

## Seroprevalence of *Toxoplasma gondii* Infection Among Pregnant Women in Shandong Province, China

<sup>1</sup>Hui Liu, <sup>2</sup>Ke-Sheng Xin, <sup>1</sup>Yu-Hong Jiang and <sup>3</sup>Zhi-Yong Jiang

<sup>1</sup>Qindao Women and Children's Hospital, 266034 Qindao, Shandong Province, People's Republic of China

<sup>2</sup>Teachers College of Qindao University, 266071 Qindao, Shandong Province, People's Republic of China

<sup>3</sup>Haici Medical Center of Qindao, 266033 Qindao, Shandong Province, People's Republic of China

---

**Abstract:** The seroprevalence of *Toxoplasma gondii* infection in pregnant women was investigated in Shandong Province, China between August 2010 and September 2013. A total of 7956 serum samples collected from 15 representative administrative regions in Shandong Province, China were evaluated by Enzyme-Linked Immunosorbent Assay (ELISA) for the detection of specific antibodies. Overall, 13.33% (1218/9139; 95% CI: 12.63-14.02) of the samples was positive for specific IgG against *T. gondii*. The highest seroprevalence was found in low educational standards (15.77%; 533/3379; 95% CI: 14.55-17) and followed by secondary educational standards (12.15%; 454/3736; 95% CI: 11.1-13.2) and high educational standards (11.41%; 231/2024; 95% CI: 10.03-12.8). Furthermore, the seroprevalence of *T. gondii* was the highest in less more 8 weeks (time of pregnancy) (14.12%; 431/3053; 95% CI: 12.88-15.35), followed by 8-12 weeks (13.03%; 508/3900; 95% CI: 11.97-14.08) and >12 weeks (12.76%; 279/2186; 95% CI: 11.36-14.16). The present result indicated infection with *T. gondii* is prevalence in pregnant women in Shandong Province, China which provides relevant "base-line" data for conducting control strategies and measures against toxoplasmosis in this region and elsewhere in China. This is the first report of the comprehensive survey of *T. gondii* seroprevalence in pregnant women in Shandong Province, China.

**Key words:** *Toxoplasma gondii*, seroprevalence, pregnant women, Shandong Province, China

---

### INTRODUCTION

Toxoplasmosis caused by *Toxoplasma gondii* is one of the more common parasitic zoonoses world-wide. It has been found worldwide in nearly one-third of the human population (Zhou *et al.*, 2011). Almost infected adults are usually asymptomatic but can cause mortality in the very young and the immune-compromised disease like ADIS patients occasionally (Elmore *et al.*, 2010). Importantly, *T. gondii* infection in pregnant women may cause poor obstetric outcomes such as hydatidiform mole, spontaneous abortion, teras, still-born and sterility (Gao *et al.*, 2012).

The seroprevalence of *T. gondii* infection in pregnant women is 6.1% in Mexico (Alvarado-Esquivel *et al.*, 2006), 43.8% in France (Berger *et al.*, 2009), 35% in Austria (Edelhofer and Prossinger, 2010), 53% in Brazil (Vaz *et al.*, 2010), 10.3% in Japan (Sakikawa *et al.*, 2012), 34.4% in Iran (Babaie *et al.*, 2013), 30.9% in Tanzania (Mwambe *et al.*, 2013). *T. gondii* infection in pregnant women has been reported in many provinces of China ranging from 0.5%

(Cheng *et al.*, 2006) to 25.5% (Zhong and Xue, 2006) in China. However, these literatures were published in the Chinese language in local journals and are not readily accessible to international readers. Moreover, little information is available about the seroprevalence of *T. gondii* infection in pregnant women living in Shandong Province, China (He *et al.*, 1999; Liu and Li, 2001). Therefore, the objective of the present investigation was to examine the *Toxoplasma gondii* seroprevalence in pregnant women in Shandong Province, China. The results should provide base-line data for recommendations with regards to prevention and control of toxoplasmosis in this region and elsewhere in China.

