randomly to conduct the study namely Fatima Al-Zahra Official Languages, Hoda Shaarawy official languages (in Hadayek Helwan) and 25 January official languages (in El-Massara).

Second stage: From each school, two first-grade classes and two second-grade classes were randomly chosen. Twelve classes in total were involved in the study.

Third stage: Adolescents in the selected classes who agreed to participate were included in the study.

Sample size:

Based on data from literature **(Sulistyawati et al., 2018)**, considering the level of significance of 5%, and the power of study of 80%, the sample size can be calculated using the following formula:

$$n = \frac{2(Za/2 + Z\beta)^2 \times p\,(1-p)}{(d)^2}$$

where, p = pooled proportion obtained from previous study; d = expected difference in proportion of events; $Z_{\alpha/2}$ =1.96 (for 5% level of significance) and Z_{β} = 0.84 (for 80% power of study). Therefore,

$$n = \frac{2(1.96 + 0.84)^2 \times 0.60\,(1-0.60)}{(0.05)^2} = 376.3$$

Accordingly, the sample size required is 377.

Tools for data collection:

Tool one: A Structured Interview Questionnaire.

The researchers developed it after reviewing pertinent literature in order to gather the necessary data. It was written in simple Arabic language and including two parts:

Part 1: Characteristics data of studied adolescents which include: Age, gender, grades, academic year, residence, family size. Family Crowding Index (FCI) formula adapted from **American Association of Public Opinion Research, (2007)** Family Crowding Index= number of persons in a household /number of rooms used for sleeping, less than 3 was regarded as not crowded and more than 3 was regarded as overcrowded. Scoring for crowding index, not crowded family (<3) and Overcrowded family (>3).

Part 2: Knowledge of studied adolescents about climate change (pre/post)

It was used pre/post mobile intervention and included (8 items) about meaning, causes, factors contributing to CC, major environmental problems of CC, dangers of increasing CO_2 in the atmosphere, an indicator of CC, consequences of CC, and methods for eliminating CC and the effect **(UNICEF, 2015) (WHO, 2021)a** and **(WHO, 2021) b.**

Scoring system:

Knowledge taken from the adolescents was validated using the key model answer. The score questions was categorized as the following: A complete correct response given two score, incomplete response given score one and unknowing or wrong response given score zero. The total knowledge score ranged from 0-16. The total score was converted into percentage and interpreted as the following: < 50% scored 8 are regarded as poor, 50 - < 75% scored from 8<12 are regarded as faire and ≥75% scored 12 are regarded as good.

Tool two: Studied Adolescents' Daily Life Reported Practice (pre/post): It was created by the researchers using relevant literature to assess the studied adolescents' daily life reported practices about CC, it consisted of 9 statements measuring the indoor and 6 statements measuring the outdoor daily life practices for example, turn off lights I'm not using, buy energy efficient light bulbs, use rechargeable batteries, decrease plastic products, separate the wet and dry household waste, minimize use of papers and participation in tree plantation drives.

Scoring system:

Reported practices were calculated as a score of one for done practice and zero score for not done in each statement. The total score of practice ranged from 0-15, the total practice scores were categorized as < 60% is considered inadequate practice which score ranged from 0< 9 and ≥ 60 % is considered adequate practice which score ranged from 9-≤15.

Tool three: Studied Adolescents' Attitude Likert Scale Toward Climate Changes

It was created by **Morgado et al., (2017).** it was used to evaluate the studied

adolescents' attitude towards CC it consisted of 10 statements, for example, CC is caused by natural processes, flood is one of the CC impacts, air pollution has influenced health, CC has effects on mental health, such as stress and Infectious diseases, for example, dengue fever, can possibly increase by CC events. The Likert Scale was rated from 1- 3, with (1) disagree, (2) Neutral, and (3) agree.

Scoring system:

The total score of attitude rated from 10-30. The positive attitude (≥60%) with a score rated from 18-≤ 30. The negative attitude (<6%) with score rated from 10-<18.

Tool four: Studied Adolescents' Awareness About Climate Change and Its Effect (pre/post):

It was developed by **Skalík, (2015)** and modified by researchers, it composed of 20 questions to evaluate studied adolescents' awareness about CC and its effect, for example, CC is unbreakable, is more harmful than beneficial, is caused mostly by human activities, causes a rise in sea levels, affecting wind pattern, increases incidence of floods, increases the water shortage problem and developed countries contribute more to CC. Each question carried one mark in case of yes but zero in case of no or do not know.

Scoring system:

The total awareness score ranged from 0-20, the total score was then converted to percentages and was interpreted as follows: High awareness (≥ 75%) with a score ≥15, moderate awareness (60 % -< 75%) % with a score ranged from 12-<15 and low awareness (<60%) with score < 12.

Data collection procedures:

II. Operational Design

a- Preparatory phase:

In order to create the study tools for data collection, the researchers reviewing the existing literature and the various studies related to CC using internet searches, magazines, articles and books.

- **Validity:** Three experts in Pediatric Nursing and Community Health Nursing evaluated and validated tools. In order to ensure relevance and completeness, modifications were performed as required.

