ISSN (Print) 0023-4001
ISSN (Online) 1738-0006

Korean J Parasitol Vol. 50, No. 3: 225-227, September 2012
http://dx.doi.org/10.3347/kjp.2012.50.3.225

▣ BRIEF COMMUNICATION

Seroprevalence of Toxoplasmosis in the Residents of Cheorwon-gun, Gangwon-do, Korea

Hye-Jin Ahn[1,†], Pyo Yun Cho[2,†], Seong Kyu Ahn[2], Tong-Soo Kim[2], Chom-Kyu Chong[3], Sung-Jong Hong[4], Seok Ho Cha[5] and Ho-Woo Nam[1,*]

[1]*Department of Parasitology and Catholic Institute of Parasitic Diseases, College of Medicine, Catholic University of Korea, Seoul 137-701, Korea;* [2]*Department of Parasitology, College of Medicine, Inha University, Incheon 400-712, Korea;* [3]*Department of Biochemistry, College of Natural Science, Chungbuk National University, Cheongju 361-763, Korea;* [4]*Department of Medical Environmental Biology, College of Medicine, Chung-Ang University, Seoul 156-756, Korea;* [5]*Department of Biomedical Technology, College of Medicine, Inha University, Incheon 400-712, Korea*

Abstract: The seroepidemiological status of toxoplasmosis was surveyed among the residents of Cheorwon-gun, Gangwon-do by means of ELISA using a crude extract antigen of *Toxoplasma gondii*. The sera of 1,661 adult residents (866 males and 795 females) were collected and checked for IgG antibody titers, which showed 17.0% positive rate (282 sera). The positive rate was significantly different between the sex; 20.6% for males and 13.1% for females ($P < 0.05$). The positive rates were higher in fifties of males (28.7%) and forties of females (20.0%). This positive rate of toxoplasmosis in Cheorwon-gun residents is regarded as the highest among the surveys of different geographical regions of Korea. This high positive rate may due in part to peculiar geographical locality of the surveyed area near the naturally well preserved demilitarized zone (DMZ) or presumably consumption of the pork imported from high endemic nations. Therefore, it is necessary to study further the epidemiology of toxoplasmosis in Cheorwon-gun.

Key words: *Toxoplasma gondii*, seroprevalence, Cheorwon-gun, ELISA

Toxoplasma gondii, an apicomplexan protozoa, can infect a broad range of host animals, including humans. This infection passes by asymptomatically and opportunistically in most infected hosts, but can cause toxoplasmosis in some individuals with such symptoms as encephalitis, chorioretinitis, and lymphadenitis in acquired infections and abortion and neonatal mortality in congenital infections [1-3].

In the Republic of Korea, seroprevalence of toxoplasmosis has been reported sporadically among various groups of outpatients in hospitals. It has been recognized generally that the positive rates of Koreans are in the range from 1.9 to 7.7% [4-6], except for patient groups or residents in Jeju island of 12.9% [6] or more recently 13.2% [7], which is maintained higher than the other regions of Korea. However, all positive rates in Korea are still significantly lower than, approximately 1/10 of, those of other endemic countries of 30-70% [1]. Here, we present a survey which has screened the seroprevalence of toxoplasmosis among the residents in several villages of Cheorwon-gun, Gangwon-do, which are localized near the demilitarized zone (DMZ) facing the North Korea and resulted in a 17.0% of the positive rate, the highest among the surveys ever done in Korea.

A total of 1,661 sera were collected from residents (866 males and 795 females) of villages scattered over the 6 administrative regions of Cheorwon-gun, including urban and rural environments, from November to December 2010 and the same 2 months of 2011, under the regulation of the IRB Committee of Chung-Ang University (No. 2010-06-03) held on June 18, 2010. The sera were checked for IgG antibody titers by ELISA using a crude extract RH strain antigen of *T. gondii* according to the method of [4], which resulted in a 17.0% positive rate (282 sera) (Table 1). The positive rate was significantly different ($P < 0.05$) between the sex, 20.6% for males and 13.1% for females, as analyzed by the Student's *t*-test. Regionally, the residents of Geunnam-myeon showed the highest positive rate of 26.3%, with a similar differential partition of the sexes. The residents of Gimhwa-eup, which neighbors with Geunnam-myeon, showed a lower prevalence of 13.3%, with an equiva-

