

## Effect of Nano-Teaching Sessions regarding Human Monkeypox Infection on Knowledge, Attitude and Preventive Measures among Pregnant Women

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### Abstract

**Background:** The monkeypox virus causes the infectious illness known as "human monkeypox infection," which has significant health hazards for the public. The two major goals of the global response to the monkeypox outbreak were to improve knowledge and attitudes as well as to use preventative measures to stop the disease from spreading further. **Aim of the study:** was to evaluate the effect of nano-teaching sessions regarding human monkeypox infection on knowledge, attitude and preventive measures among pregnant women. **Subjects and Methods: Research design:** This study used a quasi-experimental design. **Setting:** The research was carried out at the prenatal care unit in Al-Nahal medical center that provides healthcare services to the population of Zagazig, Egypt. **Subjects:** 70 pregnant women were included in a purposive sample. **Tools of data collection:** three tools were used; a structured Interviewing questionnaire, attitude questionnaire regarding human monkeypox infection among pregnant women and preventive measures questionnaire regarding human monkeypox infection among pregnant women. **Results:** There was a highly statistical significant correlation between pregnant women's preventive measures and their knowledge at pre and post nano-teaching sessions and their attitude after implementation of nano-teaching sessions regarding human monkeypox infection. **Conclusion:** Implementation of nano-teaching sessions had a highly statistically significant effect on improving pregnant women's knowledge, attitude and preventive measures toward Human monkeypox Infection. **Recommendations:** Continuous campaigns to improve women's knowledge, attitude, and preventive measures are crucial because controlling outbreaks requires the substantial cooperation of a knowledgeable and aware society.

**Key words:** Attitude, Knowledge, Human Monkeypox infection, Nano-teaching sessions, Preventive measures.

### Introduction:

The World Health Organization's (WHO) declares human monkeypox (HMPX) a global emergency. Between 1 January 2022 and 19 August 2022, the monkeypox virus spread quickly from non-endemic to endemic regions, affecting 94 countries and infecting 41,358 individuals. 387 individuals were reported from seven endemic African countries, while 40,971 patients were reported from 87 non-endemic countries in Europe, North America, Australia, and Asia (Awan et al., 2022).

In 1970, the first human case of HMPX was discovered in the Democratic Republic of the Congo. Since then, several outbreaks and solitary instances have been documented, with Central and West Africa accounting for the bulk of illnesses. The first recorded occurrence of HMPX infections outside of Africa occurred in the United States of America in 2003. The virus has spread to other countries and the number of cases

raised significantly outside of the US, Israel, and Singapore (Abd ElHafeez et al., 2023).

After smallpox was eradicated, Petersen et al., (2019) stated that there are four species of poxvirus infections were discovered, and the zoonotic monkeypox virus is the cause of Monkeypox. Although it affects several taxonomic species, it is still unknown who the original host was. The monkeypox virus can infect a person for five to twenty-one days (Alshahrani et al., 2022).

Moreover, vertical transmission of the monkeypox virus from mother to infant is a possibility. The second most likely method of transmission is through sexual interaction. According to recent Italian study, the semen fluid of all three individuals contained monkeypox virus DNA. Similar to earlier epidemics, the majority of patients in this one were bisexuals, males who have sex with other men, persons who have several sexual partners, and people who had experienced

unsafe sex. Blood-borne transmission is another method that the monkeypox virus can infect humans (**Dhawan and Choudhary, 2022**).

Although the exact nature of monkeypox infection in humans is unknown, **Alakunle et al., (2020)** mentioned that it is frequently characterized by a prodromal period of a skin rash that tends to be more concentrated on the face and limbs, along with a fever, acute headache, lymphadenopathy, myalgia, and extreme sepsis. Although the illness usually resolves on its own, immunocompromised people are more susceptible to more serious cases and a greater fatality rate.

Pregnant women are not included in the majority of studies on HMPX infections. But prior research on pregnancy studies has revealed a significant mortality risk for smallpox infections once they are acquired during pregnancy, particularly when they occur in the third trimester of pregnancy or in individuals who have hemorrhagic sickness. Smallpox is a virus that belongs to the Poxviridae family. There aren't any reliable data on the effects of monkeypox infection during pregnancy, even though there may be similarities between the two virus strains. Reports on rare cases, mostly from underdeveloped nations, don't enable the extrapolation of robust evidence regarding the true risk of unfavorable maternal and perinatal outcomes in individuals who have historically contracted the common cold during pregnancy (**D'Antonio et al., 2023**).

The fetus under inspection has demonstrated hepatomegaly, peritoneal effusion (hydrops fetalis), and skin lesions. These symptoms are related to placental cytokine response, increased vascular permeability, and MPXV-induced cellular harm (**Mbala et al., 2017**). Ocular problems, myocarditis, pneumonia, encephalitis, and serious bacterial infections from skin lesions are among the potential consequences of monkeypox. Patients with severe monkeypox may require hospitalization, supportive care, and antiviral drugs to mitigate the severity of their lesions and expedite their recuperation (**Kannan et al., 2022**).

Currently, there isn't a particular HMPX vaccine that has been authorized. However, smallpox vaccination offered cross-protection against the monkeypox virus. **Meo et al., (2022)** have stated the availability of three

generations of smallpox immunizations. The first-generation immunization served as a smallpox preventive measure until 2008. This vaccine was extremely successful in controlling smallpox and was crucial to its global eradication. Following WHO, 1980 declaration that smallpox was extinct, this vaccination was discontinued. The second-generation vaccination, known as the live attenuated vaccine virus immunization made in tissue cultures, has been used for populations that may be more susceptible to the orthopox virus. In Canada and Europe, the Ankara-Bavarian Nordic (MVA-BN) Modified Vaccinia, a third generation vaccine, has received approval for human use (**WHO, 2022**).

Monkeypox during pregnancy is associated with a higher incidence of vertical transmission, intrauterine fetal mortality, and miscarriage. The risk of fetal loss was similar for infections acquired in the first or second trimester. The European Union, Canada, and the United States have granted licenses for the third-generation Bavarian Nordic smallpox vaccine. The European Union views it as generally safe because it contains a non-replicating virus and pregnant women who have close contact with people who have been proven to be infected with monkeypox should be urged to avoid it. Individually deciding whether to treat and monitor a pregnant person in an outpatient or inpatient setting depends on the specific consequences of any medication on pregnancy and lactation (**D'Antonio et al., 2023**).