- **Reliability:** The researchers used reliability to test the internal consistency of the tools by giving the identical tools to the same subjects twice, with a two-week interval between each administration. Test-retest reliability was used to compare results from reported testing. Using Cronbach Alpha, the study tools' dependability was evaluated. Cronbach's Alpha for the adolescents' knowledge, reported practices, attitude, and awareness of climate change was 0.866, 0.911, 0.842, 0.873, and 0.842, respectively.

- **Pilot study**: Before beginning the actual data collection, a pilot study on 10% (38 students) of the study sample was conducted to assess the tools' clarity, applicability, and time requirements for filling. After analyzing the data from the pilot research, the appropriate adjustments and tool reorganizations were made. Adolescent who took part in the pilot study were not included in the study sample.

Ethical considerations:

The adolescents being studied, as well as their parents, gave their oral consent to take part in the study. They were given the assurance that all information gathered about them would be kept private and used only for the study's. studied adolescent and their parents assured that have a right to accept or refuse the participation, also to withdraw without given any rational. Participants' privacy, safety, security, and protection all were guaranteed.

Field work:

Data were gathered over a six-month period beginning from the first of December 2021 to the end of May 2022.

Construction of mobile intervention for studied adolescents about climate change includes the following:

The researchers greeted and introduced themselves to studied adolescence before enrolling in the study. They also described the study aim. After that the data collection was

done using the aforementioned tools as a pretest, the questionnaire was then given to the adolescence being studied, and the researchers evaluated their responses. Based on the assessment's findings and in the light of relevant literature, the mobile intervention was created.

Knowledge regarding CC included meaning, causes, factors contributing to CC, major environmental problems of CC, dangers of increasing CO_2 in the atmosphere, an indicator of CC, consequences of CC, and methods for eliminating CC effect. Give instructions about good practices to eliminate CC and its adverse effect, as turning off lights when not using, buying energy efficient light bulbs, using rechargeable batteries, decreasing plastic products use, separating the wet and dry household waste, minimizing the use of papers and participation in tree plantation drives **(UNICEF, 2015), (WHO, 2021)a** and **(WHO, 2021)b.**

Following the implementation of the mobile intervention, a post-test that lasted six months was conducted. To that end, 20 messages for theoretical knowledge and three videos about good practices to avoid the negative effects of CC were sent to each studied adolescent via mobile. These messages and videos were written in a straightforward manner to be appropriate for all studied adolescents.

Different methods of teaching and media were employed, such as discussion, movies, and images sent via mobile devices by creating a group on Whats App to send messages to all the adolescents under study and creating a soft-designed booklet. More communication between researchers and all of the studied adolescents in order to share knowledge and experiences between groups and assess the impact of the messages and videos on studied adolescents' knowledge, practices, attitude, and awareness.

The mobile intervention is guided by a softly designed booklet sent via Whats App includes knowledge about good practices to avoid adverse effect of CC.

- **Evaluation phase:** After the mobile intervention, the knowledge, attitudes, practices, and awareness levels of the studied adolescents were assessed using the same tools for the pretest and posttest.

III. Administrative Design

The manager of the study setting gave official approval to carry out the current study, the aim of the study and expected results were clearly demonstrated.

IV. Statistical Design

The Statistical Package for Social Sciences (SPSS), version 24, was used to analyze the data. Descriptive data represented the majority of the first collected data, which was coded, reviewed, tabulated, and statistically analyzed using numbers, percentages, means, and standard deviations. Variables were compared using the differences chi-square test. The correlation co-efficient test was used to determine whether two variables were correlated. Results were considered insignificant at $P > 0.05$, significant at $P < 0.05$, and high statistical significant at $P < 0.01$.

Results

Table (1) clarifies that 60.5% of studied adolescents were male. Concerning age, more than half (51.5%) were in age 17 years with a Mean ± SD of 16.91±0.67. less than three fifth (56.8%) of them were in the second secondary grade. As regards family crowding index 53.6% were not crowded (<3). As well, less than three quarter (71.9%) of them had a family size range from 4< 6 member. Regarding the level of mother and father education, 50.1% and 33.7% had secondary and university education respectively. Regarding parents employment status, there were 59.2% of mothers employed, and 82.5% of fathers had employment.

Table (2) shows that more than half (53.1%, 53.6% & 54.4%) of studied adolescents knowledge had incorrect knowledge about the meaning, causes and factors contributing to CC respectively at pre mobile intervention, which changed to 77.7%, 76.7% & 74.0% respectively had complete correct knowledge at post mobile intervention. As well, 52.3%, 56.0%, 55.7%, 55.7%, and 54.4% of them had incorrect knowledge about the major environmental problems, dangers of increasing CO_2 in the

atmosphere, indicators, and con sequences, and methods for eliminating CC respectively at pre-mobile intervention, which improved to 78.0%, 76.4%, 74.3%, 74.5%, and 75.3% respectively had complete correct knowledge at post mobile intervention.

Figure (1) demonstrates that, more than half (54.4%) had a poor level of knowledge pre-mobile intervention which improved to 80.4% had a good knowledge levels post mobile intervention. As well, between the before and after intervention, there was a highly statistical significant difference at (X^2 =386.898 at P<0.001).

Figure (2) clarifies that more than half (57.3%) of the studied adolescent had a source of knowledge from the television, 39.5% from friends and family. Only 4.8% from the radio.

Table (3) reveals that there was a highly statistically significant difference between daily life reported practices before and after the implementation of the mobile intervention regarding all the items at P<0.001.

