"Lead Awareness: The Effect of Health Education Programs on Safeguarding Pregnant Women's Health During Pregnancy"

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Abstract

Abstract: Lead is considered one of the most important pollutants in the air, land, and food, and it has a great impact on human health, and it has a great impact on the health of pregnant women. **This study aims to** evaluate the effect of the health education program on safeguarding pregnant women's health from lead exposure during pregnancy. **Design:** A quasi-experimental research design was utilized in this study. **Setting:** The study was conducted at the local unit area in Shubra El-Khema, Egypt, since it was the largest area in population number, with high arithmetic exposure to lead pollution. **Sample:** A cluster random sample was used to select homes using the village map obtained from the Office of Health at Shubra El-Kheima. City. **Tools:** Two tools for data collection were used I) A structured interviewing questionnaire assessing demographic characteristics of pregnant women, assessing pregnant women's knowledge regarding hazards of lead pollution, and pregnant women's reported practice regarding lead pollution. II) Observational checklist to assess the indoor and outdoor environment of the house**.** **Result:** the current study revealed that, 80% of pregnant women had poor knowledge regarding the hazard of lead pollution- pre-programs improved to 70% of them had good knowledge post-program, on the other hand, 80 % of pregnant women had wrong habits regarding cleaning the house to control the lead pollution pre- program, improved to 75% of them doing the action right post-programs, Also, 75% of pregnant women not done practice regarding nutritional habits that effect lead pollution, improved to 75% of them done practice post-program, and 75% of them had bad environment pre-program, improved to 70% the good environment after health education program. A statistically significant difference positive correlation between pre and post-programs p=0.001. **Conclusion:** there was a correlation between pregnant women's total knowledge, total practice, and total score regarding cleaning the house, nutritional habits to control lead pollution, and observation checklist to control indoor and outdoor lead pollution with highly statistically significant differences pre and post-program ($p<0.001$) **Recommendations:** continuous implementation of health education programs about hazards of lead pollution and its impact on pregnant women health and pregnancy outcomes.

Keywords: Pregnant women's, lead pollution, and health educational program.

Introduction:

Lead (Pb) is a naturally occurrin heavy metal that may be found in both th environment and industrial goods. Lea may be emitted into the atmosphere a airborne particulate matter. Motor vehicles and industrial sources were historically significant contributors to lead air pollution. **Tong et al (2019).**

According to **WHO (2016),** 600,000 new cases of children with intellectual disabilities occur annually, and 99 % of children affected by high exposure to lead live in low- and middle-income countries, Also, According to WHO, 143,000 deaths per year result from lead poisoning. At high levels of exposure, lead damages the brain and central nervous system, causing coma, convulsions, and even death. Children who survive such poisoning are often left with intellectual impairment and behavioral disorders, at lower levels of exposure, lead is now known to produce a spectrum of injury across multiple body systems. In particular, lead affects brain development in children, resulting in reduced IQ, behavioral changes such as shortening of attention increased antisocial behavior, and reduced educational attainment. These effects are believed to be irreversible. Adults are at increased risk of kidney disease and raised blood pressure.

The respiratory system absorbs 30-70% of inhaled lead into the bloodstream. Adult gastrointestinal absorption is less efficient and averages 10% of the quantity eaten. About 50% of dietary nutrients are absorbed by children. Because they breathe more than adults, children absorb three times more lead from the environment. Children with inadequate iron and calcium intake absorb lead more easily. **Leggett ,(2020).**

In a study conducted by **Selevan et al. (2019),** it was shown that girls between the ages of 8 and 18 years. who had blood lead levels as low as 3 μg/dL had delays of 2 to 6 months in tanner stage measures, which include the growth of breasts and pubic hair, as well as the onset of menstruation. However, it was seen that non-Hispanic white girls did not have any significant delays.

Lead pollution effects on pregnant women and children such as: As blood lead levels grew, gestational hypertension and high blood pressure during delivery increased in 30,851 Boston Hospital deliveries between 2015 and 2018. The average blood lead level was 6.9 ± 3.3 μg/dL. Lead levels after delivery correlated positively with systolic ($r = 0.081$, $p = 0.0001$) and diastolic ($r = 0.051$, $p = 0.002$) blood pressure. At a reference level of 0.7 μg/dL, the relative risk doubled at blood lead levels of 15. **Cory-Schlecta et al (2019).** Swelling, high uric acid levels, and slow renal function are common signs of preeclampsia. High blood lead levels increase preeclampsia risk. The red blood cell lead levels differed significantly between normotensive ($N = 20$) and hypertensive or preeclamptic ($N = 19$) pregnancies. The researchers found a link between maternal blood pressure and red blood cell lead. **Dawson et al. (2017).**

Lead pollution affects pregnant women and children. The most compelling evidence to date regarding spontaneous abortion is a prospective research conducted in Mexico City.

This study revealed a statistically significant correlation between the levels of lead in the blood of pregnant women (with an average of 11.0 µg/dL) and the likelihood of experiencing spontaneous abortion. The odds ratios for spontaneous abortion in the blood lead groups of 5-9, 10-14, and >15 µg/dL were 2.3, 5.4, and 12.2, respectively, as compared to the reference group. **Borja- Aburto et al.(2016).** Preterm delivery, low birth weight, length, and head circumference In Mexico City, case-control research revealed that the levels of lead in the cord blood of preterm children were higher, with a mean of 9.8 µg/dL, compared to term infants, who had a mean of 8.4 µg/dL. A birth cohort research done in Mexico City revealed a negative correlation between maternal bone lead load and birth weight, as well as birth length and head circumference at delivery. **Adams and. Victor**. **(2019)**.

Congenital Anomalies In a case-control study**, Needleman, et al. (2018)** found an increased risk between living in an area with water lead levels greater than 10 µg/L (ppb) and delivering a child with a neural tube defect. **Walsh,(2018)** found, in a registry-based study, that women occupationally exposed to lead were more likely to deliver an infant with a neural tube defect than women not exposed to lead (OR = 2.87, 95% CI = 1.1–6.4). The rate of linear development after birth was inversely associated with the amount of lead in the blood during pregnancy, but only when babies were exposed to high levels of lead after birth. Infants born to mothers with prenatal blood lead concentration above 7.7 µg/dL (the median level in the group) and whose blood lead levels rose by 10 µg/dL between 3 and 15 months of age had a reduction in height of about 2 cm at 15 months of age ($p = 0.01$). **Choudhari, et al (2019).**

Pregnant women's nutrition may be influenced by their health state. Consuming sufficient amounts of essential minerals (calcium, iron, zinc, vitamins C, D, and E) has been shown to reduce the absorption of lead. Iron deficiency anemia is linked to higher levels of lead in the blood, which may lead to increased absorption of lead. Additionally, it has a separate harmful effect on the development of the fetus. Insufficient calcium levels may lead to an increase in bone remodeling since the mother's bones are a significant supplier of calcium for the growing fetus and breastfeeding baby. Both the usage of sheesha and cigarette smoking have been linked to elevated levels of lead. **Yapici, et al (2016).**

