ORIGINAL ARTICLE

Effectiveness of a structured teaching program on anxiety and perception regarding toxoplasmosis among seropositive pregnant women in Northern Upper Egypt

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ABSTRACT

Background: Toxoplasmosis is a major opportunistic infection caused by single-cell protozoan from the Coccidia family. Up to 95% of infected individuals remain asymptomatic, nevertheless, it may be a leading cause of foodborne illness-related hospitalisation and death. Primo-infection can cross the placental barrier and cause life-threatening sequelae for the fetus leading to miscarriage, hydrocephalus and, retinochoroiditis. Moreover, the infection may cause infertility, endometritis, and uterine atrophy and, impaired folliculogenesis for the mother.

Aim: To evaluate the effectiveness of an educational program on perception and anxiety level regarding toxoplasmosis among seropositive pregnant women in Beni-Suef in Egypt.

Subjects and methods: A quasi-experimental design was used with 50 seropositive pregnant women attending the inpatient/outpatient antenatal care units. Tools: A structured knowledge questionnaire, pre-test/post-test/retained-test knowledge assessment sheet and Zung's self-rating anxiety scale.

Results: Pre-program 96% of women scored poor knowledge and no participants (0.00%) reported severe anxiety; whereas, immediately post-program 70% of women scored good knowledge and 84% reported severe anxiety. After implementation of the program, all women (100%) gained a good knowledge score while 48% of them reported severe anxiety. Significant association between mean knowledge scores and demographic variables ($p < .0001$) was found.

Conclusions: Although the program is effective to enhance women's perception regarding Toxoplasmosis, it exaggerated the anxiety level for pregnant women. A negative association was found between women's perception and anxiety level, however, this relation was not significant.

Recommendations: Implementation of health education programs aimed at primary prevention of toxoplasmosis is recommended for all women of childbearing age.

Key Words: Perception, Toxoplasmosis, Anxiety, Structured educational program

1. INTRODUCTION

Toxoplasmosis is a ubiquitous protozoan parasite.[1] It is one of the most common human zoonoses[2] and caused by infection with the obligate intracellular protozoan parasite Toxoplasma gondii (T. gondii),[3] that is estimated to infect about a third of the world's human populace causing a wide range of health implications.[1] It is distributed in humans, all warm-blooded animals including birds and mammals throughout the world.[4,5] The seroprevalence of human T. gondii infection varies in different parts of the world and has

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been reported with rates up to 75%.[6] The infection is more prevalent in humid and warm climates.[7] The prevalence rate is also increased with age but doesn't differ enormously between the two sexes (females and males).[2] Moreover, the disease is more common among those consuming under-cooked meat.[7]

Toxoplasma is a single-cell protozoan that affiliates to the Coccidia family. It is an obligatory intracellular protozoan with a heterogeneous life cycle in humans and other vertebrates.[8] Toxoplasma has double hosts and double life cycles: (1) definitive hosts; a sexual cycle that take place in the feline's small intestine (cat) family;[2, 9] (2) intermediate hosts; an asexual cycle in infected warm-blooded animals, including humans.[2] Most or all mammals and marsupials can serve as intermediate hosts.[10] T. gondii exists in three infective stages: (1) Tachyzoites, an invasive rapidly dividing proliferative form of the parasite; (2) Bradyzoites, a slowly dividing in tissue cysts, which can persist inside human cells for protracted periods; and (3) Sporozoites, an environmental stage, and the sporozoite, protected inside an oocyst.[2, 9]

Feline family (domestic and wild cats) are the only definitive host in which sexual proliferation (oocysts are exclusively produced) of the parasite occurs in the intestine, resulting in the shedding of oocysts in their faeces into the environment, thereby contaminating soil and water resources that become infective a few days later.[2, 11, 12] One cat can shed up to 10 million oocysts/day, for up to 14 days, after the primary infection. Shedding of oocysts depends on the source of infection in that feline tainted by tissue cysts; oocysts are shed by only 30% to 50% of infected cats.[4] Closing the cycle, cats typically become infected when eating rodents and/or birds that contain cysts.[11, 13]

Humans generally acquire T. gondii infection by four principle routes as illustrated in Figure 1. The foodborne route is important. Ingestion of tissue cysts by eating raw/inadequately cooked infected meat or eating uncooked foods that may be unintentionally contacted with contaminated meat.[8, 11, 14, 15] Also, the transmission of this parasite occurs by the exposure to contaminated soil, drinking municipal/well un-bottled and un-boiled water that contains Sporozoites inside the oocysts. Exposure of children may occur during their playtime in sand pits.[16] Animals are infected by eating infected animals, by ingestion of or coming in contact with infected cat faeces.[9] Cattle and other herbivorous animals contract the infection from grass and pastures contaminated with cats' faeces.[17] Moreover, Tachyzoites may be found in the milk from an intermediate host, including cattle, sheep, and goats. Human cases have only been linked directly to consumption of goat's milk, although risk
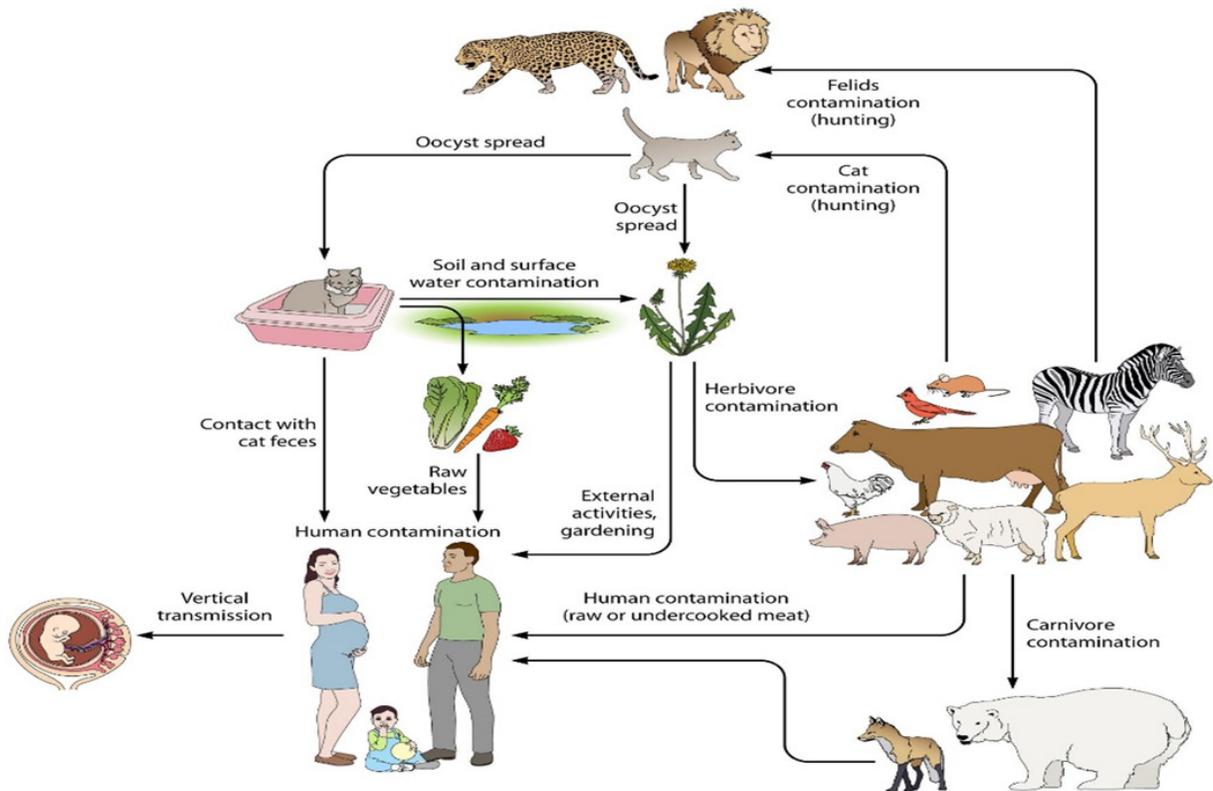
factor studies have suggested an association with drinking milk in Poland and with camel milk in the Sudan. Tachyzoites have been found in spit or sputum, saliva, urine, tears and semen, and additionally in raw eggs from experimentally but not naturally infected hens.[4] Humans can unintentionally ingest oocysts by ingesting water, soil, or food polluted by feline faeces (cultivating, eating unwashed vegetables and fruits, or cleaning a feline's litter box).[8, 13, 15] The various sources of food-borne and environmental contamination of humans are represented in Figure 1.[5] Third, mother-to-child transmission of the parasite occurs only when infection is acquired for the first time during or just before to woman's pregnancy. Infection is thought to be transmitted to the baby transplacentally or during vaginal birth.[8, 13] Fourth, blood transfusion, bone marrow transplantation, organ transplantation or allogeneic stem cell transplantation from previously infected donor to an uninfected person.[9, 15] The transmission of the T. gondii parasite may occur by sputum, breast milk, and semen. Consequently, the disease can possibly be transmitted via both oral and/or vaginal sex, significantly more frequently from seropositive one to his passive sex partner than vice-versa.[9]