Figure (3) demonstrates that 62.3% of the studied adolescents had inadequate practices before intervention, which improved to 76.1% in post-mobile intervention had adequate practices. The difference between before and after interventions was a high statistical significant difference (X^2=113.701 at P<0.001).

Table (4) illustrates that there was a high statistical significant difference between before and after implementation of the mobile intervention concerning all items of the attitude of the studied adolescents about CC at P<0.001.

Figure (4) shows that 69.5% of the adolescents in the study had a negative attitude regarding CC prior to the mobile intervention, however 78.8% had a positive attitude after the intervention. The difference between before and after mobile interventions was a high statistical significant (X^2=177.251 at p < 0.001).

Table (5) presents that, there was a high statistical significant difference between before and after mobile intervention concerning all the items of the studied adolescent awareness about CC at P<0.001.

Figure (5) demonstrates that, 59.4% of the studied adolescent had a low awareness toward CC in pre-mobile intervention, while at post 75.3% changed to high awareness. There was a high statistical significant difference between before and after mobile intervention (X^2 =332.141 at P<0.001).

Table (6) clarifies that, there was a high statistical significant correlation between all the study variables as between knowledge, practices, attitudes, and awareness level at post-mobile intervention p<0.001.

Table 1. Distribution Characteristics Data of Studied Adolescents (n=377)

Items	No.	%
Age/ Years		
16	110	29.2
17	194	51.5
18	73	19.4
Mean ±SD	16.91 ±0.67	
Gender		
Male	228	60.5
Female	149	39.5
Residence		
Urban	247	65.5
Rural	130	34.5
Educational grade		
1st	163	43.2
2nd	214	56.8
Family size		
4< 6	271	71.9
≥6	106	28.1
Family Crowding Index		
Not crowded (<3)	202	53.6
Over Crowded (>3)	175	46.4
Mother education		
Cannot read and write	17	4.5
Read / write	43	11.4
Basic	60	15.9
Secondary	189	50.1
University	68	18.0
Father education		
Cannot read and write	39	10.3
Read / write	58	15.4
Basic	63	16.7
Secondary	90	23.9
University	127	33.7
Mother Employment status		
Unemployed	154	40.8
Employed	223	59.2
Father employment status		
Unemployed	66	17.5
Employed	311	82.5

Table 2. Distribution of the Studied Adolescents' Knowledge about Climate Changes at Pre/Post Mobile Intervention (n=377)

Items	Pre – Intervention						Post – Intervention						Chi-Square	
	Complete		Incomplete		Incorrect		Complete		Incomplete		Incorrect			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	X^2	P
Meaning of climate change	46	12.2	131	34.7	200	53.1	293	77.7	57	15.1	27	7.2	340.941	<0.001**
Causes of climate change	38	10.1	137	36.3	202	53.6	289	76.7	58	15.4	30	8.0	352.185	<0.001**
Factors contributing to climate change	27	7.2	145	38.5	205	54.4	279	74.0	67	17.8	31	8.2	364.515	<0.001**
Major environmental problems	48	12.7	132	35.0	197	52.3	294	78.0	58	15.4	25	6.6	339.029	<0.001**
Dangers of increasing CO_2 in the atmosphere	33	8.8	133	35.3	211	56.0	288	76.4	62	16.4	27	7.2	370.673	<0.001**
Indicator of climate changes	30	8.0	137	36.3	210	55.7	280	74.3	62	16.4	35	9.3	354.879	<0.001**
Consequences of climate change	32	8.5	135	35.8	210	55.7	281	74.5	64	17.0	32	8.5	354.343	<0.001**
Methods for eliminating climate change	36	9.5	136	36.1	205	54.4	284	75.3	58	15.4	35	9.3	343.977	<0.001**

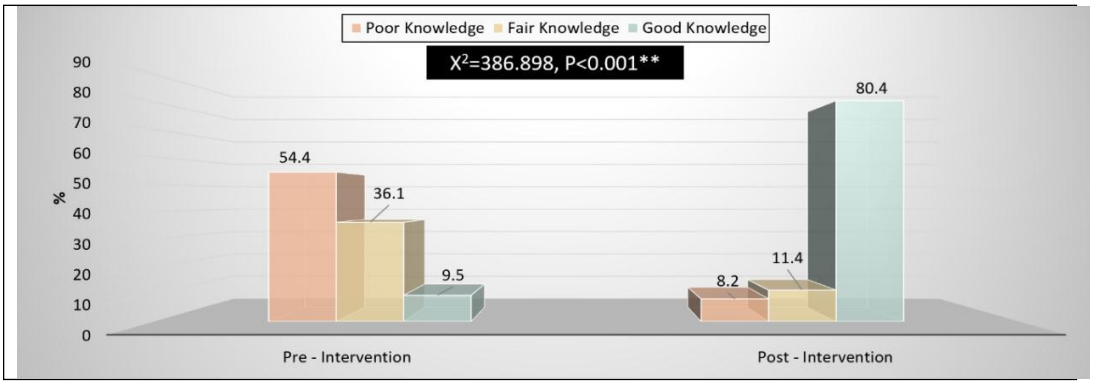

Figure 1. Percentage of Total Knowledge Level of Studied Adolescents at Pre / PostMobile Intervention (n=377)