Pregnant women for a number of reasons, it is essential to comprehend monkeypox. First of all, it assists in locating possible knowledge gaps to enhance their readiness for handling monkeypox (**Ahmed et al., 2022**). Secondly, evaluating attitudes can reveal information on the attitudes, views, and readiness of expectant mothers to take preventative action and apply recommended practices. Strategies to improve infection control protocols and foster productive patient-family communication can be developed using this knowledge as a reference. Thirdly, by knowing what influences what, policies and interventions may be created to empower women to protect themselves from infectious diseases (**Dhawan and Choudhary, 2022**).

**Significance of the study:**

According to **WHO, (2022)**, one of the obstacles to halting the resurgence of HMPX is a lack of knowledge about the illness particularly among susceptible populations that include pregnant women. So, the first step towards changing attitudes and actions is to address knowledge among pregnant women regarding human monkeypox. There is often a correlation between increasing knowledge and attitudes' rising influence on behavior. In other words, attitudes that rely on a wealth of information are more reliable, significant, and useful predictors of behavior than attitudes that rely on incomplete or inaccurate knowledge. Most studies on monkeypox infection in humans do not include pregnant women to assess their knowledge and attitude toward HMPX. Consequently, the current study looked at how nano-teaching sessions affected pregnant women's knowledge, attitudes and preventive measures about the HMPX virus. This could have an impact on their adherence to HMPX preventive measures, which could improve their readiness for future infectious disease outbreaks.

**Aim of the study**

This study aimed to evaluate the effect of nano-teaching sessions regarding human monkeypox infection on knowledge, attitude and preventive measures among pregnant women.

**Research Hypothesis:**

**H1:** Implementation of nano-teaching sessions will be effective in improving pregnant women's knowledge regarding human monkeypox infection.

**H2:** Nano-teaching sessions will enhance the attitude of the pregnant women regarding human monkeypox infection.

**H3:** Nano-teaching sessions will enhance pregnant women's preventive measures regarding human Monkeypox infection.

**Subjects and methods****Research Design:**

This study used a single group pre-test and post-test in a quasi-experimental design.

**Setting:**

The current study was carried out at the prenatal care unit in Al-Nahal medical center which provides healthcare services to the

population of Zagazig, Egypt. It is connected to the Ministry of Health and Population. It was selected because it was the primary location in Zagazig City with a high attendance rate where women could receive prenatal care.

**Study subjects:****Sample type:**

There were seventy pregnant women in a purposive sample.

**Sample size:****Subjects:**

Sample size depends on **Ibrahim et al., (2024)**; effect of monkeypox nano-teaching sessions on nurses' practice which showed that high level of practice was 42.0% before intervention which upgrade to 76.0% after intervention program, confidence level is 95.0% two side, with power of study 95.0%. Add 20.0% to variability of participants. Sample size calculated to be 70 participants. Open Epi, Version 3, open source calculator.

**Inclusion criteria:**

- Women who are pregnant in the first and second trimesters.
- Pregnant women older than eighteen.
- Free from any illnesses.

**Tools of data collection:**

To accomplish the aim of the current study, the researchers employed the following tools.

**Tool I: A structured Interviewing questionnaire:** In order to get the information required to fulfill the goals of the study, the researchers created it in simple Arabic.

The three portions were as follows:

**Part I: Demographic characteristics:** There were eight questions in all, including age, education, place of residence, history of chicken pox, etc.

**Part II: Previous and current obstetric history:** The number of parities, gravidity, current gestational age per week, and way of previous birth are the four questions that are included in this part.

**Part III: Women's knowledge regarding human monkeypox infection (pre/post test):** The researchers implemented it from **Rony et al., (2023)** and **Oche et al., (2024)** and developed it in clear language. Pregnant women's knowledge about human monkeypox infection is evaluated by using this part.

**Scoring system of knowledge part (part III in tool I):** It includes 28 questions. The questions had a maximum possible score of (28), with "zero" for a wrong response and "1" for a right response. Total knowledge score was calculated as follows:

- **Satisfactory knowledge:** if the score  $\geq 60.0\%$ .
- **Unsatisfactory knowledge:** if the score  $< 60.0\%$ .

**Tool II: Attitude questionnaire regarding human monkeypox infection among pregnant women (pre/posttest):** Researchers developed this tool based on studies from **Rony et al. (2023)** and **Alshahrani et al. (2022)** to assess pregnant women's attitudes toward infection with human monkeypox.

**Scoring system for Tool II:** This attitude scale involved 11 questions in the Arabic language. The response of the statements was measured by using a three point Likert scale; (0) disagree, (1) neutral and (2) agree. For each item, the scores were summed-up and giving a maximum total score which was (22). These scores were converted into a percent as follows:

- **Positive attitude:** If the score  $\geq 60.0\%$ .
- **Negative attitude:** If the score  $< 60.0\%$ .

**Tool III: Preventive measures questionnaire regarding human monkeypox infection among pregnant women (pre/posttest):** It was written in simple Arabic language and discussed the important precautions that should be done to avoid getting human monkeypox (**Oche et al., 2024**).

**Scoring system of Tool III:** It includes 8 questions which were scored as "1" for a positive response (yes) and "zero" for no response. The overall preventive measures scores were summed up and the maximum total score was (8). Total preventive measures score was calculated as follows:

- **Competent:** if the score  $\geq 60.0\%$ .
- **Incompetent:** if the score  $< 60.0\%$ .

#### **Content validity and reliability:**

A panel of three expert professors from Zagazig University's faculty of nursing (two professors of obstetrics and gynecological

nursing, one professor of community nursing) and one specialist from the faculty of medicine who specialized in obstetrics and gynecologic medicine evaluated the three tools and the nano-teaching sessions for thoroughness. The suitability and readability of the contributions were evaluated as well. The panel of experts assessed the tools' legitimacy in terms of both their look and content. In addition to other minimal but necessary changes, a few phrases and parts were modified. Cronbach's alpha is used to evaluate the reliability of the research tools. Its results were 0.82, 0.75 and 0.72 for knowledge (part III in tool I, attitude (tool II) and preventative measures (tool III), respectively.

#### **Pilot study:**

It included seven pregnant women (10.0% of the total sample size in the research). They were taken out of the research. The most essential purposes of it were to establish the time necessary for each form and evaluate the forms' accessibility, practicality, implementation, item counts, and item designs.