Up to 95% of the cases of immunocompetent individuals infected with toxoplasma protozoon remain asymptomatic[14] or have a subclinical course with minor symptoms because their immune system keeps this protozoon from causing illness. It is nevertheless the most common food-borne parasitic infection requiring hospital treatment and the third most common indication for hospital admission due to food-borne infection.[1, 9]

The vast majority of literature reported that 10% to 20% of people infected with toxoplasmosis are symptomatic; in spite of a survey of flare-ups of toxoplasmosis has suggested that up to a further 50% may experience mild symptoms.[4] T. gondii protozoon can be categorized into four symptoms groups: (1) cervical lymphadenopathy (T. gondii have been estimated to cause 3%-7% of clinically significant cases of lymphadenopathy). The infection is characterized by non-specific symptoms. An infected individual can experience mild influenza-like symptoms that last for weeks to months as headache, glandular fever or flu-like illness, sore throat, low-grade fever, myalgia, and generalised malaise, with possibility of brief erythematous (maculopapular) rash and splenomegaly;[3, 4, 9] (2) typhus-like exanthematous form with myocarditis, a typical pneumonia, meningoencephalitis, and potentially death; (3) retinochoroiditis, that may be severe and requires enucleation; (4) central nervous system (CNS) involvement. In addition, several reports suggest that T. gondii disease might be responsible for an additional wide variety of symptoms, and advancement of several clinical

entities.[9] Immunocompromised people can face severe and fulminating life-threatening symptoms, especially ocular toxoplasmosis (retinochoroiditis), pneumonia, and encephalitis. In immunocompetent non-pregnant women, acute infection may lead to uveitis, eye lesions, and impaired eyesight.[1, 9]

Figure 1. Sources and cycle of Toxoplasma infection in humans[5]

Women who have already acquired their T. gondii infection before pregnancy, except if the women are immunosuppressed, are not at risk for delivering an infected baby.[3] Immunity usually prevents access of the pathogen to the embryo, and it is viewed as defensive. Hence, preventive efforts concentrate on seronegative women who can be recognised from "immune" women, who will remain seropositive throughout their childbearing lives.[11] Directly, three factors are correlated with the incidence of congenital toxoplasmosis in newborns, namely (1) the incidence of primary infection in pregnant women; (2) the gestational week that the pregnant woman acquired the infection; (3) public health programs implemented for prevention, detection, and treatment of the infection during pregnancy. However, several cases of congenital infection are most likely not recognised as: (1) the primary infection is related to no specific symptoms in the great majority of individuals; (2) the infection might be asymptomatic in newborns; (3) symptoms within the baby might develop gradually and be non-specific; (4) difficulty in the recognition of toxoplasma protozoa attributed to the etiologic agent once symptoms eventually appear.[2]

It is crucial to detect infections throughout pregnancy while they are still acute since it is usually throughout this period that the expectant mother runs the risk of transmitting the disease to her fetus.[18] Laboratory diagnosis, i.e. amniocentesis for PCR (polymerase chain reaction) and serologic assays, plays the most important role in congenital toxoplasmosis infection diagnosis as well as confirmatory diagnosis of toxoplasmic encephalitis and ocular Toxoplasmosis.[2] Toxoplasma infection mainly relies on serological tests. Serological tests help to determine whether the infection was acquired in the distant past or recently. Many serological tests are used for the detection of various antibody classes, i.e. IgG, IgM, IgA, and IgE, in body fluids, mainly serum. IgM antibodies are detectable about one week after the onset of infection and persist for several months, though they may remain detectable months or even years after the acute infection. Serological screening of pregnant women allows the detection of a recently acquired toxoplasma infection and the implementation of chemotherapy in order to prevent congenital infection and/or prevent sequelae in the newborn.[2, 13, 18] Case definition, proposed by the European

Research Network on Congenital Toxoplasmosis, based on the probability of infection could be used for diagnosis and serological evaluation of primo-infection (see Table 1).[19, 20]

Other useful diagnostic tools to determine the infection of the fetus are the PCR and ultrasound.[13] The PCR and/or culture at 18-20 weeks' gestation or if ≥ 4 weeks after maternal infection.[21] The amplification of T. gondii DNA in amniotic fluid should be done at 18 weeks of gestation or later. If done at the 18th week, this test has an overall sensitivity of 64%, a negative predictive value of 88%, and a specificity and positive predictive value of 100%. Its sensitivity and specificity for amniotic fluid obtained before 18 weeks of gestation have not been studied. In addition, the procedure done early in pregnancy is associated with a higher risk to the fetus and is likely less useful.[13] Concerning the ultrasound, this procedure is recommended for women with suspected or diagnosed acute infection acquired during or shortly before pregnancy. It may reveal fetal morphology, the presence of fetal abnormalities, including hydrocephaly, CNS abnormalities, brain or hepatic calcifications, symmetric fetal growth restriction, splenomegaly, ascites, and nonimmune hydrops.[3, 13] Additionally, placental examination can aid with diagnosis of congenital toxoplasmosis if parasite T. gondii has been isolated from specimens or if there are histopathological findings suggestive of the infection.[18]

Toxoplasmosis may be a leading cause of foodborne illness-related hospitalisation and death. T. gondii protozoon has an adverse effect on both mother and fetus. Generally infants of women who are seropositive before becoming pregnant are not at risk.[20] Primary maternal infection ("primo-infection") with T. gondii protozoon during or just before pregnancy is associated with a lack of protective immunity, the parasite (T. gondii) might cross the placental barrier and may pass the infection to the embryo and may cause health-threatening sequelae for the fetus. The damage and abnormalities to the unborn fetus depend on the gestational week; complicating medical conditions are more common amongst seroconverted women earlier in pregnancy. If the transmission occurs it can lead to miscarriage, intrauterine fetal death (IUFD), and stillbirth, pathophysiology of the CNS, such as cerebral and intracranial calcification, microcephaly, hydrocephalus or a child born with signs of Toxoplasmosis.[14, 20, 22] Although infants who are infected during pregnancy often show no symptoms at birth, they may develop symptoms later in their life with potential retinochorioiditis, vision loss, seizures, and convulsions. Moreover, psychomotor and mental impairment may develop in the fetus leading to life-long disabilities in children.[22, 23]

Table 1. The evaluation criteria for maternal serology

−	IgG		−	IgM					Seronegative patient
+	IgG	(< 200 UI)	−	IgM					Previous infection
+	IgG		+	IgM	+	IgA	IgG avidity < 15%		Acute infection
+	IgG	(> 300 UI)	+	IgM	−	IgA			Probably recent infection
+	IgG	(< 300 UI)	+	IgM	−	IgA			IgM chronic carrier
+	IgG	(> 300 UI)	−	IgM	−	IgA	IgG avidity > 30%		Probably reinfection
−	IgG		+	IgM	−	IgA			Natural IgM

Women can also be susceptible with a positive correlation between chronic toxoplasma infection and infertility that includes the development of endometritis and fetal rejection due to local release of T. gondii from latently located cysts in endometrial tissue on stimulation during placenta formation.[24] Uterine atrophy, impaired folliculogenesis in the ovaries and reproductive failure due to hypothalamic dysfunction as a result of chronic toxoplasmosis.[1]

Protozoan parasite Toxoplasma oocysts can be rapidly destroyed by temperatures higher than 151°F (66°C), and can also be killed with boiling water. The oocysts found in water are resistant to chlorination but may be eliminated by filtration or boiling. Tissue cysts and Tachyzoites are inactivated at PH < 4.0. Tissue cysts remain viable for approximately 10 minutes at 122°F (50°C) or 4 minutes at 140°F (60°C). Additionally, freezing at 10°F (12°C subzero) for 2-3 days may destroy a high percentage of the cysts.[10]

Primary prevention of T.gondii during pregnancy occurs by preventive behavior directed to food hygiene. Women should take precautions to avoid exposure to toxoplasmosis by following the World Health Organization (WHO) Five Keys to Safer Food.[25] Pregnant women should be advised to; (1) Wear gloves when gardening, particularly when handling soil and to wash their hands thoroughly afterwards with hot water and soap; (2) Avoid under-cooked or, raw meat, particularly lamb, including any ready prepared chilled meals. Cook all red meat until no trace of pinkness remains and the juices run clear, and avoid tast-

ing meat before it is fully cooked. Hand washing thoroughly after handling the raw meat and also all kitchenware should be washed thoroughly after preparing raw meat; (3) avoid sheep and their newborns during the lambing season if the woman is at extra risk; (4) All fruits and vegetables, including ready-prepared salads, should be thoroughly washed with clean water before cooking and eating; (5) Avoid unpasteurised goat's milk or products that are made from it; (6) avoid handling or adopting stray cats; (7) avoid cat faeces in soil or cat litter and wear gloves during changing a cat litter tray, and if the woman is immune deficient or pregnant, she should ask someone else to do this for her, wash hands thoroughly afterwards, cats should be fed dried, or canned, cat food, rather than raw meat.[20]

1.1 Significance of the study

Anxiety is common during childbearing years. The hormonal changes during pregnancy may place additional stress on women's emotions, making them more vulnerable to anxiety. Pregnancy is thus a period of potential stressor and relatively a high-risk period for women with pre-existing a number of psychological health problems which arise during or soon after pregnancy.[26–28] Various situations and conditions can increase the frequency and severity of the anxiety and pregnancy can often amplify this anxiety.[29] Some women are worried about whether their babies are healthy (previous pregnancy losses or fertility problems can make this an especially overriding worry). Anxiety during pregnancy may be associated with a variety of adverse consequences in terms of obstetric complications and pregnancy outcomes.[27] Pregnant women can become more anxious when an unexpected threat occurs as invasion of any microorganism or parasite such as T. gondii which could have an adverse effect on the pregnancy outcome. As a result, women may experience mood swings, a surge of energy and walking may become more difficult.[30]