Sources of lead poisoning such as sources of occupational exposure to lead include lead-glazed ceramic pottery, cosmetics such as kajal, Surma, mascara, and lipstick, as well as foods and other consumer items including lunch boxes, candy wrappers, lollipops sticks, and plastic dinnerware. Lead may be found in several sources such as jewelry, drinking water (via drinking utensils), paint, soil polluted with lead, as well

as hobbies and recreational activities. **Hien, et al (2018).** Criteria for Blood Lead Testing in Clinical Settings When symptoms or physical signs of lead poisoning are present, they might be difficult to distinguish since they are often vague and frequently seen. The symptoms include constipation, stomach discomfort, anemia, headache, tiredness, myalgias and arthralgias, anorexia, sleep disruption, trouble focusing, and hypertension, among other manifestations. **Esteban , et al (2019).**

Venous blood lead level (BLL) testing is the most effective screening and diagnostic method for detecting recent or continuing lead exposure, as opposed to exposure that occurred in the past. Due to the higher likelihood of contamination when utilizing the finger-stick approach, it is necessary to verify an elevated blood lead level (BLL) acquired from finger-sticking by performing venipuncture. Blood lead levels (BLLs) exhibit a reasonably quick response to sudden or occasional fluctuations in lead consumption, such as when youngsters consume lead paint chips. Additionally, during relatively brief durations of exposure, BLLs demonstrate a direct correlation with the amount of lead ingested. For persons who have had significant or long-term exposure in the past, blood lead levels (BLLs) often do not accurately reflect the overall amount of lead in the body. This is because most of the lead is deposited in the bones and may have "normal" levels in the blood. **Wedeen, et al ,(2017).**

Zainab Saqr, Director of the Lead Pollution Control Program, (2012) stated that at Shubra El-Kheima. City lead deposition on land poses many threats to cleaning workers, nearby inhabitants, and the environment. Children and pregnant women who live near the foundry site or inside the site floor and inhale or swallow high percentages of lead-contaminated fugitive dust are at risk of serious health problems from battery handling chemicals like cadmium, arsenic, antimony, and selenium. Dust builds up on crops and in Ismailia Canal water.

The role of nurses provide health education for pregnant and lactating women. Effects of Lead Poisoning on Pregnant Women and their Children. Seek to identify the origin of lead exposure and provide guidance to expectant mothers on how to prevent further exposure. Evaluate the sufficiency of nutrition and provide a well-rounded diet that includes sufficient amounts of iron and calcium. Conduct confirmatory and subsequent blood lead tests. For women who are exposed to work hazards, it is important to examine the correct use of personal protective equipment. Promote the practice of breast-feeding**. Daniell , et al .(2019)**. In addition, nurses guide pregnant women about General Nutritional Recommendations for Pregnant and Lactating Women. Effects of Lead Poisoning on Pregnant Women and Children. Pregnant and breastfeeding women should have a well-balanced diet to ensure sufficient intake of vitamins, nutrients, and minerals. It is recommended to assess the iron

levels of all pregnant and breastfeeding women and treat them with iron supplements to address any iron deficit. It is necessary to assess the dietary sufficiency of pregnant and nursing women and provide them with suitable nutritional guidance and prenatal supplements. Women requiring aid should be directed to initiatives, such as the Supplemental Nutrition Assistance Program. Pregnant and nursing women should refrain from consuming chemicals that have the potential to harm the developing fetus or newborn. **Von Schirnding, et al (2019).**

Significance of the study:

Lead pollution in Egypt is the main source of air pollution as it represents more than 75% of total pollution in Egypt. Diesel fuel burning is responsible for 18% of the total lead pollution in Egypt. The cement factories and foundry copper are responsible for the other ratio of lead pollution**. Bakir and Amitai, (2019).**

According to the **U.S. Environmental Protection Agency (EPA)(2012).** reported that, Site soil and water samples at Shubra El-Kheima. it contained significant amounts of lead and other elements. Lead was found in soil samples up to the water level and in 33% of the soil. The water exceeded Egyptian and international drinking water limits with 5 micrograms of lead per liter. Lead exposure causes disorders of the blood vessels, kidneys, neurological system, and central immune system, especially in pregnant women. The foundry site study confirmed the serious spread of these pollutants, requiring several measures, the most important of which are removing contaminated dust from the floors, walls, and ceilings, cleaning the scrap to be recycled, removing all contaminated materials, and transporting them to a safe sanitary landfill, and removing the soil. Exposure to hazardous material up to one meter underground and several options.

Exposure to low levels of lead can result in serious and irreversible health and behavioral problems, especially in pregnant women and their children. The lead levels can cause serious long-term health problems and harm almost every part of the body, especially the brain and reproductive organs. Lead can damage the developing brain and nervous systems of unborn children much more easily than those of adults. The effects of lead are most severe in children, and the high concentrations cause lead poisoning can lead to death. **Olympio, Gonçalves, Günther, &Bechara,(2020).**

Aim of the study:

This study aims to evaluate the effect of the health education program on safeguarding pregnant women's health from lead exposure during pregnancy through :

1-Assessing pregnant women’s knowledge and practice regarding hazards of lead pollution

2- Assessing indoor and outdoor surrounding the house environment.

3-Planning and implementing the health educational program regarding pregnant women's needs.

4-Evaluating the effect of health educational programs on improved knowledge, practice, and indoor and outdoor surrounding the house regarding the hazards of lead pollution.

Research Hypothesis:

The pregnant women's knowledge, practices, and indoor, and outdoor surrounding the house environment will be improved after implementing the health educational program regarding the hazards of lead pollution**.**

Subjects and Method:

Methodology :

Research design: A quasi-experimental design was used to achieve the aim of the current study.

Setting: The study was conducted in East Shubra El-Kheima City. Shubra El-Kheima consists of 4 neighborhoods., East Shubra El-Kheima district is the setting of the study, The total population of Shubra El-Kheima is 1, 142, 948 people, East Shubra El-Kheima City, was the largest area in the population number and had higher arithmetic exposure to lead pollution.

Study subjects: A cluster sample was used to select homes with the assistance of the Shubra El-Kheima. City. Development Authority map, randomly selected pregnant women were met during the scheduled visits; each pregnant woman was visited 4 times/ week.

Sample size: The subjects of this study included all pregnant women living in the East Shubra El-Kheima. City, were 3000 pregnant women in the year 2019. Accordingly, the estimated sample size was 300 pregnant women included in the study.

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

Tool: A structural interviewing questionnaire. These two tools are the first tool divided into 3 parts :

Part I: Demographic characteristics of pregnant women including the age, level of education, occupation, monthly income, children's age, child sex, number of children, type of father's work leads to exposure leads of lead pollution, and types of child toys lead to lead pollution

Part II: Pregnant women's knowledge about lead pollution such as the meaning of lead pollution, types of pollution, hazards of lead pollution, and lead poisoning.

Scoring system: the answers to these questions were scored as should be "1" for correct answers, 0" for incorrect answers, don't know. The score of each item was stumped up and then converted into a score :

Poor knowledge: from >50%

Average knowledge: 50-70 %

Good knowledge : > 75 %

Part III: Pregnant women's reported practice about hazards of lead pollution such as :

- **Pregnant women's reported practices towards cleaning the house**, such as: covering the floor, and cleaning the floor cover daily.
- **Pregnant women reported practices regarding habits to ease lead pollution**, like use of the newspaper food, don 'not warning before use.

