

CLINICAL STUDY

Prevention of toxoplasmosis in pregnancy: Knowledge of risk factors

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Abstract

Background. Infection with *Toxoplasma gondii* is common and usually asymptomatic, although it can have catastrophic consequences in a pregnant woman if passed to her developing fetus. Counseling of pregnant women about risk factor reduction may reduce the risk of congenital toxoplasmosis. This study was undertaken to assess and compare the knowledge of obstetricians and internists or family practitioners regarding well-established risk factors for toxoplasmosis infection.

Methods. The study surveyed 102 obstetricians, internists and family practitioners to assess their knowledge of risk factors for toxoplasmosis infection as well as their practices for primary prevention counseling of pregnant women. Responses were analyzed for differences.

Results. Obstetricians were more likely than internists or family practitioners to provide appropriate counseling on reducing the two most common risk factors for toxoplasmosis infection (undercooked meat consumption and gardening without gloves). However, over one quarter of all participants inappropriately advised pregnant women to avoid all cat contact. Obstetricians, internists and family practitioners were all likely to fail to identify undercooked meat consumption as the primary risk factor for toxoplasmosis transmission.

Conclusions. Obstetricians appear to provide more appropriate counseling for primary prevention of toxoplasmosis than internists and family practitioners, but both groups of physicians inappropriately advised avoidance of all cat contact. Education of obstetricians, internists and family practitioners on risk factors for toxoplasmosis transmission is needed and may lower the rate of congenital toxoplasmosis as well as decrease the frequency of cat abandonment during pregnancy.

Keywords: *Toxoplasmosis, survey, risk factors, primary prevention*

Introduction

Primary infection with *Toxoplasma gondii* is common and usually of little clinical consequence, remaining asymptomatic in up to 90% of individuals infected. In the USA, the overall age-adjusted seroprevalence is 22.5%, with a seroprevalence of 15% in women aged 15–44 years [1]. Although usually asymptomatic, primary infection with *T. gondii* can be transmitted transplacentally to the fetus, causing congenital toxoplasmosis.

Congenital toxoplasmosis is rare, occurring in an estimated 400–4000 newborns per year in the USA, but it can cause severe manifestations. These range from miscarriage to microcephaly, hydrocephalus, seizures, mental retardation and chorioretinitis [2]. In view of the asymptomatic nature of toxoplasmosis

in adults and its high seroprevalence, primary prevention might decrease the likelihood of congenital toxoplasmosis.

Knowledge of the life cycle of *T. gondii* is necessary to understand how to advise women to decrease their risk of primary toxoplasmosis while pregnant. *T. gondii* exists primarily in 3 forms during its lifecycle. Oocysts are the product of sexual reproduction, which occurs in the small intestine of a cat only after it is first exposed to infected meat (uncooked meat or small rodents) containing tissue cysts. Oocysts are then excreted in the feces of a cat for approximately 2 weeks following its first exposure to infected meat, and they become infectious 1–5 days following defecation [3]. Tissue cysts contain bradyzoites, which are slowly dividing *T. gondii* contained by an immune response. Tachyzoites are the asexual,

rapidly dividing forms of *T. gondii* that disseminate through a host before any adequate immune response. Tachyzoites can be acquired from ingestion of uncooked tissue cysts or infective oocysts. They circulate for 7–10 days before being contained in tissue cysts if there is an adequate immune response. Once a person or cat has been infected by *T. gondii*, repeat exposure is unlikely to lead to further formation of tachyzoites or oocysts. It is the tachyzoite form of *T. gondii* that can cross the placenta and lead to congenital toxoplasmosis.

Pregnant women who have not previously been infected by *T. gondii* can become infected by either ingestion of tissue cysts in undercooked meat or ingestion of infective oocysts deposited by a recently infected cat. Multiple studies have addressed the contribution of various risk factors to seroconversion and thus primary infection with *T. gondii* during pregnancy. These studies have found the most significant risk factor to be undercooked meat consumption [4,5,6,7]. One study estimated that up to 63% of seroconversions during pregnancy were secondary to undercooked or cured meat consumption [4]. In addition, these studies also demonstrated a significant association between soil contact via gardening or eating raw or unwashed vegetables and fruits with *T. gondii* seroconversion. Two studies found contact with cat litter to be a risk factor [5,7], whereas two studies found no association between contact with cats or cat litter and *T. gondii* seroconversion [4,6]. Other risk factors include infrequent washing of kitchen knives used to cut raw meat [7] and travel outside the USA, Europe or Canada [4].

