

ENVIRONMENTAL AND BEHAVIOR FACTORS ON THE INCIDENCES OF TOXOPLASMOSIS AMONG MARRIED WOMEN

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ABSTRACT

Background: Toxoplasmosis is a condition in which a person is infected with *Toxoplasma gondii*. Humanitarian transmission is closely linked to the environment in which they live and the conduct that allows the entry into the body of Oocyst *Toxoplasma gondii*. Toxoplasmosis in married women is very dangerous because it can cause conditions of infertility, repeated spontaneous abortion, stillbirth, and congenital abnormalities. This study aimed to analyze the association between environmental and behavior on toxoplasmosis incidences among married women.

Subjects and Method: This was a case-control study carried out at the Alternative Medical Clinic, Aquatreat Therapy Indonesia Foundation in Bogor City during 2019. Total of 160 women were enrolled in this study and divided into 2 groups: 80 in case group and 80 in control group. The dependent variable was toxoplasmosis behavior. The independent variables were environmental and behavior factors. Data were collected from clinical laboratory results and questionnaire and analyzed using a multiple logistic regression.

Results: In environmental factors, presence of pets at home (OR= 3.73; 95%CI= 1.83 to 7.61; $p < 0.001$), presence of wild cats or neighboring cats that are often seen around the house (OR= 2.63; 95%CI= 1.24 to 5.58; $p = 0.012$), and risky environment (OR= 9.60; 95%CI= 3.74 to 24.61; $p < 0.001$) were significantly associated with toxoplasmosis among married women. In behavior factors, consumption of raw vegetables/vegetables (OR= 4.53; 95%CI= 1.23 to 16.73; $p = 0.023$), consumption of smoked meat/ steak/ undercooked (OR= 3.32; 95%CI= 0.12 to 0.77; $p < 0.001$), food buying habits at roadside stalls (OR= 8.64; 95%CI= 0.03 to 0.50; $p < 0.001$), and washing hands before eating (OR= 0.29; 95%CI= 1.80 to 25.50; $p = 0.006$) were significantly associated with toxoplasmosis among married women.

Conclusion: Environmental and behavior factors are positively associate with toxoplasmosis among married women.

Keywords: determinant, environment, behavior, toxoplasmosis, married woman

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BACKGROUND

Toxoplasmosis is a condition when a person infected with parasite of *Toxoplasma gondii* which comes from animals, especially mammals, as a source of infection. Humans can become infected through oocysts that are accidentally ingested with food, direct contact with soil that has been contaminated with oocysts, contact with pets and being in a risky environment such as many livestock. Toxo-

plasmosis in married women, both pregnant women who have given birth and who are planning a pregnancy or future mothers, is very dangerous because it can cause infertility conditions, repeated spontaneous abortion, stillbirth, and congenital abnormalities when giving birth to a child infected with *Toxoplasma gondii*.

About 30% to 65% of the world's population is estimated to have chronic Toxo-

plasma infection (Triana, 2015). Countries with agricultural areas with tropical climates such as Indonesia and suitable conditions for gardening and farming, increase human contact with land and livestock and allow increased contact with raw meat (Nugrahani & Nurdian, 2018). Toxoplasmosis cases in humans in Indonesia range between 43 to 88%, while in animals it ranges from 6 to 70%. The prevalence of toxoplasmosis in Indonesia is thought to continue to increase along with changes in lifestyle in society (Siregar et al., 2014).

Infection in humans can occur via 3 main transmission routes: food consumption (consumption of meat infected by tissue cysts), animal-to-human transmission (ingestion of oocysts in cat feces infected), and mother-to-fetus (congenital infection through the placenta during pregnancy) (Condoleo et al., 2018; Robert-gangneux & Dardé, 2012).

Toxoplasmosis is the major zoonosis, and prevention requires multiple approaches due to the complex life cycle of the causative agent, *Toxoplasma gondii*. Environmental pollution by oocysts is a key factor in the transmission of *T. gondii* to humans and meat-producing animals (Afonso et al., 2013).

The environmental transmission cycle is usually through feces of pets or other livestock containing oocysts, contaminating soil, water, fruit or vegetable plants, attaching to pets or mechanical vectors, and other objects if there is contact with contaminated soil or plant sources, it can be entering the human body. Oocysts are most often transmitted from cats or dogs and other mammals such as pigs, cows, sheep, goats, rabbits and other pets. Toxoplasmosis transmission can also be through mechanical vectors (flies, cockroaches and mice).