- **pregnant women reported practices regarding nutritional habits lead to lead pollution** such as the child didn't eat breakfast, didn't eat three meals and snacks.

Scoring system: The answers to these questions should be "1" to done reported practice."0" not done to practice

Scoring system about nutrition habits :

This part contains 18 questions, which were the following :

Always = 1 (all the week)
Sometimes = 2 (5times/ week)
Rarely = 3 (once every week)
Never = 4

The questions from (3, 4, 5, 6, 7, 8, 11, 12, 13, and 18)are code following:

Never = 1
Rarely = 2(once every week)
Sometimes = 3(5times/ week)
Always = 4(all the week)
Total score = 18 points.

Total scores :

Done practice = > 50%
Not done practice =< 50

Tool II: The observational checklist to assess the home environment was divided into two sections: **Indoor** lead pollution such as home paint, water pipes, and water supply exposure the pregnant women and their children, and, **outdoor** surrounding the house environment observing greenery or trees outside the homes, burning wastes beside the house, and home structure

Scoring system: The answers to these questions were scored should be "1" to yes."0" to

total score :

Good environmental >50 %
Bad environmental <50%.

Fieldwork:

Fieldwork: Following the acquisition of official permissions to conduct the study, the objectives of the research were communicated to the chosen participants. The study was conducted for nine months, from February 2019 to October 2019, 4 days /week visits took from 30: to 45 minutes, and the family was visited 4 times. The researchers visited 6 houses/ day, 4 days per week (24 houses/ week).

Preparatory phase, implementation phase, and evaluation phase

This study was preceded by a **preparatory phase** in which the following activities were performed:

The researchers did a computer search about the study topic. Then reviewing past and current literature covering the various aspects of the problem was done using books, articles periodicals, magazines, and studies related to the research study.

The researchers took the official letter from the Dean of the Faculty of Nursing, Kafr El-Sheik University, which contains the purpose of the research. Then, the researchers visited the environmental monitoring of the Egyptian Ministry of Health and Population and obtained an official document about the arithmetic mean a year (2009) from points of air monitoring about lead measurement in Cairo. The highest point was in the East Shubra El-Kheima district. Also, observe an arithmetic mean increase each year than the previous year.

Before collecting the data another official letter to the Health Office of East Shubra El-Kheima district to

obtain the district map. This map helped the researchers in selecting the houses and collecting the data.

Phase two: development of the health educational program: In this phase, the researchers analyzed the pretest then tailored the health educational program to the needs of each pregnant woman and immediately did the post-test. There was a commonality among the pregnant women's needs from the educational program. Where there was a lack of knowledge in almost all items and a need for improvement of their habits.

Phase three (implementation phase): in this phase, the researchers implemented the health educational program followed by the immediate posttest. and how to improve the indoor and outdoor environment.

A handbook containing the knowledge needed to be provided and showed video on how to control lead pollution were presented.

Explanation was done for the information about the meaning of pollution, lead, lead pollution, and sources of lead pollution. Also, explaining the habits that cause lead pollution and why children are more vulnerable to lead pollution, this information was stressed in the second visit.

On the third day, the researchers discussed the signs and symptoms of lead poisoning; and methods of prevention and protection from lead poisoning.

On the fourth day, the researchers provided information about: foods that reduce lead poisoning, foods that increase lead poisoning, and correct ways of cleaning the house.

Phase four (Evaluation phase): After implementing the health educational program, immediately the researchers applied the post-test to evaluate the knowledge acquired.Then the researchers stressed the items related to knowledge and habits. Then, after three months, a retention test was applied using the same questionnaire to evaluate acquired knowledge, and habits and observe the environment.

Reliability: Reliability was applied by the researchers for testing the internal consistency of the tool, by administration of the same tools to the same subjects under similar conditions two times 15 days. Answers from the repeated testing were compared (Test-re-test reliability was 0.82) and Cronbach's Alpha reliability was 0.890.

A Pilot Study: has been conducted to test the clarity, applicability, and understandability of the tool. It has been conducted on a sample of 10% (30) pregnant women. The participants of the pilot were included in the main study sample since no major changes were required.

Ethical Consideration: To protect data privacy, all ethical considerations were considered, including verbal consent for research participation, an explanation of the study's goal, and the right to withdraw without explanation

Statistical Design:- Data were analyzed using SPSS 24. We provided qualitative data as numbers and percentages. The chi-square test compared groups. Results were statistically significant if $P > 0.05$.

Limitation of the study: All the families refused to give blood samples from their pregnant women to make

lead blood tests measure lead poisoning in the maternal blood and very few references were found related to the topic.

Results:

Table (1): shows that the mean age of pregnant women is 25.88 ± 0.71. The mean age of fathers is 33 4 ± 0.8. Also, 49.3% of fathers and 63.3% of pregnant women had a diploma / secondary education. 74.6% of pregnant women were housewives. 70% of fathers' were worker+ hand workers. 55.7% of them had 1 – 2 children and 50.3% of the children were females. And, for 7.3% of pregnant women, the monthly income is not enough

Figure (1): Illustrates that 66.8% of fathers who exposed to lead pollution during their work. This figure revealed that 11.5% of the fathers worked in doku cars, 10.9% stories 10.4% painters, and 9.9% repaired batteries.

Figure (2): Illustrates that 65% of types of child toys lead to lead pollution the child sucking figures. And only 15% of them lead pollutants batteries for toys

Figure (3): Illustrates that 80% of pregnant women a poor knowledge regarding lead pollution, 15 %of them had average knowledge, and only 5% had good knowledge pre-program improved to 70% of them had good knowledge post-health educational program.

Figure (4): Illustrates that 80% of pregnant women have wrong habits regarding cleaning the house and only 20% of them doing the action right cleaning the house pre-program improved to 75% of them doing the action right while 25% of them had wrong habits regarding cleaning the house post health educational program.

Figure(5): Shows that 80% of pregnant women had bad habits regarding the control of lead pollution only 20% of them took action right regarding lead pollution pre-program improved post-program, 80% of the action right and only 20% of them had bad habits post-health education program.

Figure(6): Shows that 75% of pregnant women had not practiced nutritional habits that affect lead pollution and only 25% of them had done practices regarding nutritional habits that affect lead pollution health education program improved to 75% of them done practices regarding nutritional habits and only, 25% of them had not done practice regarding nutritional habits post health educational program.

Table (2): Illustrates that, 52. 4% were Peeled paintings from walls, 96.3% had a tab at home as a source of drinking water, 100% of pipes inside a house were made from steel or lead, 51.6% had carpets as a method of covering the floor and 73.4 had family member smoke at home. Regarding outdoor environment exposure of the studied sample to lead 26.6% had burning rubbish beside the house

Figure (7): The figure showed that 75% of them had a bad environment, and 20% of them good environment

pre-health education program, improved to 70% of them had a good environment post-health education program.

Table (3): shows, a statistically significant difference between the total knowledge score of the studied sample and all items of pregnant women's and father's age, level of education, pregnant women's and father's occupations, sex of children, number of children and monthly income P =<0.001**

Table (4): Presented a statistically significant difference between the total practice score regarding cleaning the house and all items of; pregnant women and fathers' age, sex of the children, Number of children, monthly income, level of fathers' & and mothers' education, and pregnant women's occupation. P =<0.001.