#### **Field work:**

When the pregnant women arrived at the previously mentioned study location, the researchers met those who fulfilled the eligibility conditions and were willing to participate in the study. The researchers gave the pregnant women an introduction and explained the goal of the study to them. They subsequently verbally agreed to cooperate after that. The women were seen by the researchers three days a week (Sunday, Tuesday, and Wednesday) from 9 a.m. to 12 p.m., following their completion of their checkup and follow-up visits at the prenatal care unit. This was because these were the days that the women visited for antenatal care. For a total of three months, from the beginning of June 2024 to the end of August 2024, data were gathered for the current study. To accomplish the aim of the study, the following stages were selected and finished:

#### **Preparatory stage:**

During this phase, the researchers reviewed modern and past literature that was pertinent to the study issue in order to gain a thorough theoretical recognize of all the problem's parts. The researchers looked through books, journals, textbooks,

newspapers, magazines, and websites with information from scientific publications in order to do this. The creation of study tools and nano-teaching sessions were then finished. It included the theoretical basis and preventive measures against human monkey box infection and was written in Arabic.

#### Assessment stage:

After pregnant woman received education about the research objectives, they were asked to complete the pretest study tools. Each pregnant woman received them on her own. It took an average of 10 minutes to complete. The post-evaluation was conducted using the same tools as were used for the study. From the initial interview until the evaluation, the researchers communicated with the women by social media and by phone to guarantee their compliance with the study. The researchers provided them with any additional information or answers about any questions they had over the three months following the initial interview.

#### Planning & Implementation stage:

The content of the nano-teaching sessions was created by the researchers as a colorful lecture (power point) using the results of the evaluation phase and a review of the literature. Its goals were established by considering the demands, requirements and gaps in attitude, knowledge, and preventive measures that were found.

#### Description of nano-teaching sessions:

After studying the demands of the pregnant women, the primary aim of the study was determined. Additionally, it was broken down into many objectives and the assignments were then designed so that the sequencing of the sessions reflected the nano-teaching sessions. The study was supposed to be delivered over the course of seven nano-teaching sessions. Each nano-teaching sessions included ten pregnant women and lasted 10 minutes. The demands of the research participants and an evaluation of the relevant literature were taken into consideration while developing the guide booklet's aims. The booklet's content was designed to be given out on an individual basis to each pregnant woman.

**General objective of nano-teaching sessions** was to evaluate the effect of nano-

teaching sessions regarding human monkeypox infection on knowledge, attitude and preventive measures among pregnant women.

**Specific objectives:** Pregnant women who complete the nano-teaching sessions regarding human monkeypox infection will be able to:

- Define Human monkeypox Infection.
- Ascertain the reason for the human monkeypox infection.
- Identify the symptoms and signs associated with a human monkeypox infection.
- Determine the duration of HMPOX incubation.
- Enumerate the HMPOX transmission methods.
- List effect of HMPOX on pregnancy.
- Identify complications of HMPOX.
- Recognize preventive measures for HMPOX.
- Determine HMPOX treatment and vaccine.

▪ **The nano-teaching sessions** consisted of two main parts: **the theoretical part** covered the fundamental knowledge of HMPOX. This theoretical part was addressed in sessions 1, 2, 3, 4, and 7. **The practical part** included HMPOX preventive measures. This practical part was covered in sessions five and six.

#### The followings were the schedule for the nano-teaching sessions:

**Session 1:** In the first session, the definition and causes of HMPOX were covered.

**Session 2:** It addressed HMPOX symptoms, indications, and the duration.

**Session 3:** The HMPOX transmission method was discussed.

**Session 4:** This session covered complications and the impact of HMPOX on pregnancy.

**Session five and six:** the researchers discussed HMPOX preventive measures in it.

**Session 7:** It covered HMPOX treatment and vaccination.

#### Evaluation stage:

During this phase, each pregnant woman completed two evaluations, the first of which was used as baseline data (pre-test) at the beginning of the research. One month following the pretest, the second evaluation (posttest) was administered. For the pre and post-test, the identical assessment tools (part III in tools I, tool II, and tool III) were utilized.

**Administrative and ethical consideration:**

According to the ethical code (ID/ZU.Nur.REC:0179), the Zagazig University Faculty of Nursing Research Ethics Committee (REC) accepted the current study's research after considering all ethical considerations. To acquire each pregnant woman's trust and confidence, the study's aim was explained before any of the tools were used. She was told that the methods employed in the study would not have an adverse effect on the pregnant women, and that the data acquired would be kept secret, before she verbally accepted to participate in the research. Pregnant women were informed that they might leave the research at any moment without any explanation. This was accomplished by formally requesting permission from the directors of the aforementioned location. These questions were in response to correspondence from the faculty of nursing outlining the purpose of the study, the types of data collection tools that would be employed, and the anticipated outcomes of its implementation.

**Statistical analysis:**

All data were collected, tabulated and statistically analyzed using IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp. The mean  $\pm$  SD and median (range) were used to convey quantitative data, whereas the terms number and (%) were used to express qualitative data. To compare two pairs of normally distributed variables, the paired t test was employed. When applicable, the Fisher Exact test or the Chi square test was used to compare the percentage of categorical variables. Paired categorical data were compared using the MC Nemer test. To evaluate the link between the various research parameters, the Pearson's correlation coefficient was computed; all tests were two-sided. A p-value of less than 0.05 was considered statistically significant, whereas a p-value of more than or equal to 0.05 was considered statistically insignificant.  $(\text{After value} - \text{Before value}) / \text{before value} * 100$  is the percent of improvement.