Personal hygiene behavior factors and consumption habits are also risk factors that can increase the risk of transmission to toxoplasmosis to humans. In people who like to consume raw or undercooked meat and raw vegetables and fruits that are contaminated with toxoplasmosis disease-causing agents. Another way of transmission can also be through consumption of unpasteurized milk, cross-contamination of cooking utensils, transmission also through blood transfusions and organ transplants (Aditama, 2016).

Until now, no vaccine has been found that is effective in preventing toxoplasmosis, so the most effective prevention is to break the chain of the life cycle *Toxoplasma gondii* by avoiding foods containing cysts or oocysts, avoiding contact with cat feces, environmental hygiene, personal hygiene, and control host (Wiyarno, 2013). Therefore, various studies of various risk factor variables are needed which may be the main determinant of the transmission of this toxoplasmosis disease, especially in women who are married and will soon become mothers, because *Toxoplasma gondii* infection in women is very dangerous, especially when entering pregnancy.

Women who are infected with *Toxoplasma gondii*, during pregnancy the infection will pass to the fetus through the placental cord and cause infection, the fetus has a miscarriage or the baby is born but has some physical and non-physical defects. Physical defects such as hydrocephalus, microcephalus, incomplete limbs, intestines out of the stomach, and others.

Whereas in non-physical cases such as attacking brain nerve cells, brain calcification, idiots, and others. Toxoplasmosis can cause lifelong disabilities in infected children (Oktarina, 2014) so that prevention efforts can be carried out earlier if the characteristics and determinant factors are known.

SUBJECTS AND METHOD

1. Study Design

This was a case control study to assess the relationship between exposure and disease by determining the case group and the control group with case studies of women of child-bearing age who are married and have received treatment and consultation at the Foundation's Alternative Medicine Clinic. Aquatreat Therapy Indonesia which is located in Bogor City during 2019. Determination of cases and controls is based on documented laboratory examination results. well so that it makes it easier to involved patients as potential respondents.

2. Population and Sample

The study population was focused at the Bogor City Center Clinic on patients who had undergone a toxoplasmosis, rubella, cytomegalovirus, and herpes simplex virus (TORCH) examination in the laboratory. The study sample consisted of the positive case group toxoplasmosis and the toxoplasmosis negative control group selected using a non-probability sampling method by means of purposive sampling based on inclusion and exclusion criteria made by the researcher and calculated using a paired case-control study formula with the OR value of the previous study of 0.53 (Oktariana, 2014) so that the minimum number of samples in this study is

$n_1 = n_2 = 80$ with a ratio of cases and controls 1: 1 so that the total is 160 samples consisting of 80 case samples and 80 control samples.

3. Study Variables

The dependent variable of this study was the incidence of toxoplasmosis which is based on the results of previous laboratory examinations from respondents who are well documented in the clinic. While the independent variables were environmental factors and behavioral factors.

4. Study Instrument

Primary data collection was carried out through structured interviews with online questionnaires using the google form application then distributed to prospective respondents who had previously agreed and are willing to participate in this study as respondents.

5. Data Analysis

Data analysis was performed using univariate and bivariate using analysis chi-square and multivariate analysis using multiple logistic regression.

RESULTS

Based on the results of the Chi-square analysis, several variables of environmental and behavioral determinants that have a significant relationship with the incidence of toxoplasmosis are presented in Table 1.

Table 1. Results of chi-square analysis environmental determinants and behavioral toxoplasmosis disease in women already married ever medication and consulting in alternative medicine clinic therapy foundation Aquatreat Indonesia in Bogor City 2019

Variables	Respondents Characteristics N = 160							
	Case		Control		OR	95%CI	P	Note
	n = 80	%	n = 80	%				
Pet								
Yes	37	23.1	15	9.4	3.73	1.83 to 7.61	<0.001	B
No	43	26.9	65	40.6				
Cats Around the house								
Yes	67	41.9	53	33.1	2.63	1.24 to 5.58	0.012	B