It was clear from **Table(5)** that there was a highly statistically significant correlation between total knowledge, total reported practice regarding cleaning the house, and total reported practices regarding nutritional habits leading to lead pollution pre and post-program p= < 0.01*

Discussion:

Lead is a metal that is cheap, useful, and found in many products in many places in the environment. Lead is a heavy metal that causes toxicities when entered through breathing, eating, or absorbed into the human body. Lead is a highly toxic substance, exposure to which can produce a wide range of pregnant women's health effects. It is particularly harmful to young children, especially those under 5 years old. Lead is a well-known non-biodegradable toxic metal in the environment. More than a million children in developing countries are suffering permanent neurological damage due to lead pollution complications**. Tabaku, et al. (2019).**

Regarding to demographic characteristics of the study sample, the current study revealed that, less than half of pregnant women aged between 20< and 30 years, and the mean age Mean ± SD 25.88 ± 0.71. Also, the father's age is more than two-thirds the age between 30< and 40 years, and the mean age Mean ± SD is 33.44± 0.81. More than half of fathers' level of education diploma /secondary education, and more than two-thirds of pregnant women the level of education diploma /secondary education. Regarding the father's occupation more than two-thirds of them work (Worker+ Handwork), while, the majority of pregnant women housewives, and children aged (months) the child rang between 1 and 60 months. Regarding the child sex, less than half of them were female. Also, regarding the number of siblings, more than half of them have 1-2 children, and the majority of them have a monthly income not enough. The study agrees with **Taylor et al. (2019)** study conducted in Vietnam, "Adverse effects of maternal lead levels on birth outcomes in the ALSPAC study: a prospective birth cohort study." and found that, for pregnant women aged 49.0% of them the age between 25 < and 30 years, the mean age of 26.88 ± 0.71. Also, 66.7% of fathers the aged between 30 <and 40 years, and the mean age was 33.47± 0. 71. Regarding level of education, 50.0% of fathers

and 65.0% of pregnant women had secondary education, 75.0% of pregnant women were housewives.

Regarding fathers' work leads to exposure to lead pollution, more than two-thirds of them who exposed to lead pollution during their work. One-fourth of fathers worked in doku cars, storage, and paint, and the minority of them worked repairing batteries. The study agrees with **Little, et al.,(2019)** study conducted in America about "Blood lead levels and growth status among African-American and Hispanic children in Dallas," and found that, 66.8% of fathers who were exposed to lead pollution during their work. Also, the study conducted by **Deborah, (2018)** at the study conducted in the University of Washington, "Childhood Blood Lead Levels and Associated Risk Factors in Vietnam "found that, 70.0 % of fathers who exposed to lead pollution during their work. From the investigator's point of view, most of the fathers work in manual occupations and are exposed to lead contamination most of the time, and they did not attend any workshops to prevent lead contamination, Therefore, parents need to participate in workshops to educate them about protecting themselves from lead pollution

Regarding the child's activities lead to exposure to lead pollutants, the current study revealed that more than two-thirds of children suck their fingers and a minority of child play by battery their games, which leads to exposure to lead pollution. . the study agrees with **Kafourou, et al. (2017)** the study conducted in Pakistan about "Effects of Lead on the Somatic Growth of Children," and found that 70% children suck fingers and the minority of child play by battery their games, lead to exposed to lead pollution. From the investigator's point of view, children's battery-powered games are a great source of lead pollution for children, so mothers must be taught when buying games that the games do not contain batteries to reduce their children's lead pollution to avoid the risks that their children may be exposed to lead pollution.

Regarding the pregnant women's total score knowledge regarding lead pollution, the current study revealed that the majority of pregnant women had poor knowledge regarding lead pollution before the health education program, and more than two-thirds of them had good knowledge of the health educational program. the statistically significant improvement in pregnant women's total knowledge at the post-health educational program -test than that of pre-in all knowledge items regarding lead pollution. (p=0.001**) . the study agrees with **Yimthiang, et al. (2019)** the study conducted in Thailand about ". Screening for elevated blood lead levels and related risk factors among Thai children residing in a fishing community" found that 80% of pregnant women had poor knowledge regarding lead pollution pre-health education program, improved to 70.0% of them good knowledge post health educational program. the statistically significant improvement in pregnant women's total knowledge at the post-health educational

program -test than that of pre-in all knowledge items regarding lead pollution. (p=0.001**).From the investigator's point of view, all pregnant women did not attend any workshops related to lead pollution, which led to a lack of knowledge about lead pollution, which improved after participating health education program.

Regarding pregnant women's total scores reported practice regarding cleaning the house to control lead pollution, the current study revealed that the majority of pregnant women reported wrong habits regarding cleaning the house to control lead pollution health education program, improved the majority of them doing right action post health educational program. The statistically significant improvement in pregnant women's total reported practice at the post-health educational program -test, than that of pre in all reported practice items regarding cleaning the house to control lead pollution. (p=0.001**) . the study by **Silver, et al.** (**2017)** the study conducted in Iran about " Low-level prenatal lead exposure and infant sensory function. "found that 80% of mothers had wrong practices regarding the control of lead pollution and only 20% of them did the right action regarding control of lead pollution pre-program. improved to 80% of them doing the right action and only 20% of them had wrong practice post health education program. From the investigator's point of view, most mothers don't have good knowledge about the materials used in cleaning, which contain lead, which harms them and their children, especially since most mothers did not attend any awareness programs about the dangers of lead and materials that contain lead in house cleaning. the lead element combined with chlorine and produce a new chemical product that is dangerous to human health. The study sample's decrease in the use of chlorine could be because they felt the extent of the danger of using chlorine directly on the dust for cleaning the house after the health education program. Also, the pair of shoes carried dust from the outdoor road to inside the house; this dust may contain lead so recommended to leave the shoes outside the house.

Regarding pregnant women's reported practices regarding nutritional lead pollution, the current study revealed that nearly three-quarters of them had not practiced nutritional lead pollution, pre-health education programs, improved to the majority of them practiced post-health educational programs. The statistically significant improvement in pregnant women's total reported practice at the post-health educational program -test, than that of pre in all reported practice items regarding nutritional that affect lead pollution (p=0.001**). The study agreed by **Yao, & Huang (2016)** the study conducted in Zhonghu**.** About "The blood lead level and pregnant outcome in pregnant women with non-occupational lead exposure." And found that, 75% of mothers had not practiced regarding nutritional that affect lead pollution and only 25% of them had done practices regarding nutritional that affect lead

pollution health education program improved to 75% of them had practices regarding nutritional and only, 25% of them had not done practice regarding nutritional. From the investigator's point of view, the majority of mothers used to wrap the sandwiches in the newspaper, which was printed with lead, which was affecting the health of their children. improved the pregnant women's practice after participating in the health education program.