Before becoming pregnant, women of childbearing age are seen by internists or family practitioners, but they are followed throughout pregnancy by obstetricians. A previous survey showed that the vast majority of obstetricians counseled pregnant women on avoiding cat litter and undercooked or raw foods, but fewer provided counseling on safe gardening and over 50% responded that keeping a cat outdoors would lower the risk of toxoplasmosis [8]. A previous survey of pregnant women in the USA showed that 60% of pregnant women were aware of transmission of *T. gondii* from cats, but only 30% were aware of the risk of acquiring *T. gondii* from raw or undercooked meat [9].

Thus, all the participating practitioners offered an opportunity to discuss risk factor reduction and possibly to decrease the risk of congenital toxoplasmosis. This study was undertaken to assess the knowledge of risk factors for toxoplasmosis seroconversion during pregnancy, to determine how pregnant women were advised to lower their risk, and to compare differences between obstetricians and internists or family practitioners.

Methods

Using the directory of network providers for Blue Cross Blue Shield, Connecticut, USA, a random sample of internists, family practitioners and obstetricians was identified. These 339 healthcare providers were surveyed by mail and asked questions to assess their knowledge of toxoplasmosis transmission and their practice patterns for advising pregnant women how to lower the risk of *Toxoplasma* infection. Initial non-responders were sent a second questionnaire by mail. Demographic information was obtained regarding the respondent's age, medical specialty, the proportion of their patient population composed of women of childbearing age, whether they had practiced medicine outside the USA and their status as cat owners. For purposes of analysis, physicians who practiced internal medicine and those who were family practitioners were combined into one category (IM/FPs).

Specific questions were asked regarding the respondent's knowledge of the most likely method of transmission of toxoplasmosis, particularly from a cat, and whether indoor or outdoor cats or kittens posed a higher risk for toxoplasmosis transmission. Additional questions were asked to assess primary prevention practice patterns. Specific dichotomous questions were asked as to whether respondents advised pregnant women to avoid changing cat litter, to avoid raw meat, to garden only with gloves, to avoid cat contact and to avoid unwashed vegetables. In addition, the survey asked respondents to agree, disagree, or respond as unsure to statements about cat ownership and the risk of toxoplasmosis, changing cat litter during pregnancy, gardening without gloves during pregnancy, and eating undercooked meat during pregnancy.

To assess differences between responses of IM/FP's and obstetricians, Microsoft Excel 2000 software (Microsoft, Redmond, Wash, USA) was used for data management and data analysis. The Chi-square statistic was used to assess predetermined bivariate comparisons, and the null hypothesis was rejected when the two-sided *p* values were less than 0.05.

Results

Of the 339 questionnaires mailed, 102 were completed. The responders included 49 obstetricians, 40 internists and 13 family practitioners, achieving a response rate of 30.1%. There was no demographic information available for the non-responders. The mean age of the respondents was 46.6 years; 15% had practiced medicine outside the USA; 55% either lived with a cat or had done so in the past. There was no difference in cat ownership (past or present)

between obstetricians and IM/FPs. There was a significant difference between obstetricians and IM/FPs in the reported proportion of their patient panel that was composed of women of childbearing age ($p < 0.001$) (Table I).

The most likely method for transmission of toxoplasmosis was identified by 59 (58%) responders as changing cat litter, and by 29 (28%) responders as eating undercooked meat. Other responses included gardening without gloves (8%), living with cats (4%), eating unwashed vegetables (1%) and blood transfusion (1%). Obstetricians were more likely than IM/FPs to cite eating undercooked meat as the most likely risk factor (22/53, 42% versus 8/53, 15%), whereas IM/FPs were more likely than obstetricians (38/53, 72% versus 23/53, 43%) ($p = 0.006$) to identify changing cat litter as the most likely method for transmission of toxoplasmosis to occur.

With regard to the most likely method to acquire toxoplasmosis from their own cat, 57 (61%) responded that changing litter was the most likely, whereas 25 (27%) answered that allowing a cat to be on food preparation surfaces was the most likely. Other responses included casual contact (6%) and gardening in the yard without gloves (6%). There was no significant difference between the responses of obstetricians and IM/FPs, though 5/48 (10%) of IM/FPs and only 1/47 (2%) of obstetricians cited casual contact as the most likely method to acquire toxoplasmosis from your own cat.