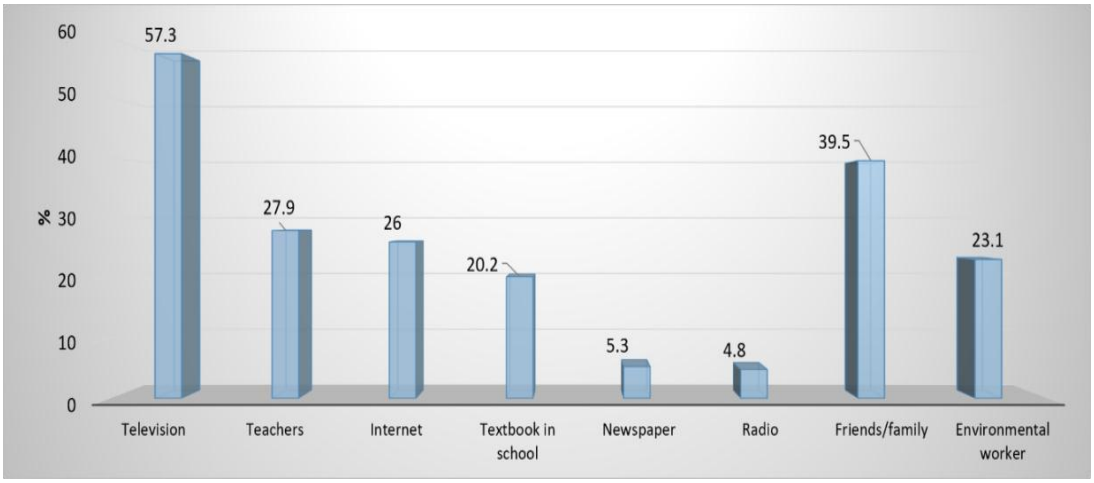

Figure 2. Percentage of studied Adolescents' Source of Information about Climate Change (n=377)

Table 3. Distribution of the Studied Adolescents' Daily Life Reported Practices at Pre / Post Mobile Intervention about Climate Change (n=377)

Items	Pre – Intervention				Post – Intervention				Chi – Square	
	Done		Not Done		Done		Not Done			
	No.	%	No.	%	No.	%	No.	%	X^2	P
Indoor daily life practices										
Turn off lights I'm not using	106	28.1	271	71.9	275	72.9	102	27.1	151.53	<0.001**
Buy energy efficient light bulbs	134	35.5	243	64.5	264	70.0	113	30.0	89.934	<0.001**
Switching off home appliances	125	33.2	252	66.8	288	76.4	89	23.6	142.246	<0.001**
Set air condition temperature at 24°C.(n=126)	151	40.1	226	59.9	255	67.6	122	32.4	57.720	<0.001**
Use rechargeable batteries	143	37.9	234	62.1	301	79.8	76	20.2	136.754	<0.001**
Decrease plastic products	140	37.1	237	62.9	265	70.3	112	29.7	83.351	<0.001**
Encourage and use recyclable products	132	35.0	245	65.0	318	84.4	59	15.6	190.682	<0.001**
Separate the wet and dry household waste.	113	30.0	264	70.0	258	68.4	119	31.6	111.566	<0.001**
Limit using of air condition at summer	131	34.7	246	65.3	267	70.8	110	29.2	98.427	<0.001**
Outdoor daily life practices										
Walk or ride cycle rather than vehicles	144	38.2	233	61.8	302	80.1	75	19.9	137.025	<0.001**
Use stairs instead of elevators	129	34.2	248	65.8	264	70.0	113	30.0	96.858	<0.001**
Minimize use of papers	144	38.2	233	61.8	286	75.9	91	24.1	109.127	<0.001**
Use cloth/cartoon bags in shopping not plastic	102	27.1	275	72.9	283	75.1	94	24.9	173.876	<0.001**
Reduction in consumption of packaged foods	125	33.2	252	66.8	285	75.6	92	24.4	136.857	<0.001**
Participation in tree plantation drives	149	39.5	228	60.5	303	80.4	74	19.6	130.998	<0.001**