Worldwide, it is estimated that primary maternal T. gondii infection occurs in 0.1% to 0.8% of pregnancies, resulting in 1 to 120 cases of congenital toxoplasmosis per 10,000 births.[4] Additionally, the WHO estimates that every year there are over a million case of toxoplasmosis in the European region caused by contaminated food.[14] A positive correlation between infertility and toxoplasmosis is shown. Using ELISA, infertile women scored higher prevalence (15.9%) of IgG antibodies than pregnant-puerperal (5.6%) ones. In Egypt, in Dakhalia governorate, a statistically significant higher prevalence ($p < .01$) of protozoan parasite T. gondii infection was found in infertile female patients (61.85%) in comparison with the control group.[1]

1.2 Operational definitions

Perception: The English dictionary defines the word "perception" as the capacity for knowledge or insight and an insight or point of knowledge.[31] While the definition stated by the medical dictionary was the mental process of becoming aware of or recognising an idea; primarily cognitive rather than the affective or conative.[32]

Anxiety: Anxiety describes a state of the mind and experience of unpleasant effect which develops depending on environmental stimulants that are perceived by the individuals as being dangerous or threatening when confronted with specific situations, demands or a particular object or event.[29]

1.3 Aim of the study

The aim of the current study was to evaluate the effectiveness of a structured teaching program (STP) on perception and anxiety levels regarding toxoplasmosis among seropositive (IgG or IgM antibodies) pregnant women in northern Upper Egypt. This general aim will be achieved by the following specific aims:

(1) Assess the prevalence of Toxoplasmosis (IgM and IgG antibodies) among pregnant women in northern Upper Egypt.
(2) Assess the knowledge of toxoplasmosis among seropositive (IgG or IgM antibodies) pregnant women.
(3) Determine the level of anxiety among seropositive IgG or IgM antibodies pregnant women with Zung's self-rating anxiety scale.
(4) Implement a STP for pregnant women with toxoplasma seropositive IgG or IgM antibodies.
(5) Evaluate the effectiveness of the structured educational program on the women's anxiety levels and knowledge deficit regarding Toxoplasmosis among seropositive pregnant women.

1.4 Research hypothesis

Hypothesizes formulated by the researcher for the current study were:

(1) After implementing the program, women's perception regarding Toxoplasmosis will be improved. The mean post-test/retained post-test knowledge scores of seropositive (IgG or IgM antibodies) pregnant women will be significantly higher than their mean pre-test knowledge scores at a significant level 0.05.
(2) The women's anxiety levels will be alleviated after implementing the program. The mean post-test/retained post-test anxiety scores of seropositive (IgG or IgM antibodies) pregnant women will be significantly less than their mean pre-test anxiety scores at a significant level 0.05.

(3) There will be a significantly statistical association between knowledge score and anxiety scores, the higher the knowledge, the lower the anxiety levels, at a significant level 0.05.

(4) There will be a statistically significant association between knowledge scores, socio-demographic and obstetric variables at 0.05 level of significance.

2. Methods and subjects

2.1 Research design

A quasi-experimental design was used.

2.2 Setting

The data collection for this study took place in the inpatient antenatal care units and outpatient antenatal clinics affiliated with all government hospitals in Beni-Suef city, Egypt, namely:

(1) The University Hospital.
(2) Ministry of Health Public Hospital.
(3) Health Insurance Hospital.

2.3 Participants

All pregnant women who were positive IgG or IgM in their serology for toxoplasmosis admitted in the inpatient antenatal care unit or attending the antenatal clinic in the previously mentioned hospitals in Beni-Suef city from September 1st 2016 to November 30th 2016 were approached, using purposive sampling technique. Of the invited women (70), 55 women agreed to participate.

(1) All subjects fulfilled the following eligibility criteria:

- Women of Upper Egypt ethnicity above 18 years of age.
- Seropositive (anti-T. gondii or IgG antibodies) toxoplasmosis.
- Pregnancy free from any complications, such as twins or known congenital anomalies.
- Have not experienced any psychological treatment.

(2) Exclusion criteria:

- Women considering termination of pregnancy.
- Women having conceived through in-vitro fertilisation.
- Women with significant comorbidities.
- Women who have any medical, obstetrical or gynecological disorder associated with pregnancy.
- Women who are have experienced any previous psychological disturbance or treatment.

2.4 Assessment tools

Three tools were used for collecting the relevant data.

Tool (I): A structured knowledge questionnaire:

After reviewing the academic literature comprehensively from electronic media, journals, published studies and books, the researcher designed and developed an interviewing questionnaire sheet to assess women's perception through evaluating knowledge about toxoplasmosis among seropositive (IgG or IgM antibodies) pregnant women attending governmental hospitals in Beni-Suef city. It consists of three sections:

Section (1) Demographics Questionnaire: It encompassed socio-demographic characteristics of respondents containing seven items (age, residence, type of family, level of education, occupational status and if they were involved with animal breeding including what types of animals).

Section (2): Obstetrical history and as gravidity, parity, number of previous abortion or stillbirth.

Section (3): Antenatal assessment sheet to assess antenatal care during pregnancy.

Tool (II): Pre-test/post-test/retained-test knowledge assessment sheet:

This sheet was distributed to all participant pregnant women three times; before the program implementation (pre-test), immediately after the program (post-test), and three months after implementation of the program (retained-test). Knowledge questionnaire of 45 items was designed by the researcher, on two aspects with a total maximum score of 70 (see Table 2).

Table 2. Total scoring

Score		
Good	$\geq 75\%$ correct answer	52 to 70 marks
Satisfactory	$\geq 50\%$ to $< 75\%$ correct answer	35 to 52 marks
Poor	$< 50\%$ correct answer	0 to 35 marks

Part (1): The first part was designed to assess the women's knowledge regarding Toxoplasmosis as the definition, causative organism, mode of transmission, risk groups, life cycle, signs and symptoms, clinical diagnosis, complications, prevention, and treatment.

Scoring keys: Knowledge questionnaire of 25 items with maximum score of 50.

0 = incorrect answer or don't know.
1 = correct answer, but isn't complete.
2 = complete and correct answer.

Part (2): The second part was designed to assess women's

knowledge regarding cultural habits regarding food and advice to consumers on toxoplasmosis and other foodborne pathogens.

Scoring keys: Knowledge questionnaire of 20 items with maximum score of 20.

0 = don't know.
1 = know.

Tool (III): Zung's self-rating anxiety scale:[33]

Standardized Zung's self-rating anxiety scale is used to assess the anxiety level. This scale includes 20 questions with a total maximum score of 80. Some questions ask for the information positively (15 positive statements) and others negatively (5 negative statements). But in all cases, the symptoms severity is scored from 1 to 4.

1 = none or little of the time answer.
2 = some of the time answer.
3 = a large part of the time answer.
4 = the most or all of the time answer.

The total raw score was converted to an anxiety index (100-point scale).

Thereby, Anxiety Index = (the raw score/80 total points) × 100 OR anxiety index raw = raw score × 1.25

Total scoring of the pregnant women's anxiety index (100):

< 45: Normal anxiety.
45 to 59: Minimal to moderate anxiety.
60 to 74: Marked to severe anxiety.
> 74 to 100 : Extreme anxiety.

2.5 Methods and phases of data collection

2.5.1 *Validity & reliability of the tools*

- The tools were revised for their content validity by 5 experts in the field. They were senior staff members with experience in obstetric & gynecological medicine, maternity & gynecological nursing. The recommended modifications were made.
- The tool is reliable as reliability was assessed by Cronbach's alpha coefficient test. The result of the test was 0.89.

2.5.2 *Administrative approval*

Official letters that described the objectives and the aim of our study were directed from the Faculty of Nursing, Beni-Suef University to the directorates of all previously mentioned governmental hospitals in Beni-Suef city to obtain their permission to collect the research subject from hospitals under their directorate.

2.5.3 *Ethical considerations*

Verbal consent took from each participant before including her in the study. They were informed that their participation is totally voluntary, so they could withdraw from the study whenever they decided. After taking consent from each participant, the researcher introduced, clarified and explained the purpose and all the objectives of the study. Total confidentiality to obtain information, as well as respect for privacy, was ensured.

2.5.4 *Pilot study*

A pilot study was done on five seropositive (IgG or IgM antibodies) pregnant women. The results of the pilot study revealed relevance, clarity, and applicability of the study tools. Women involved in the pilot were excluded from the study to avoid contamination of the study sample. The necessarily required modifications were done.

2.5.5 *Phases of field work*

While 55 women agreed to participate in the program, subsequently five women dropped-out during the study. So, the study enrolled 50 pregnant women with positive IgG or IgM serology for toxoplasmosis. Each participant took, approximately, 15-30 minutes to complete the interview questionnaire. Four phases were adopted to fulfill the purpose of the study as following mentioned: (1) assessment phase, (2) planning phase, (3) implementing phase, (4) evaluation phase. The four phases of data collection took 6 months (from September 1, 2016, to February 25, 2017).