Outdoor adult cats (> 1 year old) were identified by 48 (49%) responders as posing the highest risk for toxoplasmosis transmission, 28 (28%) responded that outdoor kittens (< 1 year old) posed the highest risk and 22 (22%) answered that all cats posed a similar risk. Obstetricians were significantly more likely than IM/FPs to respond that outdoor kittens or cats posed the highest risk for toxoplasmosis transmission (48/50, 96% versus 32/53, 60%) ($p < 0.001$). This difference was entirely a result of

the difference in response rates to the statement that all cats pose a similar risk for toxoplasmosis transmission (obstetricians, 2/50, 4% versus IM/FPs, 20/53, 38%).

Pregnant women were advised by 92 (93%) responders to avoid changing cat litter, 78 (81%) counseled pregnant women to avoid raw meat, 55 (59%) and 48 (51%) checked that they had advised pregnant women to garden only with gloves and to avoid unwashed vegetables, respectively, and 28 (29%) advised pregnant women to avoid contact with cats. Obstetricians were significantly more likely than IM/FPs to advise pregnant women to avoid raw meat (47/48, 98% versus 31/48, 64%) ($p < 0.001$) and to counsel pregnant women to garden only with gloves (33/45, 73% versus 22/48, 46%) ($p = 0.026$). There was no statistically significant difference with regard to advising pregnant women to avoid changing cat litter, cat contact and unwashed vegetables, although obstetricians appeared more likely to advise pregnant women to avoid changing cat litter and to avoid unwashed vegetables (Table II).

A total of 94 (92%) responders agreed with the statement that pregnant women should avoid changing cat litter, and no difference was noted between obstetricians (94%) and IM/FPs (91%). There was also no difference in agreement to the statement that pregnant women should never eat undercooked meat (obstetricians, 75% versus IM/FPs, 75%). However, 15% of both obstetricians and IM/FPs disagreed with the statement that pregnant women should never eat undercooked meat.

A total of 67 (66%) responders agreed that cat ownership increased the risk of toxoplasmosis in pregnancy, although more IM/FPs than obstetricians held this belief (IM/FPs, 40/53, 75% versus obstetricians, 27/49, 55%) ($p < 0.001$).

A total of 57 respondents (60%) agreed with the statement that pregnant women should avoid gardening without gloves. Obstetricians were more likely than IM/FPs to agree with this statement (obstetricians, 36/47, 77% versus IM/FPs, 21/48, 44%) ($p = 0.004$).

Respondents who were current or past cat owners were more likely than respondents who had never

Table I. Baseline demographic characteristics of responders.

Characteristic	Obstetricians	IM/FPs	<i>p</i> Value
Mean age (years)	46.7	46.5	NA
Proportion of panel composed of women of childbearing age			
0–25%	6%	60%	< 0.001
26–50%	32%	38%	
> 50%	62%	2%	
Practiced medicine outside USA	11%	19%	0.54
Past or present cat ownership	53%	56%	0.96

IM/FPs, internists and family practitioners; NA, not applicable.

Table II. Advice aimed at primary prevention of toxoplasmosis.

Advice	By obstetricians	By IM/FPs	<i>p</i> value
Avoid changing cat litter	48/49 (98%)	44/50 (88%)	0.15
Avoid raw meat	47/48 (98%)	31/48 (65%)	< 0.001
Garden only with gloves	33/45 (73%)	22/48 (46%)	0.026
Avoid contact with cats	12/47 (26%)	16/51 (31%)	0.82
Avoid unwashed vegetables	28/46 (61%)	20/49 (41%)	0.15

owned a cat to believe that allowing a cat on food preparation surfaces was the most likely method to acquire toxoplasmosis from your own cat (cat owners, 19/52, 37% versus non-cat owners, 5/41, 12%) ($p=0.02$). In addition, cat owners (past or present) were slightly more likely to report that the most likely method for transmission of toxoplasmosis was eating undercooked meat (cat owners, 20/52, 38% versus non cat owners, 7/41, 17%) ($p=0.06$). In all other survey questions, no differences based on cat ownership were detected between groups.

Comment

Although fetal infection with toxoplasmosis is uncommon, it usually occurs in an asymptomatic pregnant woman, and can have devastating consequences. In view of the asymptomatic nature of primary toxoplasmosis infection, counseling of pregnant women is of paramount importance in lowering the risk of fetal infection. Effective counseling for primary prevention requires knowledge of the risk factors for transmission of toxoplasmosis.