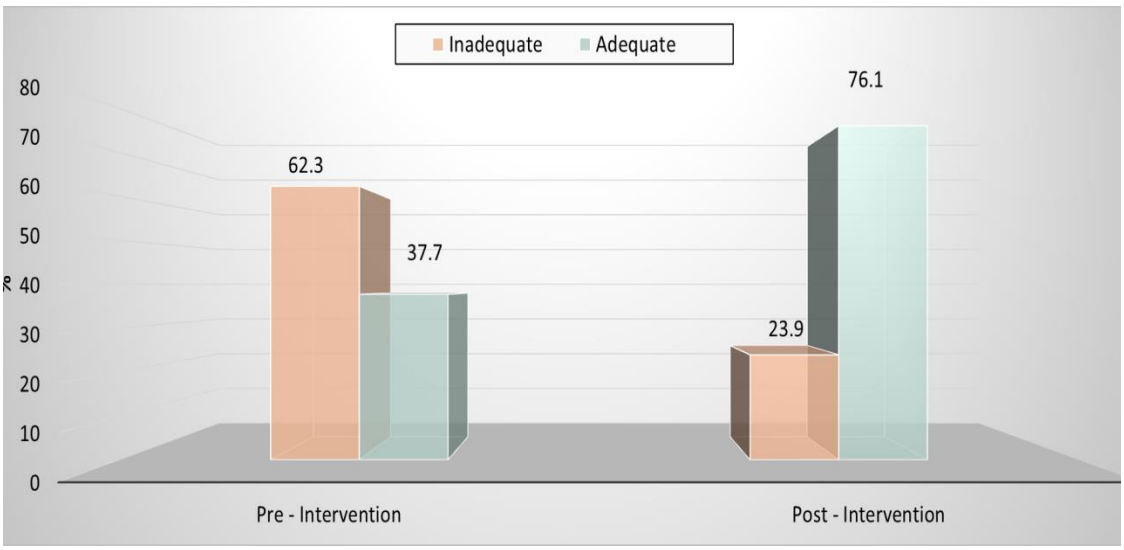

Figure 3. Percentage of Total Reported Practice Level of Studied Adolescents at Pre / Post Mobile Intervention (n=377)

Table 4. Distribution of the Attitude of Studied Adolescents at Pre / Post Mobile Intervention about Climate Change (n=377)

Items	Pre – Intervention						post – Intervention						Chi – Square	
	Agree		Neutral		Disagree		Agree		Neutral		Disagree			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	X^2	P
Climate change is caused by natural processes	38	10.1	87	23.1	252	66.8	295	78.2	46	12.2	36	9.5	372.984	<0.001**
Flood is one of the climate change impacts	49	13.0	62	16.4	266	70.6	264	70.0	67	17.8	46	12.2	303.00	<0.001**
Climate change affect health	27	7.2	43	11.4	307	81.4	317	84.1	34	9.0	26	6.9	482.648	<0.001**
Air pollution has influenced health	44	11.7	79	21.0	254	67.4	276	73.2	55	14.6	46	12.2	316.711	<0.001**
The increases in cardiovascular diseases are related to CC.	32	8.5	57	15.1	288	76.4	276	73.2	63	16.7	38	10.1	385.316	<0.001**
Climate change has effects on mental health	37	9.8	74	19.6	266	70.6	286	75.9	57	15.1	34	9.0	373.573	<0.001**
Climate change can increase food and waterborne diseases such as diarrhea	34	9.0	53	14.1	290	76.9	262	69.5	67	17.8	48	12.7	350.521	<0.001**
Infectious diseases, for example, dengue fever, can possibly increase by climate change events	48	12.7	72	19.1	257	68.2	276	73.2	67	17.8	34	9.0	331.514	<0.001**
Personal behavior is important	51	13.5	72	19.1	254	67.4	295	78.2	51	13.5	31	8.2	350.142	<0.001**
CO_2 has a high impact on CC	36	9.5	79	21.0	262	69.5	295	78.2	57	15.1	25	6.6	401.93	<0.001**

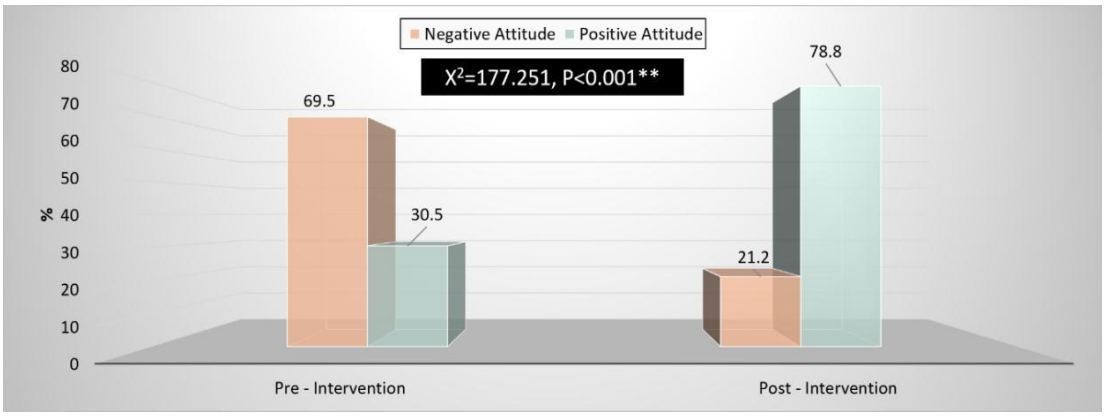

Figure 4. Percentage of Total Attitude Level of Studied Adolescents at Pre / Post MobileIntervention about Climate Change (n=377)

Table 5: Distribution of Studied Adolescents' Awareness at Pre/Post Mobile Intervention about Climate Change (n=377)