No	13	8.1	27	16.9					
Rats and their droppings around the house									
Yes	44	27.50	40	25.00	1.22	0.66 to 2.28	0.527	T	
No	36	22.50	40	25.00					
Environment at risk (lots of livestock, heat and water)									
Yes, at risk	74	46.30	45	28.10	9.59	3.74 to 24.61	<0.001	B	
No Risk	6	3.80	35	21.90					
Consumption of Fresh/ Raw Vegetables/ Fresh Vegetables									
Yes	77	48.1	68	42.5	4.53	1.23 to 16.73	0.023	B	
No	3	1.9	12	7.5					
Consumption of Smoked Meat/ Steak/ Half Cooked									
Yes	60	37.5	38	23.8	3.32	1.70 to 6.48	<0.001	B	
No	20	12.5	42	26.3					
Footstalls buying habits at roadside									
Yes	76	47.5	55	34.4	8.64	2.84 to 26.23	<0.001	B	
No	4	2.5	25	15.6					
Fresh milk consumption									
Yes	41	25.6	39	24.4	1.11	0.60 to 2.05	0.752	T	
No	39	24.4	41	25.6					
Wash your hands before Eating									
Yes, it is risky (if you remember)	8	5	22	13.8	0.3	0.12 to 0.71	0.006	B	
Not at risk (always)	72	45	58	36.3					
Washing Fruits and Vegetables Before Consuming									
Yes Risk (if you remember)	8	5	11	6.9	0.7	0.27 to 1.84	0.465	T	
Not at risk (always)	72	45	69	43.1					
Shutting down food and drinks									
Yes, it is risky (if you remember)	15	9.4	11	6.9	1.45	0.62 to 3.38	0.393	T	
Not at risk (always)	65	40.6	69	43.1					

Source: Primary Data, 2020 Information: T = Not related, B = Related

Based on table 1, the results of the study show that environmental detergent factors that have a significant relationship with the

incidence of toxoplasmosis are the variables of the presence of pets at home, the presence of wild cats or neighboring cats

that are often seen around the house and environmental conditions at risk. While the behavioral factors that have a significant relationship with the incidence of toxoplasmosis are consumption of raw/ fresh vegetables, consumption of smoked meat/ steak/ undercooked, the habit of buying food at roadside stalls and washing hands before eating. The variables of the presence of rats and their droppings around the

house, consumption of fresh milk, washing fruits and vegetables before consumption and the habit of closing food and drinks had no significant relationship.

Based on the data in table 2, the results show that behavioral factors have the most risk. high incidence of toxoplasmosis, especially washing hands before eating, which is the variable most at risk of increasing the occurrence of toxoplasmosis.

Table 2. Results of multiple logistic regression analysis of environmental determinants and behavior of toxoplasmosis in married women who have seen and consultation at the alternative medicine clinic, Aquatreat Therapy Indonesia Foundation in Bogor City, 2019

Variable	OR	95% CI	p
Wash Hands Before Meals	6.76	1.79 to 25.51	0.005
Consumption of Smoked Meat/ Steak/ Undercooked	0.31	0.12 to 0.77	0.012
Habits of Buying Food at Street Stalls	0.12	0.03 to 0.50	0.003

Primary Data, 2020

DISCUSSION

1. Relationship between Environmental Factors and Toxoplasmosis

Environment plays a very important role in transmitting toxoplasmosis to humans. Populations living in areas with environmental conditions that support transmission such as weather and climatic conditions that are suitable for survival parasite and environmental conditions that have been contaminated by Oocysts from pet/ livestock feces can contaminate soil, water, fruit or vegetable crops, sticking to pets or mechanical vectors, and other objects. If there is contact with anything that has been contaminated with the parasite oocyst, *Toxoplasma gondii*, which is an agent of toxoplasmosis, it can enter the human body through various routes such as accidental ingestion or inhalation (Soedarto, 2012).

a. The existence of *T. gondii*

Broadly speaking, the life cycle of divided into 2 cycles, namely sexual (schizogony) and

asexual (gametogony). Both of these life cycles occur in the definitive host while in intermediate hosts (birds and mammals) only a life cycle occurs asexual. So that the existence of pets such as cats, dogs or poultry such as birds is closely related to the process of toxoplasmosis transmission (Directorate General of Animal Husbandry and Animal Health, 2014). From the results of the study in Table 1. It can be seen that the variable presence of pets has a significant relationship with the incidence of toxoplasmosis where women who are married and have pets are at 3-4 times more likely to experience toxoplasmosis than those who do not have pets (OR = 3.73; p < 0.001). OR value > 1 indicates that this variable can increase the risk of toxoplasmosis. Several studies also found the same thing (Oktariana, 2014; Wiyarno, 2011) that contact with pets, especially cats, is a risk factor for the incidence of toxoplasmosis in women of childbearing age at Assalam Gemolong Hospital, Sragen Regency and in

Surabaya.

b. The presence of wild cats/ neighbors around the home

Although on serological examination about 15 to 40% of cats are infected with *Toxoplasma gondii*, only about 1% of cats excrete this parasitic oocyst in their feces. This depends on how the cat gets its food and whether the cat is kept inside. home or outside the house. Toxoplasma infection in cats or other animals occurs more often if the animal is kept outside the house, obtains food outside the home or frequently gets raw meat as food. So that the presence of wild cats or neighbors' pets but are often outside and looking for food outside the home is more at risk of transmitting toxoplasma (Soedarto, 2012). The results of the study in Table 1. indicate that the presence of stray cats or belonging to neighbors around the house is significantly associated with toxoplasmosis and can increase the risk of 2-3 times more likely to experience toxoplasmosis (OR = 2.63; p = 0.012).