As numerous studies have shown, eating undercooked meat during pregnancy is the most important risk factor for toxoplasmosis seroconversion [4,5,6,7]. However, in our study both obstetricians and IM/FPs cited changing cat litter to be the most likely method for transmission of toxoplasmosis. A surprisingly low number of IM/FPs (15%) identified eating undercooked meat as the primary risk factor. With regard to direct advice given to pregnant women, almost all obstetricians (98%) advised them to avoid raw meat, whereas only 64% of IM/FPs offered this advice. A previous survey of obstetricians also showed that the vast majority (83%) counseled pregnant women on eating undercooked foods [8]. Since consumption of undercooked meat is undisputedly the primary risk factor for toxoplasmosis transmission, all pregnant women should be counseled to thoroughly cook all meat during pregnancy. In addition, since fetal infections earlier in gestation tend to cause more severe birth defects, IM/FPs who see women before their first obstetrician appointment need to be made aware of the need to counsel women on the risk of undercooked meat consumption [10].

Pregnant women are often advised by family and friends either to avoid contact with cats or never to change the cat's litter. However, it is unclear if cats are directly responsible for a significant proportion of toxoplasmosis infections, since they are only infectious (through fecal-oral transmission of the eggs) for 2 weeks after first exposure to infected undercooked meat (including rodents). Thus, indoor cats fed prepackaged food do not pose a risk for toxoplasmosis infection, since they will not be infected in the

first place. Outdoor, hunting cats who use an indoor litter box can transmit infection if proper hygiene is not followed when changing the cat's litter (i.e., wearing gloves and/or washing hands), though the window of infectivity is narrow. Although there was no difference noted in the responses of obstetricians and IM/FPs with respect to the most likely method to acquire toxoplasmosis from a cat, it is surprising that 10% of IM/FPs cited casual contact with cats to be the most likely method for transmission. In addition, over 25% of both obstetricians and IM/FPs responded that they advised pregnant women to avoid any contact with cats. If pregnant women were to follow this advice, many cats would be needlessly abandoned. Casual cat contact does not cause toxoplasmosis transmission, and proper hygiene when changing a cat's litter eliminates the risk of transmission from an outdoor cat. Both obstetricians and IM/FPs should be encouraged to stop advising pregnant women to abandon their pets, since there is no evidence to support this practice.

Almost all obstetricians (96%) agreed that outdoor kittens or cats pose the highest risk for toxoplasmosis transmission, whereas only 60% of IM/FPs were aware of this. If more IM/FPs were educated about the exceedingly low risk of toxoplasmosis infection in indoor cats, fewer pregnant women might be advised to abandon their indoor cats.

The second most common risk factor identified in studies on toxoplasmosis seroconversion during pregnancy is soil contact via gardening or eating raw or unwashed vegetables and fruits. Outdoor cats tend to use the shelter of a garden to deposit their feces and thus can create an unseen hazard for pregnant women. However, only 59% and 51% of survey respondents advised pregnant women to garden only with gloves and to avoid unwashed vegetables. These results are consistent with a previous survey of obstetricians which showed that only 68% provided counseling on safe gardening behavior [8]. Although obstetricians were more likely than IM/FPs to offer this advice, dissemination of the knowledge of this risk factor might further reduce toxoplasmosis seroconversion during pregnancy.

The major limitation of this study is that it is a survey, and not necessarily representative of patient care. It is thus subject to both recall bias and to responder bias, since information is not available for the non-responders. Additionally, we do not know if our findings are generalizable from Connecticut to other geographic regions.

Congenital toxoplasmosis is rare but can be catastrophic. Knowledge of the life cycle of *T. gondii* and studies on toxoplasmosis seroconversion during pregnancy support the view that the primary risk factors are undercooked meat consumption, gardening without gloves and eating unwashed

vegetables. We found that significantly more obstetricians than IM/FPs advised pregnant women to avoid raw meat and to garden only with gloves, although over a quarter of both obstetricians and IM/FPs advised women to avoid cat contact. Both obstetricians and IM/FPs are in a position to offer primary prevention strategies to pregnant women. Proper advice on risk factor reduction is essential, although it is only one strategy. Pregnant women must also be informed of the negligible risk for acquisition of toxoplasmosis from indoor cats, to avoid the needless abandonment of these animals. Patients also need to be informed how to minimize the risk of acquisition of toxoplasmosis from outdoor cats through proper hygiene. Only with this knowledge can pregnant women lower their risk for fetal toxoplasmosis infection, as well as their cat's risk of abandonment during pregnancy.

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