Items	Pre – Intervention		Post – Intervention		Chi – Square	
	No.	%	No.	%	X^2	P
Climate change is an unbreakable process	82	21.8	350	92.8	389.315	<0.001**
Climate change is more harmful than beneficial	110	29.2	336	89.1	280.351	<0.001**
Climate change is caused mostly by human activities	127	33.7	345	91.5	269.211	<0.001**
Climate change increases surface temperature	95	25.2	331	87.8	300.546	<0.001**
Climate change causes a rise in sea levels	123	32.6	341	90.5	266.298	<0.001**
Climate change affecting rain pattern	121	32.1	347	92.0	287.724	<0.001**
Climate change affecting wind pattern	122	32.4	328	22.0	233.894	<0.001**
Climate change leads to coastal erosion	72	19.1	331	87.8	357.568	<0.001**
Climate change influences agricultural yields	87	23.1	342	90.7	351.650	<0.001**
Climate change poses threats to food security	101	26.8	343	91.0	320.817	<0.001**
Climate change is the cause of new diseases	125	33.2	325	86.2	220.467	<0.001**
Use of solar energy accelerate global warming	120	31.8	330	87.5	243.065	<0.001**
Excessive heat and cold are possibly increased by CC.	90	23.9	332	88.1	315.174	<0.001**
Climate change increases the incidence of floods	109	28.9	340	90.2	293.798	<0.001**
Climate change increases the water shortage problem	112	29.7	344	91.2	298.652	<0.001**
Climate change increases the rate of glacier melting	103	27.3	338	89.7	301.664	<0.001**
Gases that contributed to aggravating CC	73	19.4	335	88.9	366.638	<0.001**
Developed countries contribute more to CC	93	24.7	328	87.0	297.016	<0.001**
Developing countries are more vulnerable to the effects of CC	123	32.6	341	90.5	266.298	<0.001**
Climate change will be more severe in the future	82	21.8	351	93.1	392.539	<0.001**

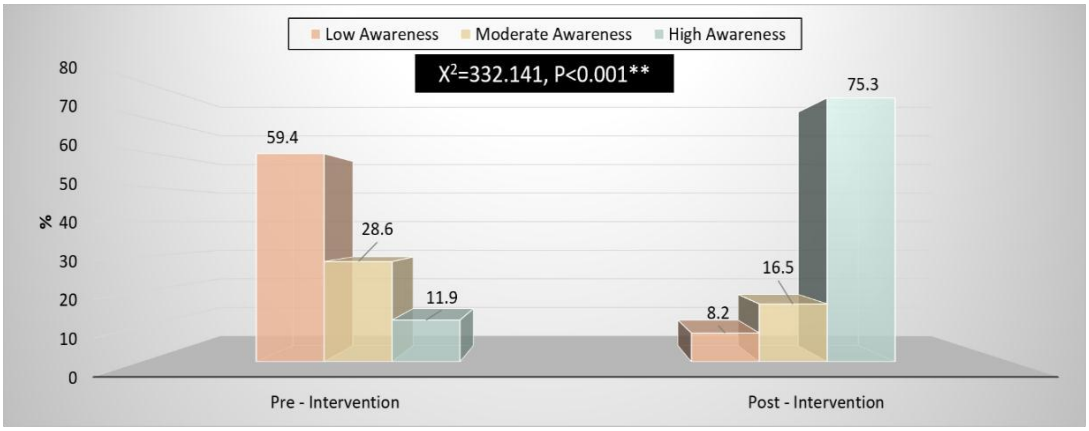

Figure 5. Percentage of Total Studied Adolescents' Awareness level at Pre ⁄ Post Mobile Intervention (n=377)

Table 6. Correlation between Total Knowledge, Attitude, Reported Practices and Awareness Level of Studied Adolescents at Post Mobile Intervention (n=377)

Variables	Post – Intervention							
	Knowledge		Practices		Attitude		Awareness	
	r	p	r	p	r	p	r	p
Knowledge	-	-	0.309	<0.001**	0.170	<0.001**	0.129	0.012*
Practice	0.309	<0.001**	-	-	0.368	<0.001**		
Attitude	0.170	<0.001**	0.368	<0.001**	-	-	0.212	<0.001**
Awareness	0.129	0.012*	0.362	<0.001**	0.212	<0.001**	-	-

Discussion

Climate change is a critical trouble all over the international that poses a large international danger to human fitness. Between 2030 and 2050, CC is anticipated to intent an extra 250,000 deaths per year. A right try to decrease the effect have to be addressed via mitigation and adaptation. A proper effort should be made to reduce the damage. It is expected that adolescents, who are members of society, will eventually deal with CC. On the other hand, adolescent make fantastic change agents for spreading CC messages. **(Sulistyawati et al., 2018)**and **(WHO, 2021)a.**

The younger generation is our future. They will live longer and will be more vulnerable to the hazardous effects of CC. The next generation has the right to save the environment, preserve natural resources, and work on their efficient use. Consequently, this study was conducted to evaluate the effect of mobile intervention to enhance adolescents' awareness about climate change and its adverse effect.

Regarding to studied adolescents characteristics, the current study results discovered that three fifth of adolescents in the study were male. This study results are nearly in the same line with the study conducted by **Mishra et al., (2022)**, whose study "Knowledge, Perception, and Behavior Concerning Impact of Climate Variability on Health: A Cross-sectional Study in the Tribal-dominated Kalahandi District of Odisha, India" and reported that more than three quarter (76.4%) of respondents were male and less than one quarter (23.6%) were female respondents.

As regards the crowding index and family size. The current study results showed that more than half were not crowded and less than three quarter are large families as the number of members in the family ranged from 4< to 6 members.

This disagreed with those of **Mishra et al., (2022)** who stated that less than two-thirds (64.9%) of the respondents had a large family comprising of eight or more members, more than one quarter (26.0%) of the participants had a median family of 4-8 members. This might be due to various adolescent samples, different areas and classification, and various characteristics of environment.