### MATERIALS AND METHODS

A total of 7956 blood samples were collected from pregnant women in hospital which are distributed in 15 representative administrative regions in Shandong Province city between August 2010 and September 2013 (Table 1). The pregnant women were 21-38 years old.

Table 1: Seroprevalence of *Toxoplasma gondii* infection in pregnant women in Shandong Province, China

Regions	No. of tested	No. of positive	Prevalence (%)	95% CI
Zibo	478	66	13.81	10.72-16.90
Zaozhuang	579	62	10.71	8.19-13.23
Dongying	662	78	11.78	9.33-14.24
Jining	572	76	13.29	10.51-16.07
Taian	361	59	16.34	12.53-20.16
Weihai	367	56	15.26	11.58-18.94
Rizhao	298	65	21.80	17.12-26.50
Binzhou	419	98	23.39	19.34-27.44
Dezhou	678	88	12.98	10.45-15.51
Liaocheng	778	54	6.94	5.16-8.730
Heze	559	69	12.34	9.62-15.07
Laiwu	789	101	12.80	10.47-15.13
Linyi	890	99	11.12	9.06-13.19
Jinan	830	102	12.29	10.06-14.52
Qingdao	879	145	16.50	14.04-18.95
Total	9139	1218	13.33	12.63-14.02

Blood samples were then centrifuged at 1,000 g for 10 min and serum was obtained, frozen and stored at -20°C until use.

ELISA was used for determination of *T. gondii* IgG antibodies. The ELISA kits were provided by Beijing Modern Golden Biotechnology Co., Ltd. Beijing, China. The procedure was performed according to the manufacturer's instructions.

The data were analyzed statistically using the PASW Statistics 18 (IBM Corporation, Somers, NY, USA); 95% Confidence Intervals (CI) are given. The value of  $p < 0.05$  differences between levels within factors and interactions were considered to be statistically significant.

## RESULTS

Antibodies against *T. gondii* were detected in 13.33% (1218/9139; 95% CI: 12.63-14.02) pregnant women. The *T. gondii* seroprevalence in pregnant women from different regions ranged from 6.94 (95% CI: 5.16-8.73) to 23.39% (95% CI: 19.34-27.44) (Table 1), having not statistically significant differences ( $p > 0.05$ ). The seroprevalence of *T. gondii* in pregnant women from 6 of the 15 representative administrative regions in Shandong Province city was  $> 13.33\%$  (95% CI: 12.63-14.02) (average value) and the highest seroprevalence (23.39%) (95% CI: 19.34-27.44) was in Binzhou city (Table 1). The highest seroprevalence was found in low educational standards (15.77%; 533/3379; 95% CI: 14.55-17) and followed by secondary educational standards (12.15%; 454/3736; 95% CI: 11.1-13.2) and high educational standards (11.41%; 231/2024; 95% CI: 10.03-12.8). Furthermore, the seroprevalence of *T. gondii* was the highest in less more 8 weeks (time of pregnancy) (14.12%; 431/3053; 95% CI: 12.88-15.35), followed by 8-12 weeks (13.03%; 508/3900; 95% CI: 11.97-14.08) and  $> 12$  weeks (12.76%; 279/2186; 95% CI: 11.36-14.16).

## DISCUSSION

*T. gondii* is a parasite widely distributed around the world, infecting humans and all warm-blooded animals. Although, it is considered as major pathogens of abortion, there is no information about the seroprevalence of *T. gondii* infection in pregnant women living in Shandong Province, China.

Seroprevalence of *T. gondii* in pregnant women in the present study was 13.33% (95% CI: 12.63-14.02) which is significantly higher than that in Anhui (8.97%) (Tang *et al.*, 1994), Gansu (7.28%) (Zhang *et al.*, 1999), Guangxi (5.93) (Guo *et al.*, 1998), Guizhou (10.3%) (Zheng, 2007), Heilongjiang (9.6%) (Zhang *et al.*, 2006), Henan (7.5%) (Liu and Guo, 2009), Hunan (6.03%) (Lin *et al.*, 2001) and Zhejiang (6.51%) (Zuo *et al.*, 2009) provinces of China but was lower than those in Hubei (22.8%) (Liu and Jun, 2009), Liaoning (21.5%) (Liang *et al.*, 2004) provinces of China. This is most likely due to difference in welfares, climates and lifestyle. Another reason for the different seroprevalence may be due to use different investigational methods.