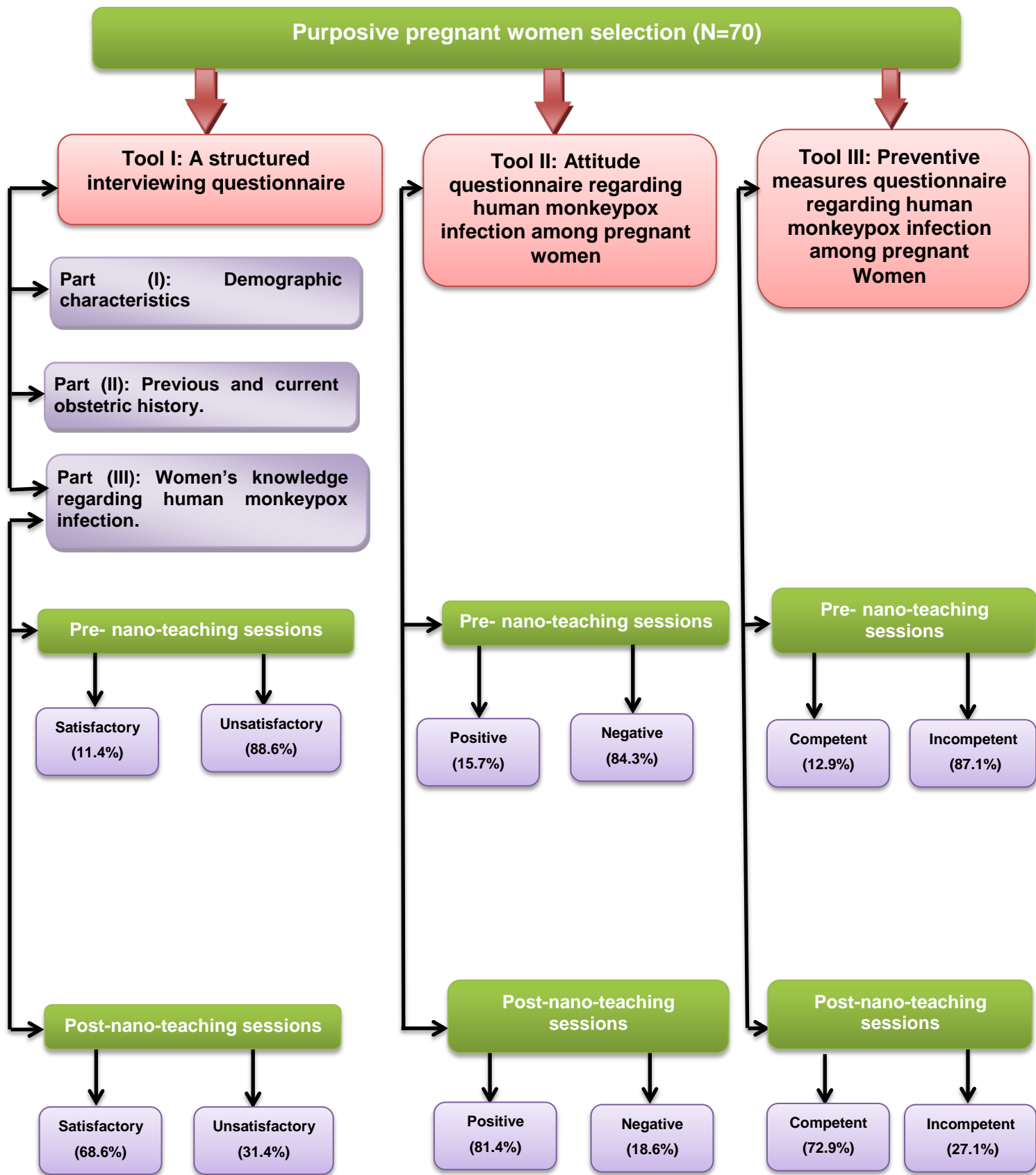


Figure (1): Analytical Flow Chart of the Study

## Results:

Nearly two-thirds of the pregnant women in the study were under 30, with a mean age of  $27.86 \pm 3.7$  years as seen in **table 1**. More than half of them (51.5%) had basic and secondary education. Meanwhile, the majority of them (81.4%) came from rural areas and all of them had a history of chicken pox. However they hadn't received nano-teaching sessions about human monkeypox in the past. Radio and T.V were the main source of information among 24.3% of them.

According to obstetric history among studied women, **table (2)** reveals that almost two fifth of them (40.0%) were in the third trimester, more than two thirds (71.4%) were multigravida and 38.6% of them had a history of more than one delivery. Regarding mode of delivery, 54.3% of studied women delivered with the cesarean section method.

**Table (3)**: shows highly statistical significant improvement in all items of knowledge concerning human monkeypox infection at pre and post nano-teaching sessions among pregnant women ( $p = 0.0001^{**}$ ), variables that achieve the highest percent correct response by pregnant women were; Monkeypox is caused by bacteria, pregnant women with monkeypox receive treatment, management options are recommended for pregnant women with monkeypox, pregnant women with suspected or confirmed monkeypox need additional antenatal fetal surveillance, timing of delivery affected by previous or current monkeypox infection, Monkeypox infection considered an indication for cesarean delivery for women with a previous or current infection, contact with the infant be handled and Special considerations for breast feeding in case of suspected or confirmed maternal monkeypox infection (85.7%,88.6%,85.7%, 84.3%,91.4%,87.1% and 92.9% respectively).

**Table (4)** refers to a highly statistical significant difference in attitude items about human monkeypox infection at post nano-teaching sessions among pregnant women ( $p= 0.0001^{**}$ ). The majority of women have a positive attitude in thoughts related to ability of Mpox transmission to the fetus, availability of Mpox prevention and control measures, restriction of travelling to Mpox infected countries, avoid dealing with animals and the importance of maintaining standard precaution

to prevent Mpox transmission (82.9%, 85.7%, 78.6, 80.0%&84.3% respectively). Meanwhile, nearly three quarter of them were agree on necessity of taking vaccination if available and the importance of investigation in case of contact within infected person (72.9% & 70.0%, respectively) after implementation of nano-teaching sessions.

**Table (5)** compare the correct response related to preventive measures items for human monkeypox infection at pre and post nano-teaching sessions among pregnant women. There is a marked high statistical significant improvement in all items after the implementation of nano-teaching sessions among pregnant women ( $p= 0.0001^{**}$ ) especially in precautions related to isolation of infected patients from others who could be at risk for infection, restriction of home visitors and abstinence from touching eyes, nose & mouth with unwashed hands (75.7%,77.1% & 80.0%, respectively).

**Table (6)** reveals a highly evident statistical improvement in knowledge, attitude and preventive measures mean score regarding human monkeypox infection among pregnant women at post nano-teaching sessions ( $p=0.0001^{**}$ ).

**Figure (2)** there is an observable highly significant improvement in satisfactory knowledge, positive attitude & competent preventive measures at post nano-teaching sessions (68.6%, 81.4% & 72.9% respectively). Meanwhile, unsatisfactory knowledge, negative attitude and incompetent preventive measures were significantly decreased at post nano-teaching sessions (31.4%, 18.6% &27.1% respectively).