Identifying and discovering the gap of knowledge in the adolescent about CC is important to engage with adolescents effectively. Knowledge measurement is necessary because there is a growing consensus that knowledge is one of the crucial components in helping a community develop its capacity for adaptation **(Sulistyawati et al., 2018).**

Regarding knowledge of studied adolescents, the current study findings demonstrated that there was a high statistical significant difference after mobile intervention compared to before mobile intervention regarding the meaning, causes, factors contributing to CC, major environmental problems, dangers of increasing CO_2 in the atmosphere, and consequences of CC as there increased the correct answer after implementation of the mobile intervention. As well the present study demonstrated that post-mobile intervention there was decrease in a poor level of knowledge and an increase in fair and good knowledge levels and the difference between before and after mobile intervention was a high statistical significant.

These study result consistent with study carried out by **Kurup et al., (2021)** whose study entitled "Informed-Decision Regarding Global Warming and Climate Change Among High School Students in the United Kingdom" on high school students by using an inquiry intervention model, revealed that students developed a strong knowledge regarding awareness related to causes and effects of CC and global warming after intervention.

Moreover, this result is agree with a study carried out by **Gautam et al., (2021)** whose study entitled "Students' Awareness towards Climate Change: A Study of Climate Change Effects on Human Health in Nepal" and found that less than three quarter (72.7 7%) answered incorrect regards meaning of CC. As well, these results were consistent with **Almulhim (2021)** whose study entitled "Public Knowledge and Perception of Climate Change and Global Warming in the Context of Environmental Challenges and Policies in Saudi Arabia" and stated that, one-third of the study sample had poor knowledge about the causes and impacts of CC. Also slightly above one quarter of the study participants had a good knowledge level, and understanding about CC.

Furthermore, the current study is inconsistent with **Yang et al., (2018)** whose studied "Associations between Knowledge of the Causes and Perceived Impacts of Climate Change: A Cross-Sectional Survey of Medical, Public Health and Nursing Students in Universities in China" and stated that, less than three-fifth (58%) students correctly known the causes of CC, the majority (88%) respondents believed that CC is bad for human health and more than two third (67%) of respondents thought that CC is controllable.This may be due to the effectiveness of the mobile intervention in improving adolescents' knowledge and filling a gap in knowledge aboutCC and effectiveness.

So, research hypothesis (H_1) which stated that implementation of mobile intervention will improve studied adolescents' knowledge about CC and its adverse effects at posttest than pretest was approved.

In relation to the source of knowledge of adolescents in the study. This study clarified that more than half of the adolescents have a source of knowledge from television and nearly two-fifths from friends and family. Only less than one-tenth from the radio. This is similar to the results of the study conducted by **Gautam et al., (2021)** whose said that more than three quarter (77.3%) television was the respondents' most important source of information, followed by teachers, the internet, and textbooks from school.

This study nearly consistent with **Biswas et al. (2021)** study conducted entitled "Public Perceptions about the Impact of Climate Change on Human Health: A Study of Bangladesh" reported that while nearly 50.4%

of respondents cited television and radio as their informational sources, only 13.5% of respondents learned about CC from the internet, and just 3% learned about it from their neighbors and friends.

However, these results disagreed with those of **Skalík (2015)** whose study entitled "Climate Change Awareness and Attitudes among Adolescents in the Czech Republic" who stated that more than two third (70%) of the participants depend mainly on the internet and social media as primary sources of information on CC followed by television. This may be due to modern technologies, such as computers, mobile phones, TVs, radios, etc., are essential in educating the uninformed adolescent about any significant problems such as CC.

Regarding studied adolescent daily life reported practices at Pre ⁄ Post mobile intervention about CC, the present study findings revealed that the difference between pre/post mobile intervention was a high statistical significant concerning all the indoor and outdoor daily life practices items, as there was an increase in the indoor and outdoor daily life practices activities that minimize CC at post mobile intervention, as less than three quarter turn off lights when not using, buy energy efficient light bulbs, decrease plastic products and limit using of air condition at summer. Also, the majority use recyclable products, walk or ride cycles rather than vehicles, and participate in tree plantation drives.

The result demonstrated that less than two-thirds of studied adolescents had inadequate practices pre-intervention, changed at post mobile intervention to less than three quarter had adequate practices. The difference between pre and post-mobile interventions was a high statisticalsignificant.

This result is parallel to the study done by **Kurup et al., (2021)** which revealed that, the majority of students shared in planting trees, use of alternative sources of energy, use public transports and walked rather than driving cars.

This may be connected to the fact that, as a result of the mobile intervention, adolescences' believe they have the power to improve or harm the environment by their actions, and that, if they act responsibly, they may lessen environmental damage, especially as it relates to climatic changes.

Hence, the research hypothesis (H_2) which stated that, implementation of mobile intervention will improve studied adolescents' daily life reported practices about CC and its adverse effects at posttest than pretest was accepted.

The international response to CC must include education as a key component. Education about CC aids young people in understanding and addressing the effects of global warming **(Gautamet al., 2021)**

Concerning the attitude of the studied adolescent at Pre ⁄ Post mobile intervention about CC, the present study findings revealed that there was a high statistical significant difference between before and after application of the mobile intervention concerning all items of the attitude of studied adolescents about CC. As in post-intervention more than three quarter agree that CC is caused by natural processes and CO_2 has a high impact on CC. The majority agree that CC affects health. As well, less than three quarter agree that flood is one of the CC impacts, and increases in cardiovascular diseases are related to CC and infectious diseases for example dengue fever can possibly be increased by CC events.