c. Environment Risky

The parasitic oocysts of *Toxoplasma gondii* can contaminate the environment and objects in the environment, such as soil, sandboxes, fruits and vegetables. With a temperature of 24°C, it will sporulate or experience ripening into an infective oocyst within 2 - 3 days (Directorate General of Animal Husbandry and Animal Health, 2014) so that living in a risky environment such as a lot of livestock, farming/ plantation locations with climatic conditions and hot but humid weather, lots of dust and frequent flooding can increase the risk of transmitting toxoplasmosis to humans. The results in Table 1. indicate that married women who live in areas with risky environmental conditions can increase the risk of experiencing toxoplasmosis 9-10 times greater than those who do not live in a risky environment (OR = 9.59; p <0.001). The results of this study are in line with a

study in Colombia which states that there is a correlation between the amount of rainfall and the incidence of congenital toxoplasmosis (Gómez-Marin et al., 2011).

This large amount of water can cause flooding. Study by Setzer and Domino (2004) found that in the United States there is an increase in patients suffering from toxoplasmosis in some areas of severe flooding. Other study also shows that there is a relationship between the occurrence of flooding and the occurrence of infection toxoplasmosis in the city of Semarang (Aditama, 2016). The incidence of toxoplasmosis tends to increase in areas that are hot, humid, and in areas that have a low elevation (CDC, 2015). Livestock and agriculture also make a major contribution to the environment which results in risky conditions because it allows contact with both domesticated and wild animals, humid environmental conditions are very suitable as an ideal habitat for the *Toxoplasma gondii* parasite because it can support its survival longer in the environment. The dynamics of the entire life cycle of *T. gondii* are strongly influenced by meteorological conditions in which high rainfall increases the prevalence due to *T. gondii* oocysts and allows it to survive during wet periods. High rainfall conditions also allow the rodent population which is also the host of the *Toxoplasma gondii* parasite to also increase (Afonso et al., 2013).

2. Relationship between behavioral factors and toxoplasmosis

a. Consumption of fresh/ raw vegetables/ vegetables

Living habits have a contribution in determining the high and low prevalence of toxoplasmosis. Living habits are shown by healthy behavior which includes personal hygiene and the quality of the human environment, both physical, biological and socio-cultural. The habit of consuming raw vegetables is closely related to local culture, in Indonesia, people who come from the Sundanese tribe in West

Java are widely known to be very fond of Lalapan, namely raw vegetables as a complement when eating with impromptu chilly.

This study has the majority of respondents from West Java with a habit of eating fresh vegetables, this is very risky to increase the incidence of toxoplasmosis as the results of the study obtained an OR= 4.53; p= 0.023 which indicates that the variable consumption habits of raw vegetables/ vegetables increases the risk of 4-5 times more likely to experience toxoplasmosis than those who do not have the habit of consuming meta/fresh vegetables. This study is directly proportional to previous research in Bali (Laksmi et al., 2016) which states that the high seroprevalence of toxoplasmosis in Bali is closely related to the habit of eating raw vegetables or vegetables.

b. Consumption of smoked meat/ steak/ undercooked

Eating meat contaminated with *T.gondii* cysts and incomplete cooking methods can cause toxoplasmosis infection (Eka Febianingsih et al., 2017). This is consistent with the results of a study which found that the habit of eating meat that was not cooked thoroughly increased the risk of toxoplasmosis infection (OR = 3.32; p <0.001). These results are also in line with study (Retmanasari et al., 2017) that handling undercooked meat for consumption is identified as a risk factor for toxoplasmosis. Livestock are a staple foodstuff of meat, if it contains bradizoit and not cooked properly/ cooked/ uncooked would be a source of toxoplasmosis infection through food (foodborne disease). Cysts bradyzoite tissue or muscle or flesh that is eaten by humans will break in in the digestive tract. Bradyzoites that are broken will repeat the tachyzoite stage and penetrate intestinal epithelial cells to then multiply in human cells (Black & Boothroyd, 2000). The prevalence of toxoplasmosis in sheep in the Brazilian region was 26.3% in Leste Potiguar and

17.8% in Central Potiguar (Andrade et al., 2013). Study on livestock (beef and lamb) in Chaharmahal va Bakhtiari Province, Southeast Iran in 2012, found as much as 12% of meat products were infected with toxoplasmosis. A total of 8.57% of cattle and 38% of sheep infected by *T. gondii* ((Azizi et al., 2014).