**Table (7)** shows that there was a highly statistical significant correlation between pregnant women's attitude and their knowledge at pre and post nano-teaching sessions ( $p=0.001^*$ ,  $p= 0.0001^{**}$  respectively). It's also evident that there was a highly statistical significant correlation between pregnant women's preventive measures and their knowledge at pre and post nano-teaching sessions ( $p= 0.024^*$ ,  $p=0.0001^{**}$  respectively) and their attitude after the implementation of nano-teaching sessions regarding human monkeypox infection (0.0001<sup>\*\*</sup>).



**Discussion:**

The World Health Organization on July 23, 2022, deemed Mpox a public health emergency of international concern (PHEIC). The current multi-country outbreak has been linked to the Mpox clade (II), which has a lower case fatality rate (3.6%) than the clade (I) (10.6%). Pregnant women and children are particularly in danger, as evidenced by the higher incidence of Mpox severity observed in vulnerable populations.

It is critical to educate the public, particularly expectant mothers, about Mpox symptoms, transmission, prevention, and the antivirals and vaccinations that are available for use against Mpox in low- and middle-income countries. More importantly, breastfeeding and contact with newborns should be made clear to pregnant women who are infected with Mpox. It is advised that the mother wait until she meets all CDC criteria before having any close, direct contact with the newborns. Nonetheless, some safety measures must be taken into account if the patient is adamant about seeing her child in person. Notwithstanding the scant facts. Therefore, the most recent research on MPX during pregnancy and the danger that goes along with it (**Abu-Azzam et al., 2024**). So, the aim of this research study was to evaluate the effect of nano-teaching sessions regarding human monkeypox infection on knowledge, attitude and preventive measures among pregnant women.

According to socio-demographic characteristics in the current study finding, almost two thirds of studied women were less than 30 years old with a mean age of  $27.86 \pm 3.7$  years. More than half of them had basic and secondary education. Meanwhile, the majority of them came from rural areas and all of them had a history of chicken pox. However they hadn't received teaching program about human monkeypox in the past. Radio and T.V were the main source of information among nearly quarter of them.

These results were consistent with a Saudi Arabian study by **Aljhdali et al., (2023)** that discovered the great majority of participants were between the ages of 18 and 29. The majority of those surveyed were either employed or enrolled in the West. Additionally, and in partial agreement with **Ibrahim et al. (2024)**, the study's participants ranged in age from 20 to less than 60 years old, most of

them had at least a bachelor's degree and lived in rural areas. A quarter of the control group reported using television, but over one-third of the study and control groups reported using the internet. A minority in both groups claimed that the Ministry of Health and Population was the primary source of information.

In contrast, **Jairoun et al. (2022)** discovered that participants had a history of human chickenpox infection. This finding contradicts that of **Ahmed et al. (2022)**, who found that the majority of participants had attended a lecture or seminar about HMPX and that social media was their primary source of information about the disease. In addition, the respondents in the **Om et al. (2024)** study obtained information about Mpox via print and electronic media, social media, seminars, and the Internet. These findings are consistent with those of previous studies (**Ugwu et al., 2022 and Miraglia et al., 2023**). It is important to emphasize the function that various media channels play in the spread of health information since appropriate knowledge typically results in appropriate practices.

This study elucidates the noteworthy impact that social media has on the dissemination of information, as well as the necessity for dependable sources of information in order for the majority of personnel to obtain up-to-date information.

According to obstetric history among studied women in the present study, reveals that almost two fifth of them were in the third trimesters, more than two thirds were multigravida and more than one third of them had a history of more than one delivery. Regarding mode of delivery, more than half of studied women delivered with the cesarean section. It is confirming **Khalil et al. (2022)** opinion who suggested that when a pregnant woman has a confirmed or suspected case of monkeypox, it is advisable to proceed cautiously. This would involve routine cardiotocography assessments of the fetal well-being every two to three times a day if the gestational age is less than 26 weeks or if the mother is ill. Fetal biometry performed 10-14 days apart, a comprehensive anatomy scan, a measurement of the volume of amniotic fluid, and fetal Doppler (central cerebral artery and umbilical artery) should all be part of the third trimester evaluation. It is advisable to have a

cesarean section. A cesarean section should be offered after discussing the (yet unquantifiable) risk of newborn infection, which may be serious, even if vaginal lesions cannot be identified in a woman with proven or presumed monkeypox infection.

The present study results shows highly statistical significant improvement in all items of knowledge concerning human monkeypox infection at pre and post intervention among pregnant women, especially in items related to the origin of monkeypox infection, possibility of receiving treatment during pregnancy, available management options for pregnant women with monkeypox, additional antenatal fetal surveillance needed for pregnant women with suspected or confirmed monkeypox, effect of previous or current monkeypox infection on time of delivery, indication for cesarean delivery for women with a previous or current infection, contact with the infant be handled and Special considerations for breast feeding in case of suspected or confirmed maternal monkeypox infection.

These in accordance with **Aljahdali et al. (2023)** According to the survey, the majority of participants correctly identified the human Mpox virus and that a skin rash is a symptom of the infection. Additionally, more than four fifths of participants were aware of the human Mpox virus. The low prevalence of human mumps infection in Saudi Arabia and the fact that the virus is not only spread from animals to humans were correctly identified by more than half of the participants. Although fewer than half of the participants accurately recognized the quantity of verified instances of the infection in Saudi Arabia and lymph node enlargement as an indication of the infection, it is evident that approximately 25% of the participants had adequate understanding of the neurological symptoms that were

Additionally, in congruence with **Ibrahim et al., (2024)** a study evaluating women's pre-interventional knowledge of Mpox found that neither the intervention nor control groups differed statistically significantly in terms of knowledge, with the majority of women in both groups having low levels of knowledge. On the other hand, after the intervention, the knowledge satisfaction level of the intervention group was significantly greater than that of the control group. Most likely, the impact of the nano-teaching sessions is responsible for the observed difference. This

meant that the first hypothesis—which said that women undertaking self-directed learning would not learn as much about the epidemiology and prevention of mpox as those receiving nano-teaching sessions was verified.