(1) Assessment phase:

The pre-test included assessment of perception and the anxiety level among the pregnant women with positive IgG or IgM serology for toxoplasmosis, through structured knowledge questionnaire and standardized Zung's self-rating anxiety scale. The data obtained during this phase constituted the baseline for further comparison to evaluate the effect of the educational program. Each woman was interviewed to collect socio-demographic data and obstetric and antenatal history and to assess their baseline knowledge about toxoplasmosis.

(2) Planning phase:

After comprehensive reviewing of the relevant academic literature, from journals, magazines, books, bulletins and the electronic media, the researcher developed a structured educational program that was administered at the end of the pre-test. It contained the definition, causative organism, mode of transmission, risk groups, life cycle, signs and symptoms, clinical diagnosis, complications, prevention, and treatment. Additionally, it contained cultural habits instructions regarding food and advice to consumers on toxoplasmosis and other

foodborne pathogens.

(3) Implementation Phase:

The design of the program was based on the pre-existing women's knowledge regarding toxoplasmosis. The program consisted of five sessions, each session lasting 25-30 minutes. It was facilitated by the head nurses from within the antenatal outpatient clinic and inpatient department. They provided the researcher with educational aid facilities as place and data show. Additionally, they collected IgG or IgM seropositive pregnant women and coordinated with them for attending the program on Monday every week. Sessions were held in facilities situated at the hospital. Each session provided a combination of lectures, group discussion, and brainstorming which was delivered by the researcher (see Table 3). An educational booklet was distributed to each participant in the program. During the study period, a total of 5 courses (10-12 women involved in each course) were held once per week.

Table 3. Overview of the elements in the educational program about Toxoplasmosis (duration 2 hours, 30 minutes)

Session	Elements	Objectives	Method
Session no. 1	Opening Ceremony	1. Welcome 2. Presentation of program objectives. 3. Enumerate the participants' expectations. 4. Distribution of pre-test.	• Discussion.
Session no. 2	Knowledge regarding Toxoplasmosis	1. Define Toxoplasmosis. 2. Identify causative organism. 3. Enumerate mode of transmission. 4. Mention risk groups. 5. Describe life cycle.	• Brainstorming. • PowerPoint. • Video.
Session no. 3	Knowledge regarding Toxoplasmosis	1. List signs and symptoms. 2. Describe clinical diagnosis. 3. List complications for the mothers. 4. List complications for the fetus. 5. Identify methods of prevention and treatment.	• Brainstorming. • lecture supported by discussion. • Power Point. • Questions and answers.
Session no. 4	Knowledge regarding cultural habits instructions and food advice to consumers on toxoplasmosis and other foodborne pathogens.	A. The recommended advice in relation to consumption and preparation of food. B. The recommended advice in relation to food storage. C. The recommended advice in relation to personal hygiene. D. The recommended advice in relation to cats care and gardening.	• Power point. • Group discussion.
Session no. 5	Closing	1. Participant's evaluation of the program. 2. Distribution of Post-test.	• Distributing educational booklet. • Summary & Conclusion. • Thanks to all participants.

(4) Evaluation phase:

During this phase, the program was evaluated by using the same previously formatted data collection tools. The immediate evaluation after the program was conducted as a post-test. Another evaluation subsequent follow-up phase (retained-test) was scheduled; three months later.

2.5.6 *Data snalysis*

The data collected were categorised, arranged, tabulated, coded, scored and analysed by the IBM, SPSS statistical package version 20 (International Business Machines Corp., Armonk, NY, USA). The analysis took place after checking data entry and correction for any errors including categorical variables such as parity, number of abortions and stillbirths, occupation, educational level, residence and continuous variables as anxiety score, age, and gestational weeks.

Continuous variables were converted to categorical ones by the author to achieve better analysis. The next mentioned statistical tests were used:

Descriptive statistics:

- Mean and standard deviations (X $\pm$ *SD*) were used to express the quantitative data.
- Percentages and numbers (number and percent) were used to express the qualitative data.

Inferential statistics: All tests were used as tests of significance at *p*-value < .05.

- Marginal Homogeneity test.
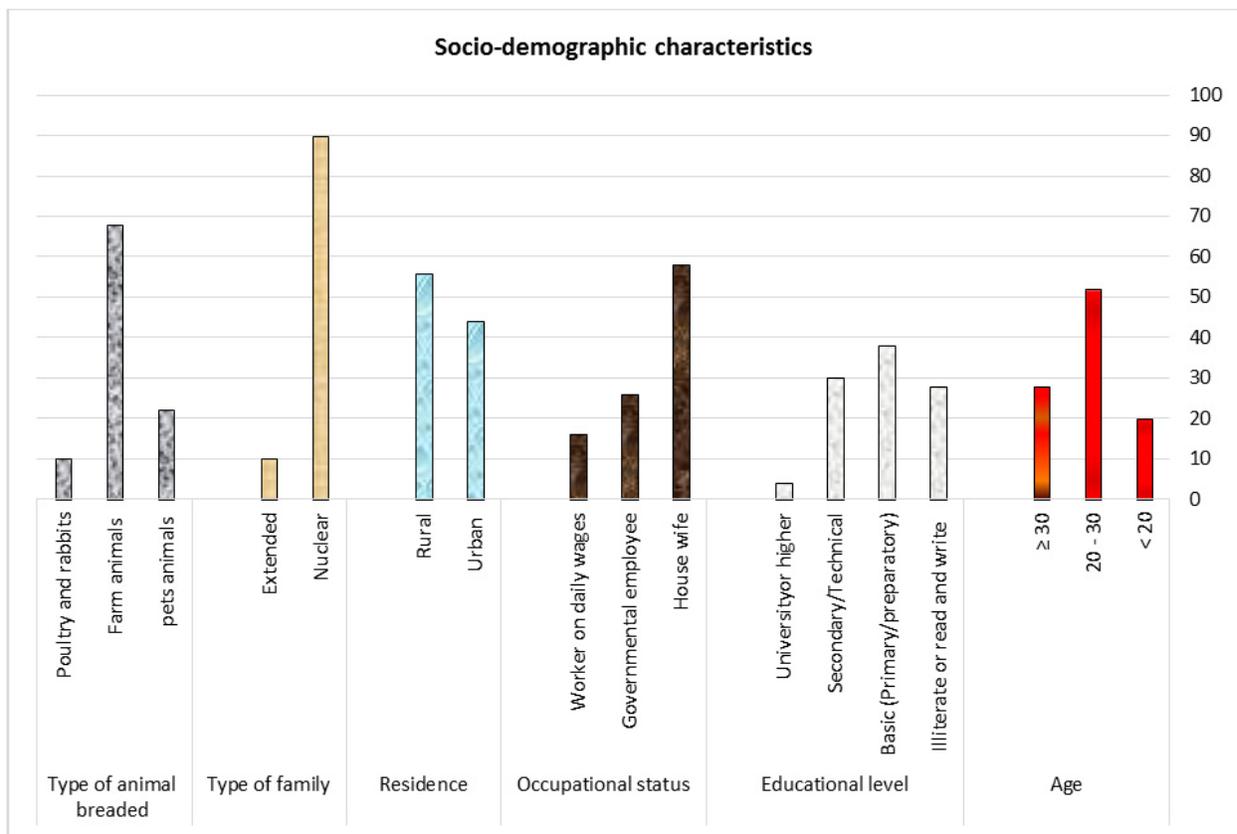- Student *t*-test.
- ANOVA test.
- LSD Post Hoc test.

- Pearson correlation coefficient (r) test.
- Colum, Pie and Bar chart diagrams were used to express the graphical presentation of the data.

3. RESULTS

Based on data from seroprevalence, a total of 70 pregnant women was positive IgM and IgG serology for toxoplasmosis throughout three months; this would suggest that, annually, there will be around 280 cases of seropositivity toxoplasmosis pregnant women. As 765 pregnant woman visited antenatal outpatient clinics or were admitted to the inpatient unit, seropositive IgG or IgM antibodies prevalence rate was on average 9.2%. As all (70 positive IgG or IgM antibodies) pregnant women had been invited, 55 women agreed to participate in the program while the remaining ones declined. So

the participation rate was on average 78.6%. Subsequently, five of interview questionnaires were excluded as it was incomplete because those women didn't come back to complete the evaluation phase. Of the remaining 50 questionnaires, 39 (70.9%) were seropositive IgG, 5 (9.1%) were seropositive IgM antibodies and 11 (20.0%) were seropositive IgM and IgG antibodies.

The data presented in Figure 2 indicates that more than half of the study sample (52.0%) was aged from 20-30 years old. More than one third (38%) of the study sample had basic education, more than half (58% and 56%) were housewives and lived in rural locations, respectively. The majority of them (90%) live with extended family. All of them bred animals in their houses, 68% bred farm animals such as sheep, cattle, goats and horses.

