*Review*

**Toxoplasma gondii as a prevalent model for**

**a positive history of mental illness**

**Mladen Cimesa1\***

1 University of Bijeljina Bijeljina, Faculty of Psychology, Pavlovica road nn Dvorovi, tel / fax +387 55 / 350-150, 351-101. www.unb.rs.ba. mladen\_cimesa@hotmail.com

\*Author to whom correspondence should be addressed

**Abstract**: Toxoplasma gondii is a parasite, specifically single-celled intracellular protozoa. His presence is recorded in most warm-blooded organisms, and therefore also in humans. T gondii has developed a special brain tropism, so this parasite is closely linked to mental illness. The correlation between T gondii and schizophrenia is at the forefront of research and is supported by many evidence, but further research points to other psychopathologies such as bipolar disorder and depression. The prevalence of T gondi is found in the form of antisocial behavior in which we include aggression as well as the percentage of suicides that are also detected. Toxoplasmosis is a parasite that plays a role in etiopathogenesis because it sabotages the proper functioning of the neurotransmitter, especially dopamine, which is one of the determinants of mental illness because its irregular and disruptive secretion induces abnormal behavior. This paper deals with the demonstration of the connection between T gondii and mental illnesses in order to better understand the pathogenesis of certain mental disorders caused by this parasite, and points to caution and prevention.

**Key words:** toxoplasma gondii, dopamine, mental illness, schizophrenia.

**1. Introduction**

Toxoplasma gondii is a parasite or single cellular protozoa intracellular activity that can be found in a variety of warm-blooded animals, it is mostly present in mammals, and also humans are susceptible to disease from this parasite (Abdel-Rahman, 2017), (Montoya and Liesenfeld 2004) , (Saadatnia and Golkar 2012), (Schlüter et al., 2014). The first description of the T gondii originates from 1908, while studies that indicated that the coccidial parasite was dated from 1960 (Tenter & Johnson, 1997). The parasite was first detected and recorded in humans in 1930, while the congenital transmission was found in sheep and rodents sometime earlier (Cenci-Goga, 2011). The parasite has developed several potential transmission paths within and between different intermediate species. T. gondii can be transmitted vertically by tachyzoites transmitted to the fetus via the placenta. Horizontal transmission of T. gondii may include different directions, i.e. Transmission can also occur via tachytoids contained in the blood, or in the case of anesthetized milk (Tenter et al., 2000). However, it is not known which of these pathways is more important epidemiologically. The main pathways of transmission are different in human populations with differences in culture and eating habits (Hill & Dubei, 2002).

Many people are infected with toxoplasmosis in the world, but the largest percentage is present in the US where more than 60 million people are thought to have been infected (Kaye 2011). T gondii can cause blindness and mental retardation in children who are congenitally infected and occurs in immunocompetent individuals, or in subjects who have problems with the immune system or immune deficiency (Sulzer et.al, 1986). The largest gears of T are domestic cats. (Dubey & Frenkel, 1972). There is also the prevalence of mental illness in humans caused by this parasite, of which schizophrenia and bipolar syndrome are one of the most common (Fekadu, Shibre, and Cleare 2010).

**2. T gondii and human populations**

The prevalence of T gondii in humans depends on the environment (which is often heavily contaminated with the oocytes), age, as well as the cultural habits, or individual habits of the persons. (Dalimi and Abdoli 2012) People who come from families with low socioeconomic status are more prevalent are for parasitic infection (Alvarado-Esquivel et al., 2012). It was found that in cold regions, the statistically lower prevalence of infection with parasite was statistically significant. (Jackson and Hutchison, 1989). The Oocytes of Toxoplasma gondii necessary a warm and humid climate because they can survive and proliferate there (Walton et al., 1966). Poor hygiene is a predictor of infection, which is again happening in the population living in poor conditions and coming from the bottom of the social scale (Jones et al., 2001). People are most often infected by the oral route, consuming food or water that is infected with a parasite. (Dubey and Beattie, 1988). In addition to this type of infection, infection through transplantation of organs is possible, if the organ itself is infected, as well as the possibility of infection through blood transfusion (Siegel et al., 1971), but also by a congenital infection, because the pregnant woman can transfer the parasite on the fetus It is also known that T gondii (Flegr, Klapilová, and Kaňková 2014), (Vyas, 2013) can be transmitted during a sexual intercourse, while the parasite itself asexually reproduces. According to Fuller Torey "Two studies have shown that adults who have schizophrenia or bipolar disorder had greater exposure to cats in childhood. In one study, 84 (51%) of the 165 affected in relation to 65 (38%) of 165 corresponding controls had a home cat in childhood (p = 0.02) (E. Fuller Torrey & R H. Yolken). The host is accelerating the sharing of tachyzoites, while the division of bradyzoites is much slower. Bradyzoites encapsulate various tissues and organs from which one is the heart, while the most important organ in the body is the brain that encapsulates.

Persons suffering from T gondii for a long period of time, and not treated with pharmacotherapy, have certain psychopathology, ie certain psychiatric symptoms (Flegr, 2013). Recent studies have shown that those infected with T gondii have a positive psychiatric history of schizophrenia, but also for other mental illnesses (Webster et al., 2013). There is a prevalence of suicide in those with parasites (Arling et al., 2009), and the risk of traffic accidents in infected patients was also reported (Kocazeybek et al., 2009). Toxoplasmosis affects the reduction of aversion to the cat's urine in rodents, in this case in the mouse, the ranges of fear are reduced (Berdoy et al., 2000), the cognitive ability of the rodent to see the cat as a predator is blurred (Vyas et al., 2007) Attraction to cat urine eventually becomes fatal. In humans, similar behavior was observed, as with rodents, as far as liability for fear is concerned, and self-assessment of their own vulnerability (Gale et al., 2015).