Regarding to Observation checklist to assess the home environment, the current study revealed that, more than half of them were peeled paintings from walls and the majority of them tab at home as a source of drinking water. Also, the majority of pipes inside the house are made from steel or lead, while, more than half of carpets as a method of covering the floor, and nearly three-quarters of family members smoke at home Also, regarding outdoor environment exposure the studied ample to lead, more than one-quarter them burning rubbish beside the house. the study by **Vigeh et al (2018**) the study conducted in Pakistan about ". Lead exposure in female workers who are pregnant or of childbearing age. Industrial health" and that, 55.0% were peeled paintings from walls, 90% had a tab at home tabs source of drinking water, 100% of pipes inside the house made from steel or lead, 60% had carpets as a method of covering the floor and 80% had family member smoke at home. About environment exposure of the studied sample to lead 40% h burning rubbish beside the house. From the investigator's point of investigator enters into the facture of paint because lead increases the durability of paint and resists mold. Also, the lead paint becomes house only if it is cracked, peeled, or chipped from walls. The current study found that more than one-third of the children are prone to painting in their mouths the painters that chi mouths are at risk of ingesting lead.

From the researcher's point of view, the studied samples are at risk of lead pollution because they drink water from old pipes made from lead or steel. while the children who live in these houses inhale lead from cigarettes smoking and shisha. And, and open burning of wastes is one of the main sources that introduce lead into the environment in many regions. Lead is present in many household products and in many other components of waste that end up in urban waste or uncontrolled waste deposits. Smoke from the open burning of waste pollutes the air and transports lead for long distances, thus reaching communities settled kilometers away from the sources.

Concerning the observation checklist to assess total score indoors and outdoors regarding exposure to lead pollution, the finding of this study indicated that the majority of study samples' homes were bad environments, improved to the majority of them good environmental post-health educational program. The statistically significant improvement in pregnant women's total indoor and outdoor good environment at the post-health educational program -test, than that of pre in all items regarding the indoor and outdoor environment that affect

lead pollution (p=0.001**). On the same line carried by **Disha, et al . (2019)** the study was conducted in Taiwan "Association of raised blood lead levels in pregnant women with preeclampsia" and found that, the majority of study sample homes were bad environments, improved the majority of them had good environments with environmental post-health educational programs. The statistically significant improvement in women's total indoor and outdoor environment at the post-health educational program -test post-health, than that of pre in all items regarding indoor and outdoor environment that affect lead pollution (p=0.001**). From the investigator the point of view, most pregnant women do not know the sources of lead pollution indoors and outdoors the home, but after the program, knowledge and practices have improved

Regarding to relationship between pregnant women's demographic characteristics and total knowledge about lead pollution pre and post-health education programs. The current study indicates that there was highly a statistically significant relation between the study sample's age, level of education, occupation, monthly income, and total knowledge (P < 0.001). The study by **Hamadneh et al.(2018)** a study conducted in the USA about " Blood lead level and correlation with pregnancy-associated anemia." The study found that, highly statistically significant positive correlation between age, gender, level of education, occupation, monthly income, and total knowledge (P < 0.001).

Regarding pregnant women's demographic characteristics and total reported practice about lead pollution pre and post-health education programs, the current study revealed that there were highly statistically significant relations between study sample age, level of education, occupation, monthly income, and total reported practice score regarding cleaning the house decreased lead pollution. (P < 0.001). The study by **Hassanian, et al. (2018)** the study conducted in Tehran about "Blood lead levels in pregnant women referring to midwifery clinic in a referral center in Tehran. "found a statistically significant difference between the total practice score regarding cleaning the house and all items of; the age of mothers and fathers, sex of the children, number of siblings, income, level of fathers' & mothers' education, and occupation. P =<0.001. From the investigator's point of view, when the level of education of the father of a pregnant woman increases, knowledge and practices towards decreased exposure to lead pollution.

Regarding to correlation between total score knowledge, total reported Practice regarding healthy habits, and total practice regarding cleaning the house, reported habits that increased lead pollution and nutritional habits to increased lead pollution pre and post-health education program. The current study represented that there was a high significance correlation between total knowledge score and total reported practice (P < 0.001)., this result was in agreement with **Rimbaud et al.(2019)** study conducted in France about "Blood lead levels and risk factors for

lead exposure among pregnant women in western French Guiana:" and found that, there was a highly statistically significant correlation between total knowledge and total reported practice regarding practices regarding nutritional p= < 0.01*.

Conclusion:

The study denoted that the pregnant women's knowledge, reported practices, and indoor, and outdoor surrounding the house environment will be improved after implementing the health educational program regarding the hazards of lead pollution**.** , that there was a highly statistically significant correlation between total knowledge, total reported health habits and total reported practices regarding nutritional habits p= < 0.01*.

Recommendation:

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

1-Implementation of health education program for pregnant women regarding hazards of Lead pollution

2-Dissemination of health education booklets about lead pollution to improve pregnant women's awareness about lead pollution and how to protect themselves

3-Further research on a large sample size and other settings is recommended.

References:

Adams R. D. and. Victor M, *Principles of Neurology*, McGraw-Hill, New York, NY, USA, 5th edition, 2019.

Bakir H., Amitai Y., Besbelli N., Cebrian M., Dargan P., and Easson E., (2019): Childhood Lead Poisoning; WHO, available at:www.who.int/ceh/publications/leadguidance.pdfThis site opened at 8/6/ 2019.

Borja-Aburto, L., Goodman, L., Blumenthal, D., and Buxton, I., (2016): "Principles of toxicology". Goodman and Gilman's Manual of Pharmacology and Therapeutics. McGraw-Hill Professional. Available at: http://en.wikipedia.org/wiki/International_Standard_Book_Number, this site opened at 8/6/ 2016

Choudhari, N. G. Sathwara, V. K. Shivgotra, et al., "Study of lead exposure to children residing near a lead-zinc mine," *Indian Journal of Occupational and Environmental Medicine*, vol. 14, no. 2, pp. 58–62, 2019.View at: Publisher Site | Google Scholar

Cory-Schlecta D. A. and. Schaumburg, **H. H** "Lead, ignorganic," in *Experimental and Clinical Neurotoxicology*, P. S. Spender, H. H. Schaumburg, and A. C. Ludolph, Eds., Oxford University Press, New York, NY, USA, 2nd edition 2019.View at: Google Scholar

Daniell, L. V. Tung, R. M. Wallace, et al., "Childhood Lead exposure from battery recycling in Vietnam," *BioMed Research International*, vol. 2019, Article ID 193715, 10 pages, 2015.View at: Publisher Site | Google Scholar

Dawson, D. M. Sullivan, and S. D. Angima, *Evaluating and Reducing Lead Hazard in Gardens and Landscapes*, Oregon State University Extension Service, 2017.

Deborah, *Childhood Blood Lead Levels and Associated Risk Factors in Vietnam [M.S. Thesis]*, University of Washington, Seattle, Washington, Wash, USA, 2018.

Disha, Sharma S, Goyal M, Kumar PK, Ghosh R, Sharma P. Association of raised blood lead levels in pregnant women with preeclampsia: a study at a tertiary center. Taiwan J Obstet Gynecol 2019;58(1):60-3.

Esteban, C. H. Rubin, R. L. Jones, and G. Noonan, "Hair and Blood as Substrates for Screening Children for Lead Poisoning," *Archives of Environmental & Occupational Health*, vol. 54, no. 6, pp. 436–440, 2019.View at: Publisher Site | Google Scholar

Hamadneh J, Hamadneh S, Massadeh A, Kassab M, Al-Bayyari N, Khader Y, et al. Blood lead level and correlation with pregnancy-associated anemia. AMJ 2018;11(4):219-26..