Figure 2. Socio-demographic characteristics of the study sample

Figure 3 illustrates the distribution of pregnant women with seropositive IgM and IgG antibodies regarding to their obstetric history. Fifty-six percent were multigravida and 52.0% were in the 1st trimester, 28.0% in the 2nd trimester, while 20.0% in the 3rd trimester. Forty percent of the study sample had no previous history of abortion and/or stillbirth while more than half (60.0%) of sample had experienced a previous

abortion.
For women's commitment to antenatal follow-up schedule appointment and number of visits, Figure 4 illustrates that all of study sample (100%) didn't follow the recommended antenatal schedule. Additionally, the majority (90%) didn't follow the recommended number of visits (≥ 5 visits) prescribed by WHO in their pregnancies, only 10% of women

visited to receive antenatal care unit $\geq$ 5 times. Most (58%) of the pregnant women took advice and knowledge from their relatives, while only 22.0% of them took their advice from medical staff.

Table 4 shows that in the pre-test the majority of the pregnant women (96%) had poor knowledge and (2%) had satisfactory and good knowledge scores whereas; in the post-test (70%) of them had good knowledge and (20%) had poor knowledge. Additionally, in the follow-up test, that assessed retained knowledge, all of studied sample (100%) gained good knowledge scores. By Marginal Homogeneity test, highly statistically significant difference was found between the three evaluations (pre/post, post/retained and pre/retained) of

assessments at p-values $< .0001$.

Table 5 reveals that in pre-test the majority of pregnant women (54%) had normal level of anxiety while no one (0.0%) had marked to severe anxiety scores. On the contrary, in the post-test the majority of them (84%) had marked to severe anxiety while no one (0.0%) had normal anxiety scores; whereas in the retained-test, the majority (50%) had minimal to moderate anxiety while 48% had marked to severe anxiety scores. Marginal Homogeneity test revealed highly statistically significant difference between the three times (pre/post, post/retained and pre/retained) of assessments at p-values $< .0001$.
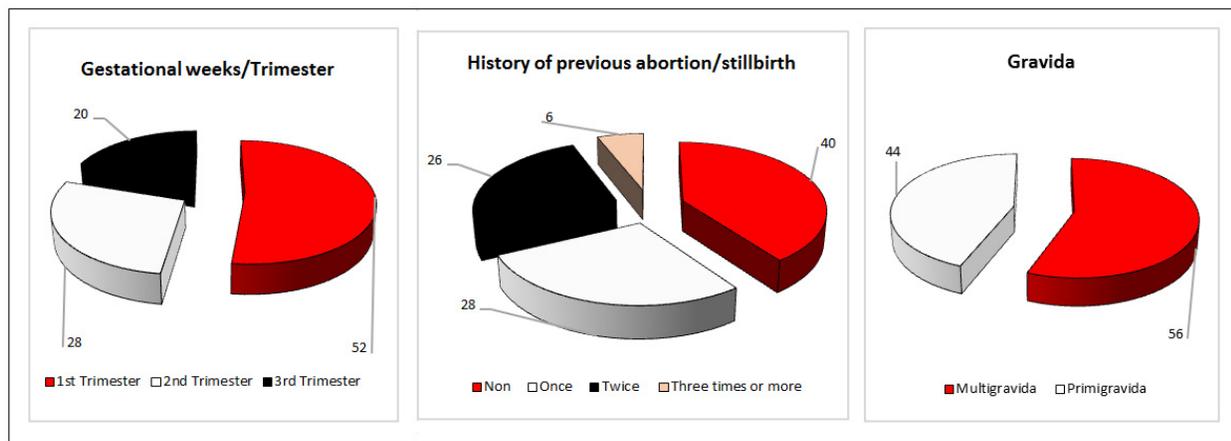

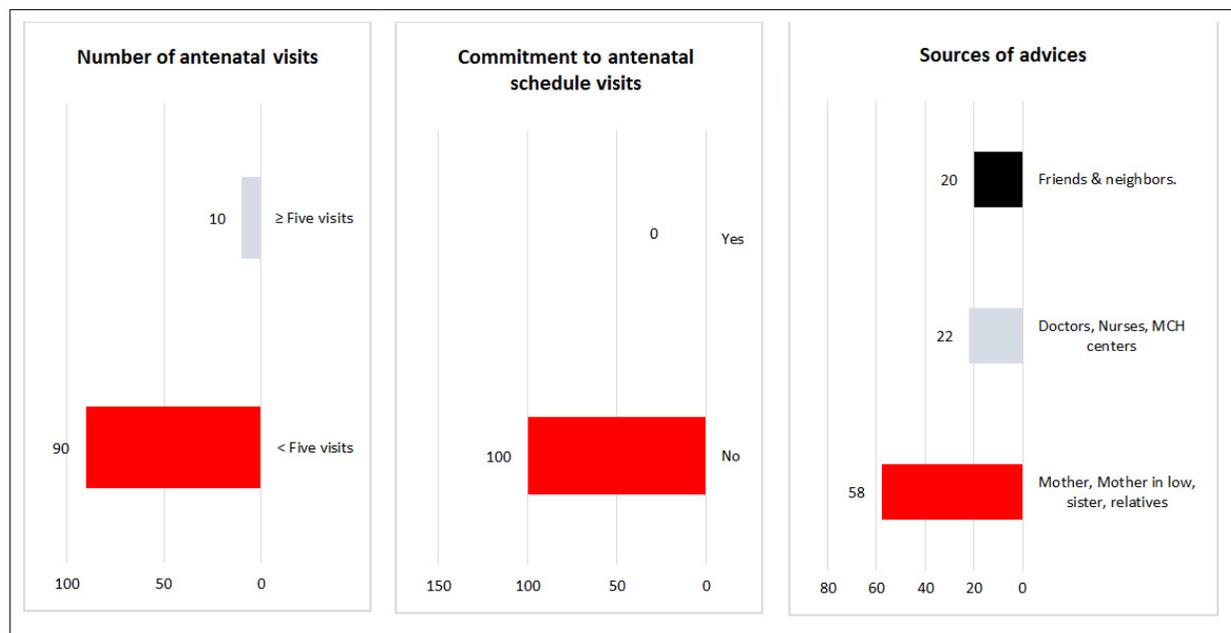**Figure 3.** Obstetric history of the study sample

Figure 4. Commitment to antenatal follow-up schedule appointment and number of visits

Table 4. Distribution of knowledge level among the studied seropositive toxoplasma pregnant women

Knowledge level	Studied seropositive toxoplasma pregnant women (n = 50)						Sig (pre/post)	Sig (post/retained)	Sig (pre/retained)
	Pre-test		Post-test		Retained-test				
	No.	%	No.	%	No.	%			
Poor (< 50%)	48	96.0	10	20.0	0	0.0			
Satisfactory (50%-75%)	1	2.0	5	10.0	0	0.0	< .0001*	< .0001*	< .0001*
Good (> 75%)	1	2.0	35	70.0	50	100.0			

Note. Sig: *p*-value for Marginal Homogeneity test; *significant at $p \leq .05$

Table 5. Distribution self-retailing anxiety level among the studied seropositive toxoplasma pregnant women

Self-retailing anxiety scale	Studied seropositive toxoplasma pregnant women (n = 50)						Sig (pre/post)	Sig (post/retained)	Sig (pre/retained)
	Pre-test		Post-test		Retained-test				
	No.	%	No.	%	No.	%			
Normal level of anxiety	27	54.0	0	0.0	1	2.0			
Minimal level : moderate level of anxiety	23	46.0	8	16.0	25	50.0	< .0001*	< .0001*	< .0001*
Marked level : severe level of anxiety	0	0.0	42	84.0	24	48.0			

Note. Sig: *p*-value for Marginal Homogeneity test; *significant at $p \leq .05$

Table 6 presents the correlation between the knowledge score of the studied seropositive toxoplasma pregnant women and self-retailing anxiety scores. Pearson correlation coefficient test (r) revealed that, the high knowledge score result to higher anxiety level score, despite, no statistically significant difference was found between the two mentioned variables.

Table 6. Correlation between knowledge and self-retailing anxiety scores among the studied seropositive toxoplasma pregnant women

	Anxiety score					
	Pre-program		Post-program		Retained	
	r	p	r	p	r	p
Knowledge score	0.248	.083	0.275	.053	- 0.163	.258

Note. r: pearson correlation coefficient

Table 7 reveals that all women achieved better mean knowledge scores, progression of good scores and regression of poor ones, after implementing the program (post-test/retained-test) than before it (pre-test), regarding all mentioned items of the demographic characteristics. There is a statistically significant association between pre-test mean knowledge scores and demographic (age, education and occupation) variables. Moreover, a significant association between post-test knowledge scores and education and occupation was observed whereas; no significant association between retained-test knowledge scores and demographic variables (*p*-values < .0001).

Relation between knowledge score and obstetrical history and antenatal visits among the studied seropositive toxoplasma pregnant women, is revealed in Table 8. The high-est mean knowledge scores, in pre-test (25.9 ± 14.2), was observed among 1st trimester pregnant women. While in post-test (78.6 ± 4.2) and retained-test (93.4 ± 3.1) the highest mean score was observed in 3rd trimester. ANOVA test revealed statistically differences between pre-test mean knowledge scores and women's gestational weeks (F = 4.47, *p* = .017). Moreover, between the women's history of abortion/stillbirth and the mean knowledge scores of pre-test (F = 28.899, *p* < .0001) and post-test (F = 21.869, *p* < .0001). Finally, Student *t*-test finds no significant relation between neither gravida, nor number of antenatal visits and women's mean knowledge scores at all times during program (pre/post/retained).