• Received 8 February 2012, revised 11 April 2012, accepted 12 April 2012.
† Hye-Jin Ahn and Pyo Yun Cho equally contributed as the first author.
* Corresponding author (howoo@catholic.ac.kr)

lent partition between sexes. The positive rates by age did not follow the general tendency but increased gradually according to the ages such that the highest in males of fifties (28.7%) and in females of forties (20.0%) (Fig. 1). Furthermore, the positive optical density (OD) values of ELISA were distributed more widely in females than in males as shown in Fig. 2. The median OD values were 0.41 in males and 0.47 in females, and the mean OD was 0.49 and 0.55, respectively, both were higher in females.

The positive rate of 17.0% marks the highest score among the Korean subjects tested, which reflects some significant changes in the toxoplasmic environment, such as eating behavior, pet-loving preference, and residential mode, that have been regarded as the reason for relatively low prevalence among Koreans compared to those of highly endemic countries [6]. Besides the congenital infection by tachyzoites, *T. gondii* is commonly acquired by ingesting tissue cysts containing bradyzoites in undercooked pork or mutton [1] and by ingesting sporozoite-containing oocysts directly in water contaminated with cat feces [8]. Here, we postulate that the reasons for the high seroprevalence among the residents of Cheorwon-gun may include the location of the villages near the DMZ and popular consumption of the imported pork from countries with high toxoplasmic endemicity.

DMZ is now known to be a most well-preserved wildlife area, in which ocular toxoplasmosis occurred among people who had experienced eating wild boar and deer captured from this region [3]. The seroprevalence of residents in Geunnam-myeon was the highest, whereas that of residents in the neighboring Gimhwa-eup showed the lowest, which could not reflect the possibility of *T. gondii* infection just by the distance from DMZ. It was interesting that most of women infections were coupled with infections of their husbands simultaneously (i.e., familial infection, presumed by the same address), and also the infections were common among relatives (presumed by the name), which suggests share of live special viscera for traditional misbelieves of stamina or of undercooked meats captured by a snare. Men in their fifties and women of forties were more highly infected, which may suggest more opportunities of dining out to enjoy boned rip or porkchop of imported pork in addition to the above-mentioned reason regardless of their residence in urban or rural localizations. Recently, pork is imported from countries of high *T. gondii* endemicity, and has been consumed nation-widely with a competitive price without any inspection of *T. gondii*. Of course, the route of infec-

Table 1. Positive rates of toxoplasmosis in the residents of Cheorwon-gun, Gangwon-do according to the region and sex

Region	No. posit./No. exam. (%)		
	Male	Female	Total
Geunnam-myeon	23/79 (29.1)	7/35 (20.0)	30/114 (26.3)
Seo-myeon	19/99 (19.2)	10/70 (14.3)	29/169 (17.2)
Cheorwon-eup	45/214 (21.0)	25/208 (12.0)	70/422 (16.6)
Dongsong-eup	46/216 (21.3)	36/298 (12.1)	82/514 (16.0)
Gimhwa-eup	16/119 (13.4)	15/114 (13.2)	31/233 (13.3)
Galmal-eup	29/139 (20.9)	11/70 (15.7)	40/209 (19.1)
Total	178/866 (20.6)	104/795 (13.1)	282/1,661 (17.0)

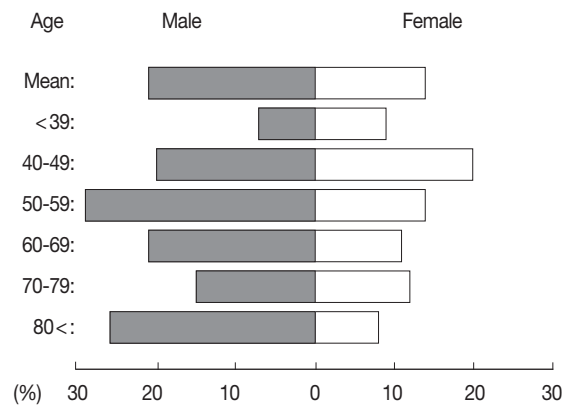

Fig. 1. Comparison of the positive rates of anti-*Toxoplasma* antibody by sex and age.