Hassanian-Moghaddam H, Zamani N, Hamidi F, Farnaghi F, Gachkar L. Blood lead levels in pregnant women referring to midwifery clinic in a referral center in Tehran. J Res Med Sci 2018;23:88.

Hien, M. Yoneda, S. Fujii, and H. T. Hai, "Effects of age, sex, and environmental factors using samples of hair from residents living in the vicinity of the Cho Dien lead/zinc mine (Vietnam) WIT Transactions on Ecology and The Environment," 2018.View at: Google Scholar

Kafourou, C. Touloumi, V. Makropoulos, A. Loutradi, A. Papanagiotou, and A. Hatzakis, "Effects of Lead on the Somatic Growth of Children," *Archives of Environmental Health: An International Journal*, vol. 52, no. 5, pp. 377–383,2017.View at: Publisher Site | Google Scholar

Leggett, R. W "An age-specific kinetic model of lead metabolism in humans," *Environmental Health Perspectives*, vol. 101, no. 7, pp. 598–616,2020.View at: Publisher Site | Google Scholar

Little, S. Spalding, B. Walsh, et al., "Blood lead levels and growth status among African-American and Hispanic children in Dallas, Texas—1980 and 2012: Dallas Lead Project II," *Annals of Human Biology*, vol. 36, no. 3, pp. 331–341, 2019...

Needleman, H. L Schell A., D. Bellinger, A. Leviton, and E. Allred, N. "The long-term effects of exposure to low doses of lead in childhood: An 11-year follow-up report," *The New England Journal of Medicine*, vol. 322, no. 2, pp. 83–88,2018.View at: Publisher Site | Google Scholar

Olympio K., Gonçalves C., Günther W., and Bechara E., (2020): Neurotoxicity and aggressiveness triggered by low-level lead in children: a review. Pan Am J Public Health.;26(3):266–75.

Rimbaud D, Restrepo M, Louison A, Boukhari R, Ardillon V, Carles G, et al. Blood lead levels and risk factors for lead exposure among pregnant women in western French Guiana: the role of manioc consumption. J Toxicol Environ Health A 2019;80(6):382-93.

Selevan, S. K. Miller, V. Nguyen, J. B. Kotch, and R. C. Fry, "Toxic metal levels in children residing in a smelting craft village in Vietnam: a pilot biomonitoring study," *BMC Public Health*, vol. 14, no. 1, article 114,

2019.View at: Publisher Site | Google Scholar

Silver MK, Li X, Liu Y, Li M, Mai X, Kaciroti N, et al. Low-level prenatal lead exposure and infant sensory function. Environ Health 2017;15(1):65..

Tabaku A., Bizgha V., and Rahlenbeck S.I.,(2019): Biological monitoring of lead exposure in high-risk groups in Berat, Albania. Journal of Epidemiology and Community Health, 52(4): 234–236.

Taylor S., Aneesah A., and Sam H., (2019): Drinking water in Egypt: the effects of water on Egyptian's health available at: http://www.aucegypt.edu/research/conf/eureca.pdf.This site opened at 27/4/2019

The U.S. Environmental Protection Agency (EPA) is responsible for the protection of human health and the environment. EPA(2012).

Tong, Y. E. von Schirnding, M and Prapamontol, **T.** "Environmental lead exposure: a public health problem of global dimensions," *Bulletin of the World Health Organization*, vol. 78, no. 9, pp. 1068–1077, 2019.View at: Google Scholar

Vigeh M, Saito H, Sawada S-I. Lead exposure in female workers who are pregnant or of childbearing age. Industrial Health 2018;49(2):255-61. Volume 5, 2019, Pages 79-85. https://doi.org/10.1016/j.enceco.2019.02.001

Von Schirnding, A. Mathee, M. Kibel, P. Robertson, N. Strauss, and R. Blignaut, "A study of pediatric blood lead levels in a lead mining area in South Africa," *Environmental Research*, vol. 93, no. 3, pp. 259–263, 2019.View at: Publisher Site | Google Scholar

Walsh M., (2018): Care Lines newsletter, published document available at: http://www.walshcarlines.com. This site opened on 22/7/2012

Wang and J. Zhang, "Blood lead level in children, China," *Environmental Research*, vol. 101, pp. 412–418, 2016.View at: Publisher Site | Google Scholar

Wedeen, M. J. Kosnett, and K. L. Hipkins, "Recommendations for medical management of adult lead exposure," *Environmental Health Perspectives*, vol. 115, no. 3, 2017.View at: Google Scholar

WHO, "Childhood lead poisoning," pp. 11-19, 2010.View at: Google Scholar

Yao H-y, Huang X-h. The blood lead level and pregnant outcome in pregnant women with non-occupational lead exposure. Zhonghua Fu Chan Ke Za Zhi 2016;38(6):340-2.

Yapici, G. Can, A. R. Kiziler, B. Aydemir, İ. H. Timur, and A. Kaypmaz, "Lead and cadmium exposure in children living around a coal-mining area in Yatağan, Turkey," *Toxicology & Industrial Health*, vol. 22, no. 8, pp. 357–362, 2016.View at: Publisher Site | Google Scholar

Yimthiang S, Waeyang D, Kuraeiad S. Screening for elevated blood lead levels and related risk factors among Thai children residing in a fishing community. Toxics 2019;7(4):54.

Zainab Saqr, Director of the Lead Pollution Control Program, (2012)Lead pollution: Impact on environment and human health and approach for a sustainable solution\

Table (1): Frequency distribution of pregnant women regarding demographic characteristics, (n=300)

Demographic data	The studied sample (N=300)	
	No.	%
Pregnant women's age : < 20 20 <30 >30	 90 140 70	 30.0 46.7 23.3
Mean ± SD 25.88 ± 0.71		
Fathers age : < 30 30 < 40 >40	 80 200 20	 26.7 66.7 6.6
Mean ± SD 33.44± 0.81		
Father's level of education:		
Illiterate	85	28.4
Read & write	50	16.7
Secondary education	148	49.3
University or more	17	5.6
Pregnant women's level of education:		
Illiterate	55	18.4
Read & write	40	13.3
Diploma / secondary education	190	63.3
University or more	15	5.0
Father Occupation:		
Employed	90	30.0
(Worker+ Handwork)	(210)	(70.0%)
Worker	50	23.8
Handwork	160	76.2
Pregnant women's occupation:		
Housewife	224	74.6
Worker	76	25.4
Children age (months): Range Mean ± SD	 1-60 months 10.96 ± 0.91	
Child Sex: Males	 149	 49.7

Females	151	50.3
Number of children :		
1 – 2	167	55.7
3 – 4	55	18.3
> 5	40	13.4
No siblings	38	12.6
Monthly Income :		
Enough	80	26.7
Not enough	220	73.3