4. DISCUSSION

Many previous studies have shown the adverse effects of maternal psychological state on pregnancy outcomes. Given the potentially high prevalence of anxiety during pregnancy,[34] trait anxiety arises in response to a perceived threat. Anxiety is a normal response to threat or danger and part of the usual human experience, but it can become a mental health problem if the response is exaggerated and interferes with daily life.[28] In the developing countries, various infectious agents encountered during pregnancy are important because they threaten both fetal and maternal health. Pregnancy-related physiologic changes suppress immunity for a certain period and thereby enhance susceptibility to infectious agents. Among these, the prevalence of T. gondii is a very high and they may cause congenital malformations (21% of abnormal embryos) in the fetus by crossing the placental barrier.[22, 35]

Table 7. Relation between knowledge score (%) and socio-demographic characteristics among the studied seropositive toxoplasma pregnant women different timings of the program (n = 50)

Socio-demographic characteristics	n	Knowledge score (%) seropositive toxoplasma pregnant women (n = 50)					
		Pre-test		Post-test		Retained-test	
		Mean ±SD	Significance LSD Post Hoc test	Mean ±SD	Significance LSD Post Hoc test	Mean ±SD	Significance LSD Post Hoc test
Age (years)							
(1) Less than 20	10	11.0 ±3.4	F = 4.469	73.6 ±24.2	F = 1.023	91.4 ±3.1	F = 0.239
(2) 20-<30	26	26.0 ±14.3	$p = .017^*$	67.9 ±25.4	$p = .367$	90.4 ±3.9	$p = .788$
(3) 30 or more	14	24.6 ±16.9	1.2^* 1.3^*	79.6 ±5.2		90.6 ±3.2	
Educational level							
(1) Illiterate or read and write	14	10.1 ±4.1	F = 28.899	44.6 ±26.2	F = 21.869	90.7 ±2.9	F = 0.285
(2) Basic (Primary/preparatory)	19	19.3 ±10.9	$p < .0001^*$	81.7 ±6.3	$p < .0001^*$	90.6 ±3.1	$p = .836$
(3) Secondary/ Technical	15	33.5 ±7.5	1.2^* 1.3^* 1.4^*	82.0 ±6.9	1.2^* 1.3^* 1.4^*	90.5 ±4.7	
(4) University graduate or higher	2	60.0 ±22.6	2.3^* 2.4^* 3.4^*	93.0 ±4.2		93.0 ±1.4	
Occupational status							
(1) House wife	29	16.9 ±9.1	F = 15.649	67.2 ±22.0	F = 4.424	90.8 ±3.6	F = 0.199
(2) Governmental employee	13	38.2 ±17.1	$p < .0001^*$	86.8 ±5.8	$p = .017^*$	90.9 ±3.0	$p = .820$
(3) Worker on daily wages	8	17.8 ±8.9	1.2^* 2.3^*	64.5 ±31.7	1.2^* 2.3^*	90.0 ±4.4	

Note. F: ANOVA test; *significant at $p \leq .05$

Table 8. Relation between knowledge score (%) and Obstetrical and antenatal visits among the studied seropositive toxoplasma pregnant women different timings of the program (n = 50)

Obstetrical characteristics	n	Knowledge score (%) seropositive toxoplasma pregnant women (n = 50)					
		Pre-test		Post-test		Retained-test	
		Mean ±SD	Significance LSD Post Hoc test	Mean ±SD	Significance LSD Post Hoc test	Mean ±SD	Significance LSD Post Hoc test
Gestational weeks/Trimester							
(1) First Trimester	25	25.9 ±14.2	F = 4.47	67.8 ±25.3	F = 1.023	90.8 ±3.9	F = 0.239
(2) Second Trimester	14	24.6 ±16.9	$p = .017^*$	74.6 ±25.2	$p = .367$	90.5 ±3.3	$p = .788$
(3) Third Trimester	11	12.0 ±4.4	1.3^* 2.3^*	78.6 ±4.2		93.4 ±3.1	
History of previous abortion/stillbirth							
(1) ≥ 3	3	61.0 ±22.6	3.4^* 1.4^* 1.3^*	94.0 ±4.2		94.0 ±1.4	
(2) Twice	13	9.1 ±4.0	F = 28.899	44.1 ±25.2	F = 21.869	90.1 ±2.8	F = 0.285
(3) Once	14	33.5 ±7.5	2.4^* 2.3^* 1.2^*	82.0 ±6.8	2.4^* 2.3^* 1.2^*	90.4 ±4.7	$p = .836$
(4) Non	20	19.1 ±10.8	$p < .0001^*$	81.3 ±6.1	$p < .0001^*$	90.8 ±3.1	
Gravida							
(1) Multigravida	28	25.2 ±14.9	t = 1.430	76.6 ±18.2	t = 1.730	90.8 ±3.8	t = 0.173
(2) Primigravida	22	19.3 ±14.1	$p = .159$	65.7 ±26.3	$p = .090$	90.6 ±3.2	$p = .863$
Number of antenatal visits through pregnancy period							
(1) < 5 visits	45	22.0 ±14.4	t = 0.861	71.6 ±22.8	t = 0.182	90.7 ±3.5	t = 0.053
(2) ≥ 5 visits	5	28.0 ± 18.3	$p = .393$	73.6 ±22.7	$p = .856$	90.8 ±4.1	$p = .958$

Note. t: Student *t*-test; F: ANOVA test; *significant at $p \leq .05$

Toxoplasmosis is a preventable disease and is becoming a worldwide health hazard as it infects 30% to 50% of the human population.[9, 36] It is well documented that toxoplasmosis is of crucial importance due to cosmopolitan distribution and a wide range of diseases it causes. It is known that toxoplasmosis has an unfavorable impact on the reproductive capacity of both men and women. Congenital toxoplasmosis results from maternal exposure to infection for the 1st time during pregnancy may lead to serious complications such as stillbirth, prematurity, miscarriage (24.2% of stillbirths and miscarriages have been related to T. gondii) or the birth of a baby with neurologic defects. Infants with congenital toxoplasmosis are mostly asymptomatic at birth, but long-term studies indicate that up to 85% of all infants develop sequelae including chorioretinitis leading to severe vision impairment, hearing loss or psychological impairment.[1, 37]

In Egypt, the majority of T. gondii infection studies emphasized Lower Egypt (Dakhalia governorate),[1, 12] Alexandria governorate,[38] Menoufia governorate,[39] Zagazig,[40] Tanta[41] and Qualyobia Governorate,[42] and only one discussed Upper Egypt (El Fayoum Governorate).[43] Nearly all of the previously mentioned studies that addressed toxoplasmosis emphasised diagnosis, the prevalence, and complications of infection, association between it and other health conditions and its determinant factors; while none have reported related preventive measures. Moreover, studies that assessed the pregnant women's perception regarding this opportunistic infection and state of toxoplasmosis-related anxiety level in Northern Upper Egypt don't exist, such data are needed for initiating an educational health program, thereby, helping

in the control measures against congenital toxoplasmosis, especially in the absence of a routine serological screening program. Beni-Suef governorate is a fertile agricultural land, in addition to that, most of its population working in agriculture activities and most of them raise and breed birds and animals, making it suitable soil for the spread of T. gondii infection. As toxoplasmosis is a preventable disease by following the WHO Keys to Safer Food and the prevention is primarily directed towards health education related to avoiding personal exposure to the parasite. Thus, the present study is very important as it was directed to assess the prevalence of Toxoplasmosis (IgM and IgG antibodies) and associated factors as well as anxiety among seropositive IgM and IgG antibodies pregnant women in Beni-Suef. Consequently, develop and evaluate the effect of attending a structured educational program for these women to enhance their Perception and reduce their anxiety level regarding toxoplasmosis.

The overall laboratory findings showing diagnostic evidence of an anti-T. gondii IgG antibodies of Toxoplasma at a prevalence rate of 23%, emphasised the scope of infection in a community, and it explained the heavy burden of morbidity due to this parasitic disease.[3] The current study illustrated that 9.2% of pregnant woman, attending antenatal outpatient clinics or admitted in inpatient units, were seropositive IgM and IgG antibodies. This is similar to the findings of Saadatnia et al. who reported that as a minimum a third of the world human population is infected with the protozoan T. gondii, making it one of the most successful parasitic infections.[2] Advisory Committee on the microbiological safety of food documented a study in England that yielded a low rate (0.023%) of seroconversion during pregnancy.[4] Based on data from other countries suggesting that transmission occurs in 30%-40% of cases, this would endorse that there are around 40 to 60 cases of congenital toxoplasmosis annually.[4] Additionally, several studies conducted in Brazil have found seroprevalence rates varying from 42% to 90%.[18] Conversely Tekkesin (2012) reported that, although congenital toxoplasmosis is not a nationally reportable disease, extrapolation from regional studies indicates that an estimated 400: 4,000 cases occur in the United States each year.[3] Additionally, in Australia, primary infection with toxoplasmosis during pregnancy is rare.[20]

Based on the prevalence rate and history of infection, the study showed that 20% of the studied sample was seropositive IgM and IgG antibodies, while 70.9% were seropositive IgG and 9.1% were seropositive IgM antibodies. These results are similar to some Egyptian national findings whilst dissimilar to others. The prevalence of IgG antibodies among pregnant women in Menoufia was 67.5%.[39] This high prevalence of anti-toxoplasmosis IgG antibodies may be due to

agricultural activities, women drinking insufficiently treated water or unboiled milk, and exposure to risk factors including contact with cats, eating insufficiently cooked/raw meat like shawarma (roasted meat, especially when cooked on a revolving spit and shaved for serving in sandwiches) and eating raw unwashed vegetables. Another Egyptian governorate recorded a lower percentage of anti-toxoplasmosis IgG antibodies in pregnant women. The prevalence of IgG antibodies among pregnant women in Dakhalia governorate, Mansoura University Hospital was 44%.[1] A similar percentage (45.8%) was reported by El Fayoum Governorate[43] and Alexandria governorate (46.2%).[38] This may be attributed to the difference in diagnostic tests, sample size, characteristics of the population in each governorate and their exposure to relevant risk factors.

