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## OBSERVATIONAL STUDY OF TOXOPLASMOSIS DISTRIBUTION: COMPARISON OF SEROPREVALENCE RATE IN UKRAINE, INDIA AND GHANA

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**Abstract.** The research paper deals with the comparison of seroprevalence rate of toxoplasmosis in Ukraine, India and Ghana. It determined that Ukrainian women of reproductive age contaminated with *T.gondii*. That fact confirmed by the 81,3 % seroprevalence rate with the predomination women living in the rural regions – 87,3±0,58 % comparatively with 71,4±1,11 % urban inhabitants. The rate of seropositive women does not differ substantially in age groups ranging from 16 to 39 years. Comparatively, toxoplasmosis in India has low incidence due to few important epidemiological risk factors: practically absence of cats like reservoir of parasite, and mostly vegetarian nutrition style. In some tropical areas where cats are abundant and the warm and humid climate favors survival of *T.gondii* oocysts, the seroprevalence toxoplasmosis is higher than in developed countries: in Ghana, the seroprevalence reached 90% among pregnant women.

**Keywords:** toxoplasmosis, invasion, transmission, seropositivity, risk factors, pregnant women, Ukraine, India, Ghana, reproductive age.

### Introduction

Toxoplasmosis is present in every country and seropositivity rate ranges from less than 10% to over 90%. High burdens had seen in South America and in some Middle Eastern and low-income countries (Torgersona, 2013). The global annual incidence of congenital toxoplasmosis was estimated to be 190 100 cases, and reproductive health of women is important too.

Toxoplasmosis is one of the most common parasitic diseases of human, thus among veterinary and workers of farms occurred with high seropositivity (Sang-Eun, 2014). More than half of the adult population infected with *Toxoplasma* in all countries around the world, and in regions with low sanitary culture, contamination is almost absolute. Human infection can result from the ingestion or handling of undercooked or raw meat containing tissue cysts. Alternatively, it can result from direct contact with cats or from the consumption of water or food contaminated by oocysts excreted in the faeces of infected cats, pigs, birds (Robert-Gangneux; Howe, 2014). Anti-epidemic measures to combat this infection are ineffective because its distribution takes place without human intervention as a source of infection (Cook, 2000).

However, toxoplasmosis, along with other groups of TORCH infections is one of the main reasons for the increasing of intrauterine fetal pathology (Vanni, 2008). Vertical transmission could lead to primary infection during within first three months of pregnancy (Kankova, 2007). Moreover, the nature and severity of the involvement of the fetus does not depend on the severity of infection in the mother, and defined terms of infection. *Toxoplasma* invasion in women at any other period of life (prior than 3 months before pregnancy) is safe for future pregnancies because of formation of non-sterile immunity. It will keep fetus from infection in case of re-infection or an exacerbation of a woman in her chronic process. Evidently, that the risk of possible damage of the fetus is high only in seronegative women with total absence of specific anti-toxoplasma antibodies (Kravetz, 2005). The purposes of the research aimed to determine the frequency of invasion by toxoplasmas in Bukovinians women of reproductive age and to compare prevalence rates in Southwest of Ukraine, Eastern European region (Bukovina), India and Ghana as well as to determine factors that assist to contaminate of seronegative women during pregnancy and suggested the prevention measures.

### Method

The current observational study conducted in Bukovina (Southwest of Ukraine, Eastern European region) within 7 years (2007-2014) involved 5329 women aged 16-39 years: 4987 pregnant and 342 women in period of planning of pregnancy. There were enrolled 62,3% (3320 persons) inhabitants of rural area and 37,7% (2009 persons) inhabitants of urban areas. Study participants were recruited based on written informed consent after explanation of the study. Actually, distribution and seropositivity rates in women of Ghana and India based upon literature data (Singh, 2004; Ayi, 2009).

Clinical, biochemical, epidemiologic, molecular-biologic and, additionally, instrumental methods of investigation used. With purpose of verification of diagnosis of *Toxoplasma gondii* invasion we took into consideration the results of serological data – presence of specific antibodies IgM and IgG, finding of DNA of toxoplasma by PCR. For establishing of clinical form of this parasite invasion, the avidity index of IgG and ophthalmoscopy results had used. Interpretation of got results conducted with taking into consideration the classification of toxoplasmosis and literature data according to clinical and epidemiological peculiarities and laboratory diagnostics of this pathology (Guy, 1995; Litwin, 1997). The results proceeded statistically.

### Results

State of invasion by toxoplasma revealed in 4332 women of reproductive age (16-39 years), that means 81,3 % from all investigated. Nevertheless, in 4301 infected women (99,3%) invasion caused by *Toxoplasma gondii* was long lasted and had latent course. In 9 patients (0,21% according to all investigated) the chronic toxoplasmosis was diagnosed. Primary infection caused by toxoplasmas revealed during the research in pregnant women were confirmed in 23 cases, that means 0,43% from the general quantity of investigated and 0,53% from the general amount of infected persons. However, on author's opinion, the index of the primary infecting by toxoplasmas does not represent an actual epidemiology situation. Thus next step of the planned inspection of pregnant authors investigated part of women with suspicion on an acute infectious process.

Frequency of toxoplasma-infected women of rural locality was 87,3%, habitants of city – 71,4%. Thus, among women which lived in town from birth (1647 persons), this index was yet lower – 68,36%. Actually the primary «fresh» invasion by *T.gondii* in urban women was considerably higher, than in rural ones (60,7% vs 39,3%). In different groups ranged by age, the frequency of exposure of seropositive women did not differ substantially (table 1).