Conversely, in a similar study conducted by **Ogoina et al. (2020)** among clinicians in Ohio, USA, almost half of the participants knew that there were medications that could effectively treat Mpox. Also, a recent study was conducted by **Peng et al. (2023)** among preclinical dental students in Malaysia. They displayed little understanding of available treatments. Out of them, only one quarter was aware that paracetamol can be used to alleviate Mpox symptoms. Perhaps the disparity in the target group accounts for this widespread knowledge gap. The cumulative results of these studies emphasize the continued significance of focused educational initiatives aimed at improving pregnant women's readiness to handle new epidemic risks.

Lack of knowledge about the signs, how the disease spreads, and how to treat it can negatively affect efforts to prevent it. Lack of knowledge about the signs, how the disease spreads, and how to treat it can negatively affect efforts to prevent it. The fact that mother classes at maternity health centers do not address newly emerging viral illnesses, such as Mpox, may be one reason for the gaps in knowledge regarding this rapidly spreading illness. Another argument would be that the dual burden of infectious diseases, both new and old, and lifestyle-related illnesses threatens the health of the people in low-income nations. This means that in order to guarantee that information about newly discovered diseases reaches as many individuals as possible, health officials and educators should think about utilizing a variety of communication platforms.

Concerning attitude levels in the present study, there was a highly statistical significant difference in attitude items about human monkeypox infection at post intervention phase among pregnant women. The majority of women have a positive attitude in thoughts related to ability of Mpox transmission to the fetus, the availability of Mpox prevention and control measures, restriction of travelling to Mpox infected countries, avoid dealing with animals and the importance of maintaining

standard precaution to prevent Mpox transmission. meanwhile, nearly three quarter of them were agree on necessity of taking vaccination if available and the importance of investigation in case of contact with an infected person after implementation of nano-teaching sessions.

These findings were in agreement with **Ibrahim et al. (2024)** who reported that in the pre-intervention phase, almost half of the study group and half of the control group had negative attitudes toward mpox. After the intervention, however, there was a noticeable difference, with most members of the study group displaying a positive attitude, compared to over half in the control group. There was a statistically significant difference that was noticed. As a result, the third hypothesis which states that, in comparison to self-directed learning, nano-teaching sessions foster a more positive attitude toward is supported by these data. The findings suggest that nano-teaching sessions are essential for improving women's readiness for reaction and mitigation, better preparing them to deal with new risks in the healthcare industry.

In congruence with **Bakheet and Abd El Wahab, (2023)** study in Assiut, Egypt revealed that prior to the teaching intervention; over two thirds of the teachers had a negative view toward monkeypox. A pessimistic outlook on the illness can be harmful because it can hinder the adoption of healthy behaviors that aid in the prevention and control of disease and negatively influence the behavior of seeking medical attention in the case of an infection. This research finding contradicted with **Meo et al. (2022)** even if his data indicate that the public's perception of the growing threat of monkeypox is positive. According to the researchers, one possible explanation for this paradox is that the groups under study may not have had equal access to various resources that would have provided information about the condition.

As regards the correct response related to preventive measures items for human monkeypox infection at pre and post intervention among pregnant women in the current study. There is a marked high statistical significant improvement in all items after the implementation of nano-teaching sessions among pregnant women ( $p=0.0001^{**}$ ) especially in precautions related to

isolation of infected patients from others who could be at risk for infection, restriction of home visitors and abstinence from touching eyes, nose & mouth with unwashed hands.

Similarly, **Gu et al. (2024)** research discovered that around three quarter of the participants demonstrated suitable precautionary measures against the monkeypox virus. In order to prevent infections, healthcare providers should always wear face masks when caring for patients. Other preventive measures include using hand gloves, keeping hands clean, and refraining from touching the mouth, nose, or eyes. On the contrary, **Aljahdali et al. (2023)** stated that almost two fifth of the participants disagreed with the adoption of appropriate preventive and control measures. Also, these findings are conflicted with **Om et al. (2024)** study that showed that most people proactively sought medical attention when exhibiting symptoms associated with mpox, resulting in high practice ratings for the condition. Though less than in previous research, more than one-fifth of respondents expressed reluctance to receive the mpox vaccine (**Zheng et al., 2020**).

After the implementation of nano-teaching sessions, the current study finding reveals a highly evident statistical improvement in knowledge; attitude and preventive measures mean score regarding human monkeypox infection among pregnant women at post intervention phase. There was an observable highly significant improvement in satisfactory knowledge, positive attitude & competent preventive measures at post intervention phase. Meanwhile, unsatisfactory knowledge, negative attitude and incompetent preventive measures were significantly decreased at post intervention.

Recent study findings also show that there was a highly statistically significant correlation between pregnant women's attitude and their knowledge at pre and post intervention. It's also evident that there was a highly statistically significant correlation between pregnant women's preventive measures and their knowledge at pre and post intervention and their attitude after the implementation of nano-teaching sessions regarding human monkeypox infection.

The results of this study demonstrate the critical significance that nano-teaching sessions have in educating expectant mothers

and providing knowledgeable training, as seen by the practices' observed improvement after the intervention. In light of new infectious dangers, this highlights the value of focused educational initiatives in fostering knowledgeable and efficient healthcare practices. The impact of the nano-teaching sessions was shown in improving pregnant women's engagement with mpox in a number of areas. After these sessions, the Mpox knowledge, attitude, and practice of the intervention group were much better, and they also showed greater confidence in their diagnosis. These results highlight the effectiveness of nano-teaching as a meaningful instructional strategy for the target communities, improving their understanding, perspective, and ability to apply new knowledge to address emerging infectious dangers like Mpox (**Ibrahim et al., 2024**).

**Conclusion:**

The findings of the current research concluded that pregnant women's knowledge, attitude, and preventative measures regarding human monkeypox infection were enhanced by nano-teaching sessions.

**Recommendations:**

**The following recommendation was made in light of the study's findings:**

- Continuous campaigns to improve women's knowledge, attitude, and preventive measures are crucial because controlling outbreaks requires the substantial cooperation of a knowledgeable and aware society.
- Pregnant women require intense health education through mother classes to enhance their awareness to ward protection against expected risks of pandemic diseases like Mpox.

**Future researches:**

- Public and health care workers with less education should participate in health education programs and be trained on proper Mpox infection prevention measures.
- More research must be done for nurses and other healthcare professionals to improve their knowledge, attitude and preventive measures regarding Mpox infection.
- Further studies with a larger number of participants could spread the results more widely.