c. Habits to Buy food at roadside stalls

Results show that the habit to buy food at roadside stalls have a significant relationship with the incidence of toxoplasmosis (OR = 8.64; p <0.001) in which these variables can be stated that the risk of toxoplasmosis is 8-9 times more risky than those who do not have the habit of buying food at roadside stalls This is related to unhygienic consumption patterns in daily life, one of which is buying food at roadside stalls which can increase the transmission of toxoplasmosis, especially if the food or drink served is not properly covered, allowing contamination of the oocysts through flies, because flies can act as a mechanical vector in *Toxoplasma* transmission, because these insects carry infective oocysts originating from cat feces that cause contamination of food or foodstuffs, water or cooking utensils in the kitchen (Soedarto, 2012).

Most of the respondents in this study were located in West Java, where most of the typical food stalls on the side of the road served a typical Sundanese food menu with sudden chili sauce and fresh vegetables which could not be ascertained the cleanliness of the processing method so that the possibility of oocyst contamination was very high. Humans can be infected with toxoplasmosis by ingesting *T. gondii* cysts from daily food, namely from the meat consumed, the level of maturity of the meat, and also the habit of washing fruits or vegetables before consumption (Directorate General of Animal Husbandry and Health, 2014).

d. Washing hands before eating

One way of self-care or human self-care to
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maintain or improve health is to prevent yourself from disease, namely washing hands. Washing hands with the right practice is a healthy behavior that is scientifically proven to prevent the spread of infectious diseases and infections. Washing hands thoroughly after contact with animals, cleaning animal habitats, and before eating is one of the measures to prevent infection with the parasite *Toxoplasma gondii* (Febianingsih et al., 2017; Ernawati, 2007).

The results of this study also show that the habit of washing hands before eating can reduce the risk of toxoplasmosis (OR = 0.293, p=0.006) or as a factor in preventing the incidence of toxoplasmosis, this is in line with study (Rachmawati, 2019) which also found that washing hands has a fairly strong relationship with the incidence of toxoplasmosis based on the results of the Fisher's Exact Test showed a significance value (p) of 0.041 where most of the respondents diagnosed positive for toxoplasmosis had less habit of washing hands.

The characteristics of respondents who mostly live and work in the Jakarta, Bogor, Depok and Bekasi areas indicate a diet that is accustomed to eating at food stalls or fast-food restaurants which are usually prepared with complete eating utensils such as spoons and forks, so that most people who will eat feel do not need to wash hands because eating using a spoon and fork. It's just that the habit of Indonesians when eating even with a spoon or fork, sometimes unconsciously picking it with the side dish on the side, this behavior has the risk of increasing toxoplasmosis.

3. Results of Multivariate Analysis

Based on the study results in table 2, it shows that the variable washing hands before eating is the variable with the highest risk of toxoplasmosis where married women who have the habit of not washing their hands regularly before eating have a 6-7 times greater risk

(OR = 6.76; 95% CI = 1.79 to 25.51; p = 0.005) experiencing toxoplasmosis or at least having a minimum risk of 1-2 times and a maximum risk of 25-26 times more risk of experiencing toxoplasmosis than women who routinely wash their hands before eating. Value OR > 1, which means that this variable increases the risk of toxoplasmosis disease. However, this variable is confounded with the habit of consuming smoked meat/ steak/ undercooked with an OR = 0.31 indicating that this variable can reduce risk or as a factor that can prevent toxoplasmosis where both variables are related to unhygienic and possible consumption behavior.

Transmission of *Toxoplasma gondii* oocysts by ingestion is accidental because food sources that are undercooked and contaminated can make *Toxoplasma gondii* oocysts survive until they enter the body, especially if food ingredients such as vegetables are very susceptible to contamination by toxoplasma oocysts from the environment if consumed raw and not being washed is very risky for the transmission of oocyst contamination in raw vegetables to enter a person's body without realizing it (Laksmi et al., 2016; Febianingsih et al., 2017).

Not only that the variable of washing hands before eating and consuming undercooked meat is also a confounding of the habit of buying food at roadside stalls (OR = 0.12) where this variable acts as a preventive factor or can reduce the risk of toxoplasmosis, this is also related to the behavior. Consumption and hygiene/ hygiene factors, most of the food sold in roadside stalls are mostly Sundanese food menus where the menu is very distinctive with raw fresh vegetables and cannot be guaranteed cleanliness during processing to the presentation of food that is prone to contamination by oocysts carried by flies or washing methods which is less clean.

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