Seropositive pregnant women's knowledge about Toxoplasmosis showed; the pre-test revealed that the majority (96%) of women had a poor knowledge score before the implication the program (pre-test). The majority of the study subjects were unfamiliar with the definition of toxoplasmosis, causative organism, and mode of transmission, life cycle, risk groups, clinical picture, maternal/fetal complications, and preventive measures. This knowledge deficit may be attributed to the low educational level as most of the study sample (66.0%) had a low level of education; 28.0% of the women were illiterate or could just read and write, while 38.0% of them had only acquired a basic level of education. Moreover, more than half (58.0% and 56.0%) were housewives living in rural areas. Such women will usually become pregnant early in their marriage in Egypt, especially in rural and upper Egypt. Therefore, they are considered a high-risk group for congenital toxoplasmosis, if they seroconvert in the pregnancy period.[44]

While assessing the effectiveness of the structured program on participants' perception regarding Toxoplasmosis, data analysis revealed that 70% of women had good knowledge scores after implementation of the program (post-test). Additionally, the entire study sample (100%) gained good knowledge in the retained-test. The results of Marginal Homogeneity test showed a significant gain in the women's knowledge ($p < .0001$). This improvement was also maintained by the follow-up test. This improvement in women's perception may be a result of the women's keenness to attend all program sessions and positive reinforcement or the long-term retention of knowledge. In this respect, Masters[45] and Yeh et al.[46] have said that people will remember about 10% of what they hear, and about 20% of what they read. On the other hand, higher scores from the post and retained knowledge tests may be due to wide varieties of educational methods used such as audiovisual materials, videos, lectures,

and discussion as well as an Arabic booklet which was distributed at the end of sessions to be available to them to take home. This is in line with Edgar Dale's or the NTL's Pyramid of Learning,[45] as the pyramid illustrated that individuals can retain 10% of what they read and 20% of what they see and hear (audiovisual). People can retain 50% of what they learn by discussion.[45, 47] In the same line, 63% reduction in toxoplasmosis seroconversion and health education in a Belgian study, reinforcing the importance of providing health education as a tool in the prevention of congenital toxoplasmosis. It is important that the educational materials be complete and accurate and that they are made available in a culturally and linguistic appropriate format.[48, 49]

When searching for a relationship between the knowledge score and sociodemographic characteristic criteria for seropositive T. gondii pregnant women, the study findings revealed that those pregnant women exhibited higher mean knowledge scores of post/retained test at all parameters of sociodemographic (age, level of educational, occupational status). Moreover, a clear positive relationship between women's mean knowledge score and age (pre-test), educational level (pre-test and post-test) and occupational status (pre-test and post-test) was found.

In the majority of the human populations, the parasite seroprevalence increases with age.[9] According to seroprevalence results in our study, we found the prevalence of seropositivity T. gondii in the middle age group (20-30 years) was more than other age groups reporting 52%. Although this result was similar to Flegr's findings[9] who reported that, most of the published data (from 88 countries) on seroprevalence are in females of childbearing age and/or those who are pregnant. The findings challenged the results of the study performed by the Advisory Committee on the microbiological safety of food[4] who declared the variation in T. gondii seropositivity with age in a number of countries. In Japan, seropositivity of anti T. gondii antibodies in (20-29 year) age group was 3%, increasing to 40% in those over 70 years of age. In the Netherlands, seropositivity the anti-T. gondii antibodies range from 20% at 25 years of age to 60% at 50 years. Wales estimated 22% seroprevalence in females of childbearing age while in East of England it was ranging from 8%-10%. However, a prevalence of 50% has been recorded in the over 50s.[4]

In our study, we found that the pregnant women with middle age group (20-30 years) were more knowledgeable towards toxoplasmosis. Preprogram, the mean score of knowledge (26.0 ± 14.3) in women aged 20-30 years was higher than other age groups. Furthermore, the results illustrated that, the older the woman, the greater the degree of reten-

tion of the information. The study findings showed that women aged 30-36 years, both mean retained-test knowledge score (90.6 ± 3.2) and post-test knowledge score (79.6 ± 5.2) are higher than the mean pre-test knowledge scores (24.6 ± 16.9). The results revealed that age had an influence on acquiring knowledge.

It is logical and generally accepted that seropositive cases for toxoplasmosis are influenced by residence, lifestyle, geographic and hygiene as well as socioeconomic conditions of the population because they create an opportunity for women to be exposed to parasite infection.[44] Only 4.0% of the study sample had university graduate education, 30.0% secondary or technical and all remaining (66.0%) had unsatisfactory level of education. Moreover, 56.0% of the women were living in rural areas and all of them (100.0%) were breeding birds and animals in their homes. All these characteristics expose women to risk factors and make them more vulnerable to infection. Other research has shown that lower levels of education, poor hygiene, and, a lower socioeconomic status may contribute to a higher rate of infection.[9]

T. gondii IgG antibodies vary between 1% to 100% depending on socioeconomic conditions,[50] other report indicated that seropositivity being highest in rural and lowest in urban areas.[4] Seroprevalence toxoplasmosis differences in rural-urban can be explained by the differential distribution of risk factors including frequent consumption of non-washed or raw fruit or vegetables, unfiltered municipal water, unpasteurized milk, and soil contact.[51] A higher number of cats in rural areas, especially inside houses, may be responsible for the higher difference in rural localities.[52]

The study findings illustrated that educational level influenced women's mean score of knowledge, the higher the level of education, the higher the degree of information retained. Consequently, by the higher mean score of knowledge before the program as well as influence women's perception and improve women's mean score of knowledge at dimensions of the post, retained-tests. These findings are similar to other authors who reported that educational level affects the learning process, the higher the persons' level of education the more likely they were to receive information.[47, 53]

Occupational status may also contribute to exposure to certain strains of Toxoplasma which may also lead to a higher rate of infection.[9] The women's occupational status revealed that 58.0% of the women were housewives and were breeding birds and animals in their homes. As mice destroy crops, most of the families, especially in rural areas and working in agriculture activity, rear cats to fight rodents and mice, hence the importance of providing health education about meat-cat-soil-related hygiene.[48, 49] Sixteen percent of

the sample was workers on daily wages (farmers, agriculture activity and gardening, slaughterhouses). There is an association between occupational status and exposure to infection, as these women were in frequent contact with cat faeces (directly and/or indirectly through the soil). The women may also drink contaminated water or eat contaminated raw vegetables or fruits.[12, 20] Another study in Egypt has found that 19.2% of workers in slaughterhouses at Zagazig were seropositive for T. gondii antibodies. Moreover, indirect hemagglutination test (IHAT) was positive in 52.4% of Tanta abattoir workers.[37]

There is a relationship between women's occupation and their mean knowledge score. Findings showed that the highest mean score of knowledge was portrayed by employed women at all parameters of the program; pre-test (38.2 ± 17.1), post-test (86.8 ± 5.8) and retained-test (90.9 ± 3.0). It is expected as employees had more chances for communication and contact as well as exchange knowledge and experience with professional ones. A statistically significant difference was found among participants' occupational status and their mean knowledge score in pre-test ($p < .0001$) and post-test ($p = .017$).

Statistical analysis of the results of our study revealed a relationship between acquired mean knowledge score for women with seropositive IgG and IgM antibodies and other related obstetric and antenatal care parameters including gravida, gestational age, history of previous abortion or stillbirth, and the number of antenatal visits. Additionally, significant relationship between women's mean knowledge score and a gestational age (pre-test), and history of abortion or stillbirth (pre-test and post-test) was found.

In relation to women's gestational weeks/trimester, the results showed that more than half (52%) of the study subjects were in the first trimester, 28.0% in the second trimester and 20% in the third trimester. As 9.1% of the study subjects were seropositive IgM antibody and 20.0% consider chronic carriers (seropositive IgM and IgG antibody), it is very important to implement the program to protect mother-to-child transmission through the placenta and prevent complications of infection.

The level of risk varies depending on the mothers' gestational age at which they acquire the infection as the lowest is in the first trimester and greatest in the third trimester.[18]

The rate of fetal transmission of T. gondii parasite during frist infection is 60% to 65% in the third trimester, while the incidence of severe fetal infection falls from 75% to a negligible risk in late pregnancy, 30% to 54% in the second and 10% to 25% in the first trimester.[13, 44]

The highest mean knowledge score observed among pregnant women in the first trimester in pre-test (25.9 ± 14.2). Moreover, in post-test (78.6 ± 4.2) and retained-test (93.4 ± 3.1) the highest score was observed in the third trimester. This may due to the fact that, in the first trimester pregnant women will be more anxious and worry about their pregnancy, hence, it gives more opportunities for women to ask, attend and read about pregnancy. A significant relationship was observed between mean knowledge score and gestational age ($p = .017$).