**Table (1): Distribution of the studied pregnant women according to their demographic characteristics (n=70):**

Demographic characteristics	No.	Percent (%)
<b>Age group</b>		
<30 year	47	67.1
≥30 years	23	32.9
<b>Mean ± SD</b>	27.86±3.7	
<b>Median (range)</b>	27(22-35)	
<b>Education</b>		
Illiterate	26	37.1
Basic education	20	28.6
Secondary	16	22.9
University	8	11.4
<b>Residence</b>		
Rural	57	81.4
Urban	13	18.6
<b>Occupation</b>		
House wife	62	88.6
Working	8	11.4
<b>History of chicken pox</b>		
Yes	70	100.0
<b>Source of information</b>		
Radio/TV	17	24.3
Health care provider	3	4.3
Social media	3	4.3
Internet	2	2.9
journals/newspapers	0	0.0
Family / friends	0	0.0
<b>Didn't receive teaching program about HMPX</b>	70	100.0

**Table (2): Distribution of the studied pregnant women according to their obstetric history (n=70):**

Obstetric history	No.	Percent (%)
<b>Gestational age per weeks</b>		
first trimester	17	24.3
Second trimester	25	35.7
Third trimester	28	40.0
<b>Mean ± SD</b>	19.6±7.6	
<b>Median (range)</b>	23.5(5-28)	
<b>Gravida</b>		
Primigravida	20	28.6
Multigravida	50	71.4
<b>Parity</b>		
Nulli para	20	28.6
Para one	23	32.8
Multipara	27	38.6
<b>Mode of delivery</b>		
Normal vaginal delivery	12	17.1
Cesarean section	38	54.3

**Table (3): Comparison of correct knowledge items about human monkeypox infection at pre and post Nano-teaching sessions among pregnant women (n=70):**

knowledge items	Pre		Post		Mp
	NO.	%	No.	%	
➤ There is an outbreak of human MPX in the world.	21	30.0	48	68.6	0.0001
➤ Monkeypox is caused by virus	18	25.7	50	71.4	0.0001
➤ Monkeypox is caused by bacteria	28	40.0	60	85.7	0.0001
➤ Monkeypox is transmitted by blood transfusion	20	28.6	38	54.3	0.0001
➤ Monkeypox is transmitted from person to another one	14	20.0	47	67.1	0.0001
➤ Monkeypox can be transmitted through eating food	13	18.6	41	58.6	0.0001
➤ Shaking or touching hands of infected person can transmit Monkeypox	11	15.7	51	72.9	0.0001
➤ transmission from the mother to the fetus can occur via the placenta or by close contact during and after birth	16	22.9	46	65.7	0.0001
➤ Incubation period is usually from 5 to 21days	12	17.1	49	70.0	0.0001
➤ Symptoms appear throughout 5 days after exposure to infection	14	20.0	47	67.1	0.0001
➤ Flu like syndrome is the early sign & symptom	9	12.9	46	65.7	0.0001
➤ Monkeypox is associated with fever and headache	13	18.6	49	70.0	0.0001
➤ Skin rash is a common sign& symptom	15	21.4	43	61.4	0.0001
➤ Lymphadenopathy is usually more prominent in monkeypox infection	16	22.9	52	74.3	0.0001
➤ Monkeypox could be prevented by cooking meat properly	14	20.0	41	58.6	0.0001
➤ Wearing condoms during sex is effective	5	7.1	45	64.3	0.0001
➤ Monkeypox increases the risk of severe morbidity and mortality for pregnant women	15	21.4	50	71.4	0.0001
➤ Effect of monkeypox on fetal and neonatal outcomes	15	21.4	41	58.6	0.0001
➤ Improving monkeypox awareness and self-symptom monitoring are key measures to prevent monkeypox.	20	28.6	54	77.1	0.0001
➤ There was a licensed monkeypox vaccine available at the time of this study	13	18.6	44	62.9	0.0001
➤ Pregnant women can be vaccinated against monkeypox.	40	57.1	55	78.5	0.006
➤ Pregnant women with monkeypox receive treatment	24	34.3	62	88.6	0.0001
➤ Treatment options are recommended for pregnant patients with monkeypox.	26	37.1	61	87.1	0.0001
➤ Pregnant patients with suspected or confirmed monkeypox need additional antenatal fetal surveillance.	30	42.9	60	85.7	0.0001
➤ The timing of delivery affected by previous or current monkeypox infection.	22	31.4	59	84.3	0.0001
➤ Monkeypox infection considered an indication for cesarean delivery for patients with a previous or current infection.	26	37.1	64	91.4	0.0001
➤ Contact with the infant be handled	22	31.4	61	87.1	0.0001
➤ Special considerations for breast feeding in case of suspected or confirmed maternal monkeypox infection.	28	40.0	65	92.9	0.0001

M: McNemar Test no significant  $p > 0.05$ , \* significant  $p < 0.05$

**Table (4): Comparison of attitude items about human monkeypox infection at pre and post Nano-teaching sessions among pregnant women (n=70).**

Attitude items		Agree		Neutral		Disagree		Hp
		No.	%	No.	%	No.	%	
➤ Worrying about monkeypox disease can be transmitted to the fetus	<b>Pre</b>	6	8.6	59	84.3	5	7.1	0.0001*
	<b>Post</b>	58	82.9	9	12.9	3	4.3	
➤ Monkeypox disease prevention and control measures should be adequately available	<b>Pre</b>	35	50.0	9	12.9	26	37.1	0.0001*
	<b>Post</b>	60	85.7	6	8.6	4	5.7	
➤ Traveling to monkeypox disease-infected countries should be restricted	<b>Pre</b>	23	32.9	9	12.9	38	54.3	0.0001*
	<b>Post</b>	55	78.6	10	14.3	5	7.1	
➤ monkeypox vaccine should be taken if it is available	<b>Pre</b>	12	17.1	24	34.3	34	48.6	0.0001*
	<b>Post</b>	51	72.9	16	22.9	3	4.3	
➤ Pregnant women should be tested when they are in contact with someone infected	<b>Pre</b>	6	8.6	20	28.6	44	62.9	0.0001*
	<b>Post</b>	49	70.0	14	20.0	7	10.0	
➤ Pregnant women can visit her family members or friends who are infected with monkeypox	<b>Pre</b>	12	17.1	24	34.3	34	48.6	0.0001*
	<b>Post</b>	52	74.3	12	17.1	6	8.6	
➤ All people with a skin rash should be tested for monkeypox	<b>Pre</b>	20	28.6	21	30.0	29	41.4	0.01*
	<b>Post</b>	36	51.4	13	18.6	21	30.0	
➤ Worrying about monkeypox will become a new pandemic, and its impact will be like COVID-19	<b>Pre</b>	16	22.9	9	12.9	45	64.3	0.0001*
	<b>Post</b>	30	42.9	31	44.3	9	12.9	
➤ Worrying about monkeypox disease is an attempt to reduce the size of global population	<b>Pre</b>	16	22.9	11	15.7	43	61.4	0.0001*
	<b>Post</b>	39	55.7	9	12.9	22	31.4	
➤ Pregnant women should avoid contacting animals that could harbor the virus.	<b>Pre</b>	11	15.7	47	67.1	12	17.1	0.0001*
	<b>Post</b>	56	80.0	10	14.3	4	5.7	
➤ Maintaining standard precautions are sufficient to prevent monkeypox virus transmission.	<b>Pre</b>	17	24.3	44	62.9	9	12.9	0.0001*
	<b>Post</b>	59	84.3	7	10.0	4	5.7	