Table 1

Frequency of revealing of seropositive (IgGtoxo +) women in different aged groups

Age	Total number of investigated	Quantity of seropositive	Quote of seropositive, %
Up to 18 years	63	50	79,4±5,71
19 – 23 years	1991	1641	82,4±0,94
24 – 28 years	2387	1924	80,6±0,90
29 years and senior	888	717	80,7±1,32
Totally	5329	4332	81,3±0,53

The primary contamination had noticed in more early periods of life of women, possibly prior to reproductive age. Nevertheless, the cases of the primary infecting by *T.gondii*, which diagnosed during the investigation, had accurate age-old dependence. More frequent primary invasion was diagnosed in groups aged 19-23 and 24-28 years (accordingly 65,2% and 30,4% cases). It was only one case (4,3%) of the primary acute invasion in group of women aged junior 18 years and none for women senior 29 years old.

Mostly women with acute toxoplasmosis shortly before contamination had changed the place of residence as well as occupation, style and quality of nourishment that were favorable for intensification of source of *Toxoplasma* and mechanism of transmission.

It was established, that the contact with source of invasion and alimentary route of transmission of toxoplasma were realized due to consumption of raw or undercooked meat products (cutlets, barbeque), blackberries, strawberries as main transmission factors revealed in the current investigation (table 2).

In 15 % of seropositive women, it was impossible to detect any of the provoking epidemiologic factor (by questioning method). However, in most of them in different age periods of life the other risk factors of contamination by *Toxoplasma gondii* parasite authors cannot excluded at all.

Table 2

Frequency of revealing of different epidemiologic factors of toxoplasmosis in enrolled women, (%)

Epidemiologic factors	Quantity of persons with noticed factor	Quote of persons with noticed factor, (%)
House-keeping of cats or close contact with them in relatives during different periods of life	3447	80,3
Consumption of undercooked meat products	24	0,55
Consumption of raw meat or semi-finished product (food stuffs)	763	17,6

### Discussion

The all-round study of epidemiologic factors had determined that in 36,3% cases two and more years prior the investigation it was evident short-lasting contact with source (mostly cats, kittens, rarely birds, pigs, dogs) with parasite transmission. Notable, that in 41,4% the duration of contact was more than 2 years, in some cases even 10-20 years, and only in 2,4 % the invasion with *Toxoplasma gondii* occurred and detected firstly and lasted not more than a few months. This received data verified idea about «old contamination» of prevalent of seropositive women. Only 2,4% of enrolled ought to discuss like acute infectious process.

The prevalence of this infection in India demonstrates a wide variation: from 7,1-12% in South India to high as 77% in women of reproductive age group in north India; another study from New Delhi found an overall anti-toxoplasma IgG seroprevalence of 45% among pregnant women (Singh, 2004; Sucilathangam, 2010). Overall high prevalence (92.5%) observed by Ayi in Ghana (2009). By Nowakowska (Poland, EU, 2014), the increased mean age (28,7 vs 26,7 years,  $P < 0,001$ ) of pregnant women was probably the most important factor in abolishing the effect of falling prevalence rates.

Provoking factors for contamination by parasite traced during different periods of life even in seronegative women. Particular almost in 20 % of them the long lasted contacts with animals were registered. In 2,2% contamination might realized by alimentary route due to consumption of undercooked meat foodstuffs. In accordance with epidemiology of toxoplasmosis, these women consisted the group of higher risk by toxoplasma invasion. There was no difference in the prevalence of antibodies in women from rural or urban areas, or from different parts of Denmark (Lebech, 1993). Thus, in rural area cats have not possibility to enter to kitchen or other rooms where food stored. In a city contamination of cats by *T. gondii* completely excluded because they lived indoor and their ration excluded raw mice meat. Simultaneously, testing of meals by these Ukrainian women was not accompanied with swallowing of raw force meat. Assumed the mentioned above, authors evidently suggest the considerable role of high sanitary culture.

Frequency of *Toxoplasma gondii* invasion in women of reproductive age in Ukraine (Southwest, Bukovina region), is 81,3% with predominance of villages habitants (87,3±0,58%) comparatively city habitants (71,4±1,11%), that prove the lack of hygiene, nutritional culture and sanitary education in rural area. Comparatively, sero-positivity of women in Ghana is high too (above 80%), and in India is less, depend on the region (ranged from 7 to 45%).

In aged group 16-39 years the seroprevalence substantially does not differ and testifies the invasion in more early periods of life, possibly prior to achievement of reproductive age (sixteen years old), clinically it means latent chronic invasion, thus frequency of primary acute toxoplasmosis cases did not exceed 0,43%. Accordingly, only seronegative women considering invasion could developed acute toxoplasmosis may have miscarriage or deliver newborn with congenital toxoplasmosis.

Contamination by *T. gondii* in women of reproductive age realized due to typical routes (animals long-lasting direct contact, consumption of undercooked pork, meat, handling kittens) and is similar to any world country, rather depend on habits, cuisine tradition etc. Strict following of personal, private hygienic rules as well as nourishment hygiene and sanitary veterinary standards allow getting a significant decreasing of infectious contamination risk for seronegative women of reproductive age of Ukraine, Ghana and India.

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