T gondii is found in three genotypes - Genotype I, genotype II, and genotype III, of which the most common type of genotype is in humans (Ajzenberg et al., 2002). Infection with genotype I and genotype II recorded in the human population is caused by abortion and fetal death (Ajzenberg et al., 2002).

**3. Mental diseases in response to toxoplasma manipulation**

The parasite in the human population causes long-term mental changes that can have lasting consequences for the infected person himself, as well as those who interact with him (Flegr et al.2003). The toxoplasmosis itself has the properties of the host's personality manipulation during its lifecycle from the indirect host to the final host (Webster 2001). Although the T gondii parasite, which primarily plays a role in the rodent world in its evolutionary adaptation and selective pressure, can find a host in all warm-blooded organisms, it can develop specific mechanisms of manipulation in humans (because people live longer than rodents). For this reason, people are receptive to the development of many pathological changes (Flegr, 2013). Toxoplasmosis is a manipulative parasite because it affects the levels of dopamine in the brain that is one of the neurotransmitters responsible for schizophrenia, but also other mental illnesses (Prandovszky et al., 2011). If we take into account that the etiology of schizophrenia goes back to this case from T gondii, then we must emphasize that T gondii are in conjunction with the genetic material that the infected person carries. So toxoplasmosis is responsible for direct brain development in the prenatal phase. It is precisely the prenatal brain aggregation itself in synergy with the pathogenesis of mental disorders in this case of schizophrenia, as well as other mental illnesses that may arise in early adolescence (Rentakallio et al., 1997).

According to neuropathological findings, it is noticed that the most common glial cells is affected by this parasite, so that in the deceased persons who have undergone brain tissue analysis, there has been a change in many glial cells from which the astrocytes were most exposed to the T gondi (Creuzet C et al., 1998). We also need to mention that the parasite affects the activation of retrovirus that has been reported in animals, and in humans, because in many cases, increased activation of retroviruses in CNS has been recorded in patients (Karlson et al., 2001) According to Brighman. "With regard to the model of manipulation-schizophrenia the T. gondii model, positive symptoms of schizophrenia, such as psychomotor agitation and hyper-responsiveness to psychotomimetic drugs, were modeled in rodents by testing locomotor responses and hyperactivity ", which gave a positive evaluation of the symptoms. Mental illnesses that are closely related to dopamine fluctuations are also OCDs and bipolar disorder so that the emptiness has a monopoly over many mental illnesses in which dopamine plays a major role (Denys et al., 2004). According to Prandovszky et al., 2011, "Dopamine is synthesized in two steps from its precursor amino acid tyrosine: (1) metabolism of tyrosine hydroxylase for the production of L-DOPA; then (2) decarboxylation with L-DOPA aromatic decarboxylase L-amino acid to dopamine. In some cells, dopamine is further metabolized to norepinephrine by dopamine b-hydroxylase. It has recently been discovered that T gondies encode a protein with high homology and exhibit similar catalytic properties to tyrosine hydroxylases found in mammals. So T. gondi synthesized L-DOPA, a precursor for dopamine, as well as tyrosine, and has been shown to increase the levels of dopamine associated with T. gondii in rodents. "

The major complications and consequences of infection of the T gondii also include people who are immunocompromised, who are mostly ill with ADIS. They have recorded a changed state of consciousness, audio and visual hallucinations. In 60% of patients with AIDS, there was comorbidity with T gondi encephalitis (Israel & Remington, 1988).

**4. Prevention against T gondii**

Preventive measures are certainly needed against toxoplasmosis because the clinical picture supports this. The incidence of T gondi infections in Western European countries in terms of children and critical contagion is 1-10 at 10 00 (LM Signoreli et al. 2006), while in Brazil the ratio is 16 per 1000, although it is possibilities of increasing the risk of infection (Rorman et al., 2006). This data tells how critical the picture is, as far as South America is concerned. Education is one of the preventive models. In the United States there is a program that educates pregnant women and future mothers about the severity of the problem associated with this parasite (Di Mario et al., 2015), (Elsheikha 2008), also gynecologists take responsibility for spreading the word about the problems that the T gondii causes (Kravetz and Federman 2005 ), (Paquet et al., 2013) and the needs of serological testing, as well as the avidity test (JL Jones et al., 2010), (Singh 2016). Preventive measures include personal hygiene, awareness of transmitters of infection (cats, dogs, rodents ) infected land, proper maintenance of animal health on farms (which are raw materials in the meat industry) and the consumption of adequately prepared food (A Cook et al., 2000). Research shows that despite some efforts made in the field of education about prevention and prevention of T gondii, significant results have not been achieved (S DiMario et al., 2009), (McLeod et al., 2009).

**5. Conclusion**

T gondii as a manipulative parasite has a strong influence on the host, both final and intermedial. So the very controversy surrounding the past years is questioned, with regard to the free will and its own determination. Because if the mind is in a certain mode of machine then it can be managed, which in this case confirms the toxoplasmosis as an organism that is able to induce behivorial alternation of another organism (Adamo, 2013). The development of a vaccine would certainly be of great use in the fight and prevention of toxoplasmosis among the human population (Del Grande et al., 2017), (Beauvillain et al. 2009) Precisely because of the lack of vaccine and poor knowledge of the population about the dangers of T gondii in America, 20% The pregnant woman decides to terminate her pregnancy after learning that they are infected with toxoplasmosis due to fear that the fetus might suffer certain deformities (Liesenfeld et al, 2001), (Bollani, Strocchio, and Stronati 2013), (Berrébi et al., 2010). T gondii confirms that in addition to genetic predispositions, but also of the stressed factors in the environmental proportion of mental disorders in humans, organisms that have in their evolutionary adaptation have found a way to control a successful host and thus exist.

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