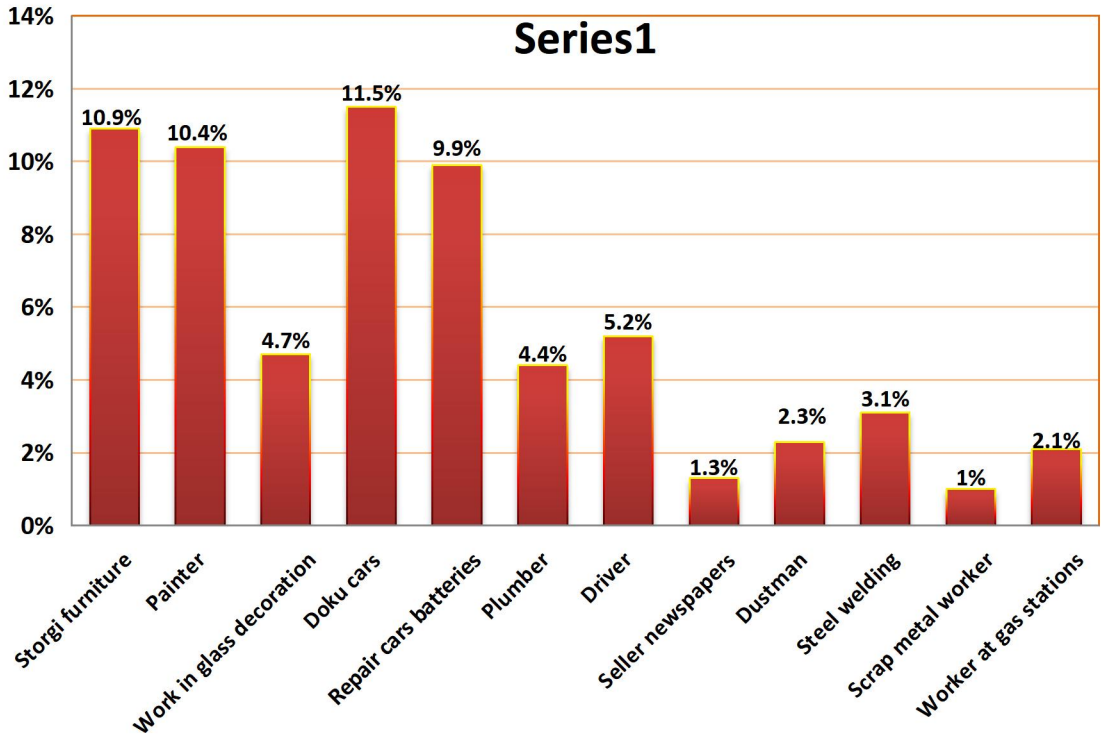

Figure (1): Frequency distribution of father's work leads to exposure to lead pollution (n=300)

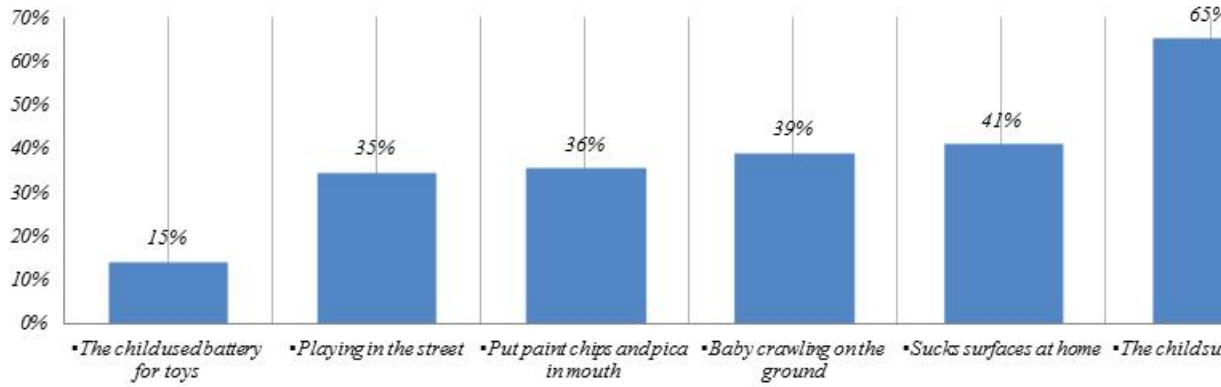

Figure (2): Frequency distribution regarding types of child toys lead to lead pollution
(n=300)

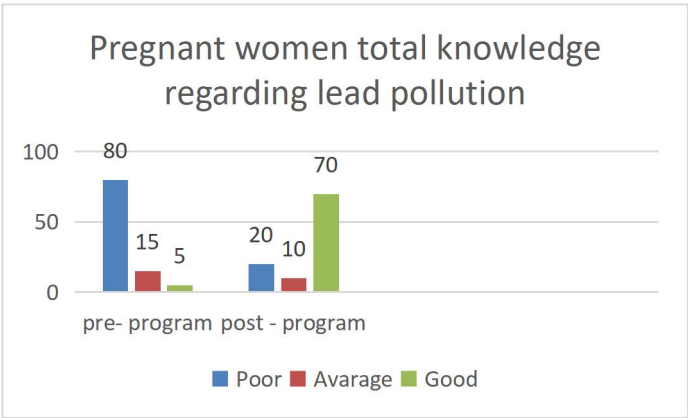

Figure (3): Frequency distribution of total score of pregnant women's knowledge about lead pollution pre and post-post-health education program,(n=300).

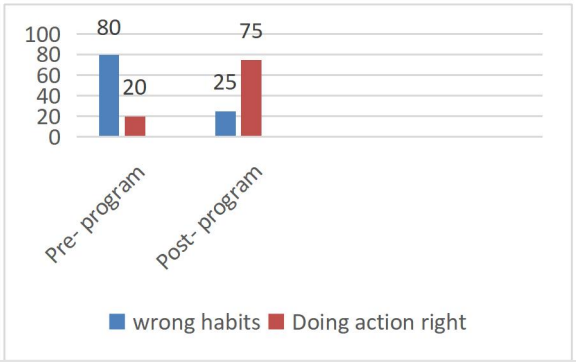

Figure (4): Frequency distribution of Pregnant women's reported practice regarding cleaning the house pre and post-health education program (n=300).

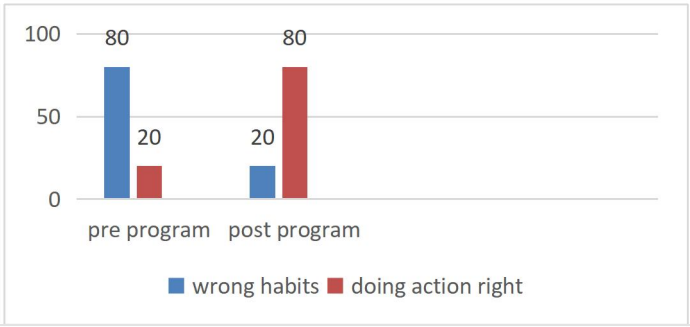

Figure (5): Frequency distribution of pregnant women's reported habits regarding control of lead pollution pre and post-post-health program (n=300).

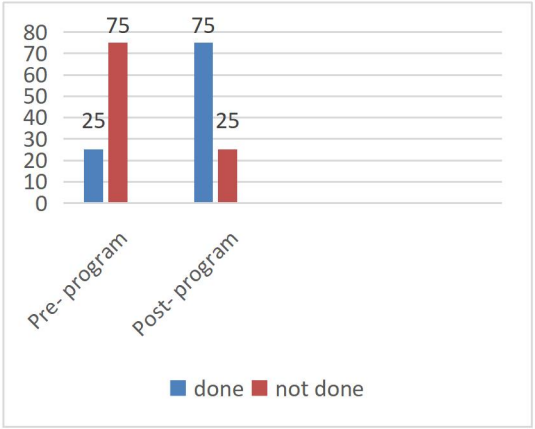

Figure (6) Frequency distribution of pregnant women's reported practice regarding nutritional habits that affect lead pollution pre and post-health education program (n=300).