In the developing countries, many gynecologists considered toxoplasmosis as the primary cause of bad obstetrical outcomes; this is viewed by the public and had created a panic reaction among all population, generally, and women, especially.[54] The seroprevalence of T. gondii infection in females who have a poor obstetric history (sporadic and/or habitual abortions) is known to be significantly higher than those without it.[8] The findings illustrated that 60.0% of seropositive T. gondii women had previous history of abortion or stillbirth (28.0% once, 26.0% twice, and 6.0% had previous three or more abortions/stillbirth). This result is similar to another Egyptian study that revealed a significant IgM and IgG toxoplasma antibody level difference between the control group and women who had more than three abortions, women aborted once or twice, and women had no history of abortion.[55] At Al-Shifa hospital, a study included aborted women (312) who attended antenatal clinic revealed, seropositive IgM antibodies were found to be 12.8% and Toxoplasma IgG antibodies were found to be 17.9%.[8] Additionally, a statistical difference between seropositive IgG antibody levels against toxoplasma in habitual abortions as compared to normal pregnancies or sporadic abortions was in an Indian study.[8]

The better mean knowledge scores (pre-test; 61.0 ± 22.6, and post-test; 94.0 ± 4.2), was reported by women who aborted trice or more. This may be attributed to women with poor obstetrical history attributed abortion, stillbirth and IUFD to toxoplasmosis and hence ask about causes and seek care for investigating and even treatment of toxoplasmosis without physician referral. The previous notion may explain the effect of poor obstetrical history in the form of repeated miscarriage and/or stillbirth on the state of women's perception as revealed from the current study. Our study revealed a significant difference between women's (pre-test; $p < .0001$ and post-test; $p < .0001$) mean knowledge score and their history of abortion or stillbirth.

The results of the current study revealed that more than half (56.0%) of the study sample was multigravida, while the remaining (44.0%) was primigravida. Statistical analysis of

the results of previous studies revealed no significant relationship between IgM and IgG antibodies and women's gravidity (multigravida or primigravida).[37] There was no observed statistically significant difference between the women's mean score of knowledge amongst those seropositive T. gondii antibodies pregnant women in relation to their gravidity, the results showed that, multigravida women scored a higher degree of knowledge at all parameters of the study; pre-test (25.2 ± 14.9), post-test (76.6 ± 18.2), retained-test (90.8 ± 3.8) compared to primigravida women; pre-test (19.3 ± 14.1), post-test (65.7 ± 26.3), retained-test (90.8 ± 3.8). This better score among multigravida women may due to their previous history of abortion or exposure to infection as well as attendance to antenatal health classes during antenatal visits.

Regarding antenatal care visits, the results of the study revealed that all pregnant women (100.0%) did not follow the recommended antenatal schedule visits. Moreover, only 10.0% of women attended the recommended number (≥ 5 visits) of antenatal visits from WHO while the majority (90.0%) did not. Antenatal visits give health care providers an opportunity for recommended number (≥ 5 visits) of antenatal visits from WHO while the majority (90.0%) did not. Antenatal visits give health care providers an opportunity for early diagnosis during pregnancy as well as prompt treatment to prevent sequelae in the infected fetus and/or minimise their intensity and frequency.[18] If treatment of T. gondii started within three weeks of seroconversion, it reduced the rate of maternofetal transmission through the placenta compared to treatment beginning later than eight weeks of seroconversion.[11] Education about meat-cat-soil-related hygiene should be provided to all pregnant women at their first prenatal visit and to every woman of childbearing age.[48, 49] Although there was no statistically significant difference between the women's means score of knowledge amongst that seropositive T. gondii antibodies pregnant women in relation to their number of antenatal visits at all parameters of the study; pre-test ($p = .393$), post-test ($p = .856$), retained-test ($p = .958$). Additionally, women who visited antenatal care clinic ≥ 5 visits scored higher degree of knowledge at all parameters of the study; pre-test (28.0 ± 18.3), post-test (73.6 ± 22.7), retained-test (90.8 ± 4.1) compared with those who had < 5 visits; pre-test (22.0 ± 14.4), post-test (71.6 ± 22.8), retained-test (90.7 ± 3.5). This better score was attributed to the screening test performed during; antenatal health classes during antenatal visits and these women (22.0%) took their advice from medical staff while others (58%) took advice and knowledge from their relatives.

While studying the effectiveness of the STP on the level of anxiety among seropositive T. gondii pregnant women throughout the period of study, an unexpected result was found. Surprisingly, the pre-test, post-test and retained-test data analysis revealed that the anxiety level ranged from normal to minimal or moderate before the program, while, in post and retained-test it ranged from minimal or moderate to marked and severe anxiety: i.e. 84.0% (in post-test) and 48.0% (in retained-test) of the study sample scored marked to severe anxiety compared with 0.0% (in pre-test). This means that marked anxiety scored the highest level immediately after the program and then decreased over the time (retained-test) but did not reach preprogram (pre-test level). Results illustrated a significant increase in anxiety level ($p < .0001$). Aggravated and marked anxiety immediately after the program may be attributed to the fact that the majority of the study sample did not know about complications, or did not expect its seriousness and consequences for the mother and her infant (intrauterine malformations miscarriage, restricted intrauterine growth, mental retardation, cardiac and cerebral anomalies, epilepsy).[3, 14, 18, 56] They did not imagine that a microbe like T. gondii may be a leading cause of hospitalisation and death. The individuals might develop uveitis, retinochoroidal lesions, visual impairment and vision loss resulting from symptomatic eye disease from Toxoplasma infection. Immunocompromised individuals can develop encephalitis, or have a further spread of the disease, which can be life-threatening and fatal.[4, 15] Annually, there are an estimated three-hundred to four-thousand cases of congenital (mother-to-child) toxoplasmosis.[4]

Severe and marked anxiety decreased later in the retained-test, this may be due to the improvement of their knowledge regarding precautions and preventive measures to avoid maternal exposure to toxoplasmosis and following the WHO Five Keys to Safer Food.[25] Additionally, although, there are no statistical differences between women's knowledge and their self-rated anxiety scores, the analysis of the women's questionnaire showed that by recognising and understanding elements of T. gondii, the women achieved a higher level of anxiety score (the high knowledge score result to higher anxiety level score). The impact of an educational program was positive for women to progress their knowledge, but it has a negative effect on their anxiety level. Pearson correlation coefficient revealed that the anxiety level of the subset of expectant mothers whose high mean knowledge score was non-significantly higher anxiety level than the other of the group of expectant mothers whose low mean knowledge score; pre-program ($r = 0.248$), post-program ($r = 0.275$) and retained ($r = - 0.163$). The elevation in anxiety level may be due to the women's place of residence with most of them (56.0%) living rurally, mostly all of them, exposed to certain strains of protozoan gondii as breeding animal,

birds, cats lower socioeconomic, poor hygiene which contributes to a higher rate of infection.[9] Rural dwellers cannot stop breeding cats as they are considered the main biological method to fight rodents, so it is not surprising to find that women's level of anxiety is aggravated, especially when they are informed that Al-Hindi and Lubbad's[8] study reported that 23.5% of aborted women with Toxopoplasmosis were found to rear cats. Frequent involvement in agriculture activity as the main work for rural dwellers and it exposes them to sources of infection of herbivores (drink insufficiently treated water unboiled milk, eating raw unwashed vegetables, and exposure to risk factors including contact with cats' faeces-contaminated soil).[12]

5. Conclusions

The study revealed high seropositivity of IgM/IgG antibodies for toxoplasmosis among pregnant women in Beni-Suef, Egypt. Statistical analysis to find an association between the pregnant women's perception and demographic and obstetric variables reveals that women's age, educational level, occupational status, gestational age, and history of abortion or still-birth history in the pre-test and post-test knowledge scores are dependent on each other. We postulate that women's perception will be enhanced, regarding toxoplasmosis, after implementing the program. Based on the results of the study, women became more knowledgeable, after implementing the program; this is mirrored by the positive effect of the program. We felt that the program would reduce or alleviate women's anxiety, but surprisingly the results of the study revealed a negative correlation between women's knowledge score and anxiety score, however, this relation is not significant. Women scored a higher level of anxiety after the implementation of the program and gained more knowledge than before. Progression of pregnant women's perception towards toxoplasmosis had unfavorable anxiety level outcomes.

Recommendations

In the light of the findings of this study, the following is recommended.

(1) As T. gondii has some unfavorable effects on the reproductive capacity of both men and women, accordingly, its life cycle should be integrated into Science curriculum at preparatory schools in Egypt.

(2) Implementation of public health program for prevention, routine screening, early detection, and treatment of T. gondii should be mandatory for all women in childbearing age.

(3) Prenatal health classes should be implemented, at antenatal clinics and MCH centers, regarding Toxoplasmosis and its preventive measures according to WHO Five Keys to Safer Food.

Conflicts of Interest Disclosure

The authors declare they have no conflicts of interest.

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