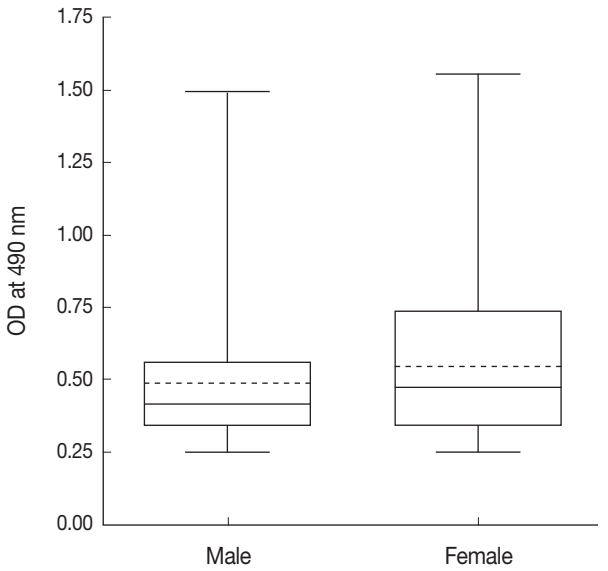

Fig. 2. Comparison of the distribution of positive anti-*Toxoplasma* antibody titers in the residents of Cheorwon-gun, Gangwon-do. Solid line indicates the median value and dotted line the mean value.

tion by ingesting oocysts cannot be ruled out because of water supply problems in those regions.

Altogether, the seroprevalence of toxoplasmosis has been screened among the residents of Cheorwon-gun which resulted in the highest positive rate among surveys done in Korea. The epidemiology of *T. gondii* infection should be further investigated in this region. Both of the proposed reasons for high prevalence in this study may well be applicable to all over the country nowadays, and thus it is necessary to screen the national toxoplasmic seroprevalence to find out symptomatic patients and to correlate it with other debilitating diseases.

ACKNOWLEDGMENT

This project was supported partly by a grant from the Korea Center for Disease Control and Prevention (800-2010023), 2010.

REFERENCES

1. Tenter AM, Heckeroth AR, Weiss LM. *Toxoplasma gondii*: from animal to humans. Int J Parasitol 2000; 30: 1217-1253.
2. Weiss LM, Dubey JP. Toxoplasmosis: a history of clinical observations. Int J Parasitol 2009; 39: 895-901.
3. Park YH, Han JH, Nam HW. Clinical features of ocular toxoplasmosis in Korean patients. Korean J Parasitol 2011; 49: 167-171.
4. Choi WY, Nam HW, Youn JH, Kim DJ, Kong Y, Kang SY, Cho SY. Detection of antibodies in serum and cerebrospinal fluid to *Toxoplasma gondii* by indirect latex agglutination test and enzyme-linked immunosorbent assay. Korean J Parasitol 1992; 30: 83-90.
5. Song KJ, Shin JC, Shin HJ, Nam HW. Seroprevalence of toxoplasmosis in Korean pregnant women. Korean J Parasitol 2005; 43: 69-71.
6. Yang HJ, Jin KN, Park YK, Hong SC, Bae JM, Lee SH, Choi HS, Hwang HS, Chung YB, Lee NS, Nam HW. Seroprevalence of toxoplasmosis in the residents of Cheju island, Korea. Korean J Parasitol 2000; 38: 91-93.
7. Hong SJ, Chong CK, Lee K, Kim DS, Hong YP, Ahn HJ, Kim HY, Ko AR, Kim YJ, Nam HW. Maintained seroprevalence of toxoplasmosis among the residents of Jeju island, Korea. Korean J Parasitol 2011; 49: 309-311.
8. Bahia-Oliviera LM, Jones JL, Azevedo-Silva J, Alves CC, Oréfice F, AddissDG. Highly endemic, waterborne toxoplasmosis in north Rio de Janeiro state, Brazil. Emerg Infect Dis 2003; 9: 55-62.