Table (2): Observation checklist to assess the home environment, indoor and outdoor regarding exposure to lead pollution (n=300)

Household settings	**The studied sample home (N =300)**	
	No.	**%**
1-**Indoor environment**:		
●Peeled paintings from walls:		
Yes	157	52.4
No	71	23.6
Not applicable	72	24.0
●**Source of drinking water**:		
▪From tap at home	289	96.3
▪From the water tank	11	3.7
●Pipes inside a house made from steel or lead		
Yes	300	100
●**Covering the floor:**		
Yes	240	80.0
-If yes, method of covering the floor:(n=247)		
Carpets	124	51.6
Iyas	116	48.4
●**Any one from the family smoke at home**:		
Yes	220	73.4
2- **Outdoor environment**:		
●Green area outside:	37	12.4
●Burning rubbish beside the house:	80	26.6
●The house near cars on the public street:	55	18.4
●The house is of old structure:	68	22.6
●Water pipes outside the house are old & and made from steel or lead:	60	20.0

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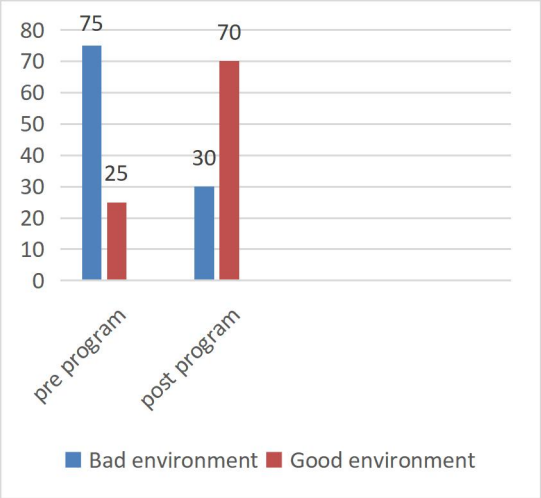

Figure (7): Observation checklist to assess total indoor and outdoor exposure of the studied sample to lead pollution pre and post-health education program (n=300)

Table (3): Relation between pregnant women's demographic characteristics and total knowledge about lead pollution pre and post-health education program (n=300).

Item of sociodemographic characteristics	**Pre-program total knowledge**			**Post-program total knowledge**		
	Good %	**Average %**	**Poor %**	**Good %**	**Average %**	**Poor %**
Pregnant women's age :						
< 20	10	20	70	65	25	10
20 <30	18	17	65	70	20	10
>30	19	17	64	75	20	5
$\times^2$	**5.719**			**8.023**		
P value	**.074**			**.000****		
Fathers age :						
30 < 40	10	15	75	70	20	10
>40	15	18	67	75	20	5
$\times^2$	**6.845**			**10.011**		
P value	**.077**			**.000****		
Father's level of education:						
Illiterate	5	10	85	60	20	20
Read & write	6	15	79	65	25	10
Secondary education	15	20	65	75	15	10
University or more	25	30	45	80	15	5
$\times^2$	**3.807**			**9.025**		

P value	**0.051**			**0.000****		
Pregnant women's level of education:						
Illiterate	5	10	85	60	30	10
Read & write	10	20	70	70	20	10
Secondary education	20	25	55	75	20	5
University or more	30	40	30	80	20	0.0
$\times^2$ **P value**	**9.548 .002**			**11.682 .000****		
Father Occupation:						
Employed	10	15	75	65	30	5
(Worker+ Handwork)	15	20	65	70	20	10
Worker	17	25	58	75	20	5
Handwork	18	20	62	88	7	5
$\times^2$ **P value**	**8.577 .057**			**10.975 .000****		
Pregnant women's occupation:						
Housewife	10	15	75	75	15	10
Worker	30	20	50	80	15	5
$\times^2$ **P value**	**9.744 .076**			**11.682 .000****		
Child Sex:						
Males	10	15	75	75	20	5
Females	25	20	55	80	15	5
$\times^2$ **P value**	**8.645 .088**			**10.782 .000****		
Several children :						
1 – 2	10	15	75	65	30	5
3 – 4	15	20	65	70	20	10
> 5	17	25	58	75	20	5
No siblings	18	20	62	88	7	5
$\times^2$ **P value**	**9.544 .089**			**12.655 .000****		
Monthly Income :						
Adequate	10	15	75	75	15	10
Inadequate	30	20	50	80	15	5
$\times^2$ **P value**	**8.933 .067**			**11.755 .000****		

Table (4) Relation between pregnant women's demographic characteristics and total reported practice about lead pollution re and post-health education program (n=300).

Demographic characteristics	**Pre-program total practice**		**Post-program total practice**	
	Wrong habits	**Doing action right**	**Wrong habits**	**Doing action right**
Pregnant women's age :				
< 20	70	30	20	80
20 <30	60	40	22	78
>30	65	35	18	82
$\times^2$	**6.564**		**9.422**	
P value	**.083**		**.000****	
Fathers age :				
< 30	60	40	25	75
30 < 40	55	45	15	85
>40	60	40	20	80
$\times^2$	**7.822**		**9.077**	
P value	**.078**		**.000****	
Father's level of education:				
Illiterate	70	30	45	55
Read & write	75	25	40	60
Secondary education	60	40	30	70
University or more	55	45	25	75
$\times^2$	**5.822**		**8.066**	
P value	**0.067**		**0.000***	
Pregnant women's level of education:				
Illiterate	70	30	25	75
Read & write	70	30	25	75
Secondary education	65	35	20	80
University or more	60	40	15	85
$\times^2$	**8.566**		**9.744**	
P value	**.075**		**.000****	
Father Occupation:				
Employed	65	35	30	70
(Worker+ Handwork)	70	30	35	65
Worker	65	35	35	65
Handwork	75	25	40	60

×²	**9.544**		**10.873**	
P value	**.059**		**.000****	
Pregnant women's occupation:				
Housewife	70	30	35	65
Worker	60	40	25	75
×²	**8.733**		**9.677**	
P value	**.079**		**.000****	
Child Sex:				
Males	60	40	40	60
Females	55	45	35	65
×²	**8.699**		**10.543**	
P value	**.089**		**.000****	
Several children :				
1 – 2	65	35	30	70
3 – 4	70	30	35	65
> 5	65	35	35	65
No siblings	75	25	40	60
×²	**8.655**		**10.633**	
P value	**.085**		**.000****	
Monthly Income :				
Adequate	70	30	35	65
Inadequate	60	40	25	75
×²	**9.944**		**11.833**	
P value	**.068**		**.000****	

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Table (5): Correlation between total Knowledge, total reported Practice regarding cleaning the house and nutritional habits lead to lead pollution pre and post-health education program. (n=300)

Variable	**Total knowledge score**			
	Pre-health education program		**Post-health education program**	
	R	P	R	P
Total reported Practice regarding cleaning the house	-0.393	<0.765	4.023	<0.01**
Total reported practice regarding nutritional habits leads to lead pollution	0.503	<0.834	5.055	<0.01**