The current study result illustrated that more than two-third of studied adolescents had a negative attitude regarding CC before mobile intervention, however after intervention changed to more than three quarter had a positive attitude. There was a high statistical significant difference between before and after mobile intervention.

This finding is consistent with **Ibrahim et al., (2018)** study entitled "Knowledge and Attitude Regarding Global Warming

Phenomenon among Assiut University Students" which reported that most of students in the study had a total positive attitude toward CC. Similarly, **Gautam et al., (2021)** who stated that education promotes behavioral and attitude changes and aids in CC adaptation.

This may be related to how better understanding of CC fosters in adolescences a sense of responsibility by fostering a positive attitude, and it may give them empower they need to counteract its negative effects.

So, research hypothesis (H_3) which stated that, implementation of mobile intervention will improve studied adolescents' attitude about CC and its adverse effects at posttest than pretest was approved.

For adolescences develop good adjustment abilities, it is crucial to be aware of the consequences of CC on their health**.** By implementing mitigation strategies and changing their behavior, people can better understand the true nature of CC and the urgency of the situation **(Almulhim, 2021).**

The current study findings demonstrated that the difference between before and after mobile intervention was a high statistical significant concerning all items of the studied adolescent awareness about CC. As there was a significant improvement in awareness regarding all items, as CC is caused mostly by human activities, increases surface temperature, causes a rise in sea levels, affects rain patterns, affects wind patterns, can lead to coastal erosion, influences agricultural yields, poses threats to food security and is the cause ofnew diseases.

As well, the current study result demonstrated that slightly less than three-fifth of studied adolescents had a low awareness regard CC before mobile intervention, however after mobile intervention slightly more than three quarter changed to high awareness. The difference between pre and post-mobile intervention was a highly statistically significant.

These results are congruent with **Gautam et al., (2021)** whose reported that only half student in the secondary school are adequately aware about the effects of CC. As well, in order to improve teachers' abilities to impart students, the appropriate problem-solving and decision-making skills on CC, orientation programs on CC should be regularly organized for the students. These programs should also include seminars and workshops for the teachers. This will increase students' awareness about CC. Additionally, conduct research on issues pertaining to waste management, firewood conservation, careful use of non-renewable energy sources, and gardening..

As well, **Almulhim (2021)** stated that the fight against CC urgently needs a rise in public awareness of effective mitigation measures. Furthermore, **Biswas et al**., **(2021)** reported that when developing CC related policies or projects, CC awareness, its effects, and the causes of CC must be integrated. Additionally, society as a whole must be involved in the process of mitigating climate change.

At pre intervention the low awareness may be due to adolescents under study were poor knowledge and adolescent are usually busy with various exams and have no time to read or ask about CC. However, after the intervention, the improvement of high awareness might be attributed to the effect of mobile intervention.

As well, the improvement in the studied adolescent awareness may be based on their overall improvement in knowledge, daily life practices, and attitudes regarding CC which help in modifying their awareness towards environmental activities and appreciating the environmental issues.

Hence, the research hypothesis (H_4) which stated that implementation of mobile intervention will improve studied adolescents' awareness about CC and its adverse effects at posttest than pretest was justified.

The present study result displayed that there was a high statistical significant positive correlation between knowledge, practices, attitudes scores and awareness score at post-mobile intervention regarding CC. This study result nearly similar to study conducted by **Sah et al., (2018)** entitled "Assessment of the knowledge and attitude regarding global warming among high school students of ramnagar, belagavi city: A cross-sectional study" who found a positive correlation between the level of knowledge and daily life practice and attitudes.

As well the study agree with **Akrofi et al., (2019)** study entitled "Students in Climate Action: A Study of Some Influential Factors and Implications of Knowledge Gaps in Africa" stated that students' attitudes is dependent on their level of awareness and knowledge about CC issues. Furthermore, **Reddy et al., (2022)** who study "Knowledge, perceptions and practices of medical students towards climate change and global warming: a cross sectional study" in Karimnagar city, who reported that there was a positive correlation between knowledge and practices regarding CC.

The aforementioned findings supported the research hypothesis (H_5), which stated that there will be a significant correlation between studied adolescents' knowledge, attitudes, reported practices and awareness about climate changes and its adverse effects at posttest.

The study proposed that knowledge, reported practices, attitudes, and awareness of adolescents ab0ut CC and its adverse effects was inadequate and needed to be improved. The current study illustrated that that after the use of a mobile intervention, knowledge, reported practices, attitudes, and awareness among the studied adolescents significantly improved.

Conclusion

The results of the present study conclude that mobile intervention had positive effect in achieving significant improvements in adolescents' knowledge, reported practices, attitudes, and awareness regarding CC and its adverse effect.

As well, there was a positive correlation between their total knowledge, reported practices, attitudes, and awareness.

Recommendation

On the basis of the current study results, it is recommended that:

- Educational program should be designed to increase climate literacy and awareness about CC and its adverse effect, as well as to empower adolescents to move towards sustainability.

- Dissemination of brochures and booklets about the consequences of climate change for adolescent students.

- Future research on a large sample and others setting is need.

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