The highest seroprevalence was found in low educational standards (15.77%; 95% CI: 14.55-17) which was consistent with that of earlier study (Liu *et al.*, 2009). The earlier and present studies indicated that health education has been proved a cost-effective intervention. The peaks of *T. gondii* seroprevalence in less more 8 weeks suggested that it is more important to control and prevent toxoplasmosis in this stage.

The ingestion of food or water that is contaminated with oocysts shed by cats is considered an important source of *T. gondii* infection in humans (Zhou *et al.*, 2011). In present study, researchers observe that people of this region have the habit of eating raw vegetables or undercooked meat. More importantly, we noted that many pregnant women have contact with cats. So, these results indicate that *T. gondii* may exist in their environment which may also pose the risk for human infection.

Toxoplasmosis can lead to abortion, stillborn, mummification in pregnant women (Elmore *et al.*, 2010). However, the present dataset could not determine whether or not *T. gondii* infection can significantly increase the risk of abortion in the pregnant women. Therefore, further studies are necessary to elucidate a potential effect of *T. gondii* on reproduction of pregnant women.

## CONCLUSION

The present results indicated the high seroprevalence of *T. gondii* infection in pregnant women in Shandong

Province, China, however, this severe situation received little attention in the past. Therefore, effective measures should be taken to prevent and control toxoplasmosis in pregnant women in this region and elsewhere, China. This is the first report of the comprehensive survey of *T. gondii* seroprevalence in pregnant women in Shandong Province, China.