**Table (5): Comparison of correct response related to preventive measures items for human monkeypox infection at pre and post Nano-teaching sessions among pregnant women (n=70):**

Preventive measures items	Pre		Post		Mp
	No.	%	No.	%	
➤ Isolate infected patients from others who could be at risk for infection.	25	35.7	53	75.7	0.0001
➤ Avoid contact with any materials, such as bedding, that has been in contact with a patient of monkeypox.	24	34.3	50	71.4	0.0001
➤ Practice good hand hygiene after contact with infected persons. For example, washing your hands with soap and water or using an alcohol-based hand sanitizer	32	45.7	59	84.3	0.0001
➤ Use masks when dealing with persons who had respiratory infection.	32	45.7	52	74.3	0.0001
➤ No visitors should be allowed at home.	31	44.3	54	77.1	0.0001
➤ Don't shake or touch hands of persons who had Skin lesions	30	42.9	51	72.9	0.0001
➤ Food should be cooked well-done before eating	29	41.4	45	64.3	0.007
➤ Avoid touching eyes, nose & mouth with un washed hands	28	40.0	56	80.0	0.0001

M: McNemar Test no significant  $p>0.05$ , \* significant  $p<0.05$

**Table (6): Effect of Nano-teaching sessions on knowledge, attitude and preventive measures score about human monkeypox infection among pregnant women (n=70):**

Items	Pre	Post	% improvement	Paired t	
				Paired t	P
<b>Knowledge score</b>					
Mean $\pm$ SD	10.1 $\pm$ 4.3	19.7 $\pm$ 5.4	95%	16.4	0.0001
Median(range)	9(5-21)	22(8-26)			
<b>Attitude score</b>			63.3%	17.0	0.0001
Mean $\pm$ SD	9.8 $\pm$ 3.0	16.0 $\pm$ 2.6			
Median(range)	10(3-16)	16(9-20)			
<b>Preventive measures score</b>			73.5%	11.4	0.0001
Mean $\pm$ SD	3.4 $\pm$ 1.3	5.9 $\pm$ 1.4			
Median(range)	3(2-6)	6.5(3-7)			

Paired t test P<0.05: significant.



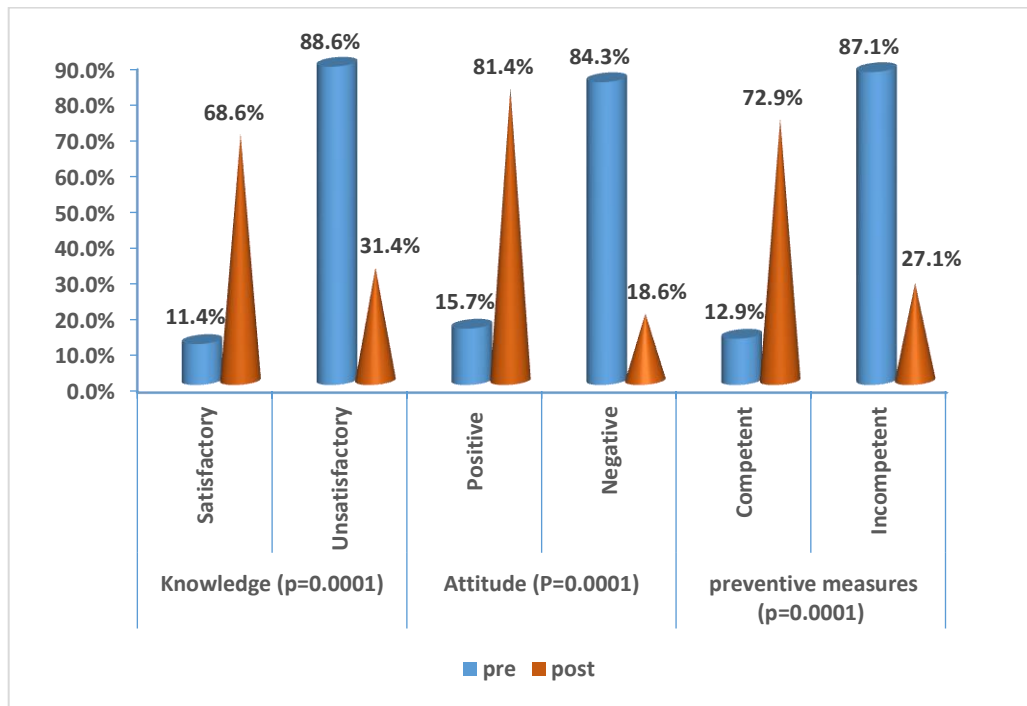


Figure (2): Percentage distribution of knowledge, attitude and preventive Measures at pre and post Nano-teaching sessions about human monkeypox infection among Pregnant women (n=70)

Table (7): Correlation between pregnant women’s knowledge, attitude and preventive measures at pre and post Nano-teaching sessions (n = 70):

Variables		Pre		Post	
		Pregnant women’s knowledge	Pregnant women’s attitude	Pregnant women’s knowledge	Pregnant women’s attitude
Pregnant attitude	women’s	r	0.400	0.427	
		p	0.001	0.0001	
Pregnant preventive measures	women’s	r	0.244	0.214	0.410
		p	0.042	0.075	0.0001

Correlation Coefficient: r, p<0.05: significant, p>0.05: non-significant

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