## REFERENCES

- Alvarado-Esquivel, C., A.Sifuentes-Alvarez, S.G. Narro-Duarte, S. Estrada-Martinez and J.H. Diaz-Garcia *et al.*, 2006. Seroepidemiology of *Toxoplasma gondii* infection in pregnant women in a public hospital in northern Mexico. BMC Infect. Dis., Vol. 6 10.1186/1471-2334-6-113.
- Babaie, J., S. Amiri, E. Mostafavi, N. Hassan, P. Lotfi, A.R.E. Rastaghi and M. Golkar, 2013. Seroprevalence and risk factors for *Toxoplasma gondii* infection among pregnant women in northeast Iran. Clin. Vaccine Immunol., 20: 1771-1773.
- Berger, F., V. Goulet, Y. Le Strat and J.C. Desenclos, 2009. Toxoplasmosis among pregnant women in France: Risk factors and change of prevalence between 1995 and 2003. Rev. Epidemiol. Sante Publique, 57: 241-248.
- Cheng, M.L., J. Wang and F. Wu, 2006. Investigation of infection of TORCH in the pregnancy in Wenlin city. J. Clin. Exp. Med., 5: 993-993.
- Edelhofer, R. and H. Prossinger, 2010. Infection with *Toxoplasma gondii* during pregnancy: Seroepidemiological studies in Austria. Zoonoses Public Health, 57: 18-26.
- Elmore, S.A., J.L. Jones, P.A. Conrad, S. Patton, D.S. Lindsay and J.P. Dubey, 2010. *Toxoplasma gondii*: Epidemiology, feline clinical aspects and prevention. Trends Parasitol., 26: 190-196.
- Gao, X.J., Z.J. Zhao, Z.H. He, T. Wang and T.B. Yang *et al.*, 2012. *Toxoplasma gondii* infection in pregnant women in China. Parasitology, 139: 139-147.
- Guo, X.B., C.J. Su, Z.B. Zuo, C.K. Su and X.Y. Xiao, 1998. Investigation of *Toxoplasma* infection in mothers and fetus. Chinese J. Perinatal Med., 2: 123-128.
- He, F.H., C. Wu and C.Y. Wang, 1999. A study of *Toxoplasma* infection among 800 pregnant women. J. Linyi Med. Coll., 21: 215-215.
- Liang, D.H., F.Z. Wang, H. Fan, S. Han, L. Duan and C. Cui, 2004. A seroepidemiologic survey on *Toxoplasma gondii* infection of pregnant women. Chinese Primary Health Care, 18: 29-30.
- Lin, M.C., Q.G. Weng, X.R. Xiao, G.Y. Cai, X.M. Ning and L. Lv, 2001. Preliminary investigation of *Toxoplasma* infective characteristics in premarital or pregnant women. Chinese J. Birth Health Heredity, 9: 100-101.
- Liu, J. and Z. Jun, 2009. TORCH infection among women at early pregnancy in Hanyang district, Wuhan. Chinese J. Birth Health Heredity, 17: 70-71.
- Liu, Q., F. Wei, S. Gao, L. Jiang and H. Lian *et al.*, 2009. *Toxoplasma gondii* infection in pregnant women in China. Trans. R. Soc. Trop. Med. Hyg., 103: 162-166.
- Liu, X.Y. and S.Y. Li, 2001. *Toxoplasma* infection in pregnant women of Rizhao city. Chinese J. Zoonoses, 5: 128-128.
- Liu, Y.R. and S.J. Guo, 2009. *Toxoplasma* infection in pregnant women. Public Med. Forum Mag., 13: 271-272.
- Mwambe, B., S.E. Mshana, B.R. Kidenya, A.N. Massinde and H.D. Mazigo *et al.*, 2013. Sero-prevalence and factors associated with *Toxoplasma gondii* infection among pregnant women attending antenatal care in Mwanza, Tanzania. Parasites Vectors, Vol. 6 10.1186/1756-3305-6-222.
- Sakikawa, M., S. Noda, M. Hanaoka, H. Nakayama and S. Hojo *et al.*, 2012. Anti-*Toxoplasma* antibody prevalence, primary infection rate and risk factors in a study of toxoplasmosis in 4,466 pregnant women in Japan. Clin. Vaccine Immunol., 19: 365-367.
- Tang, D.S., Y. Xu and T. Xu, 1994. Preliminary survey of *Toxoplasma* seroprevalence among pregnant women in Hefei district. J. Trop. Dis. Parasitol., 23: 55-56.
- Vaz, R.S., V. Thomaz-Soccol, E. Sumikawa and A.T.B. Guimaraes, 2010. Serological prevalence of *Toxoplasma gondii* antibodies in pregnant women from Southern Brazil. Parasitol. Res., 106: 661-665.
- Zhang, H., Z.P. Zhang and X.P. Liu, 1999. Diagnosis of *Toxoplasma* infection in pregnant women and their newborns by combining ELISA and PCR. Chinese J. Zoonoses, 3: 110-111.
- Zhang, J., J.Q. Dan, Z.H. Zhu, L.C. Chen and Y.P. Wang, 2006. Survey of *Toxoplasma* seroprevalence in pregnant women of Daqing city. Heilongjiang Med. Pharm., 29: 69-70.
- Zheng, Y.X., 2007. 78 cases of maternal infection of *Toxoplasma*. Guizhou Med. J., 1: 78-78.
- Zhong, Y.F. and S.H. Xue, 2006. Prevalence of TORCH-IgG antibodies in non-vaccinated married fertile-aged women in Guangzhou. Maternal Child Health Care China, 21: 3309-3310.
- Zhou, P., Z. Chen, H.L. Li, H. Zheng, S. He, R.Q. Lin and X.Q. Zhu, 2011. *Toxoplasma gondii* infection in humans in China. Parasites Vectors, Vol. 4. 10.1186/1756-3305-4-165.
- Zuo, J.F., X.M. Luo and G.M. Lv, 2009. Serological analysis of *Toxoplasma* IgG and IgM in 1491 pregnant women. China Contemp. Med., 9: 157-157.