Research Article

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Prevalence of the Parasite *Toxoplasma Gondii* in Autistic Children in Iraq

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ABSTRACT

Background: *Toxoplasmosis is a parasitic disease that can infect almost any mammalian species, if not all where one-third of the population might be infected with latent toxoplasmosis. Toxoplasmosis is more common in underdeveloped countries than developed countries where it infects a large number of people worldwide. The Toxoplasma gondii should be considered as a contributing factor in mentally ill people who have been exposed to the parasite. Toxoplasmosis primarily affects the central nervous system, putting some people at risk, more than others. The Toxoplasma gondii infection has also been linked with psychiatric illnesses; however, research on the causal pathway is limited and therefore not clearly developed. The objectives: of this humble research has been to discuss the link between Toxoplasmosis and childhood autism as a type of mental disorders.*

Materials and Methods: *Thirty autistic children were selected from the Children's hospital of Kerkuk city compared to fifteen healthy children used as control for comparison.*

Results: *Using rapid-test (IgG, IgM) of Toxoplasma gondii the prevalence of anti-T. gondii IgG in autistic children were 13.3% which was significantly ($p \leq 0.01$) higher than that in healthy children (6.67%).*

Conclusion: *It is recommended that mothers should avoid contamination of their young babies from any source of the parasites natural or artificial feeding, which might be the main pathway of infection.*

Keywords

Autistic children, IgG, IgM, Iraq, *Toxoplasma gondii*.

Introduction

Toxoplasma gondii is an obligatory protozoan parasite infects a wide variety of warm-blooded animals and is the etiological agent of one of the most common parasitic infections in humans. Infection of *T. gondii* could lead to many mental diseases meanwhile attacks soft tissues particularly the nervous system causing several nervous disorders i.e. blindness, schizophrenia, autism etc... When the immune system is weak e.g. as a result of HIV/AIDS, as in infant or young children then toxoplasmosis can lead to seizures and life-threatening illnesses such as encephalitis, a serious brain infection which may end up fatal particularly in people with AIDS, while untreated encephalitis from toxoplasmosis could well be fatal [1]. Antibodies to *T. gondii* are found in about one third of the world's population [2]. Although infection rates differ significantly from country to another however, serological studies estimate that 30-50% of the global population has been exposed to and may be chronically infected with, *T. gondii* [3]. An estimated figure have shown the highest IgG sero-prevalence to be in Ethiopia, at 64.2%, as of 2018 [4]. The untreated domestic cats (family: Felidae) are the main intermediate hosts of this parasite while their faeces could be the main source of the parasite to human and other final hosts when transmitted accidentally [5]. Infection can also be spread by eating cysts in contaminated meat, as bradyzoites change back into tachyzoites when they enter a new suitable intermediate host [6].

Many people, worldwide, suffer from psychosis meanwhile, each year, nearly 100,000 young people experience psychotic symptoms,

with a 1:100 person experiencing symptoms at some point in their lives. Psychiatric disorders e.g. delusions, schizophrenia, hallucinations, or a thought disorder, which includes perceiving things as strange or seeing things that aren't there account for about 10% of the disease burden in low and middle-income countries [7]; depression with psychotic features, and even anxiety disorders like Obsessive Compulsive Disorder (OCD) [8]. According to research, toxoplasmosis may be linked to the development of a psychotic disorder, or it may cause psychotic symptoms by affecting similar brain regions, with clinical manifestations that resemble schizophrenia [9]. *Toxoplasma gondii* infection has been linked with psychiatric illnesses however; research on the causal pathway is limited and therefore not clearly developed.

Among these disorders is the autism which is a highly varied neurodevelopmental disorder characterized by symptoms that emerge in infancy or childhood and progress without remission [10]. Several studies have found a link between maternal toxoplasmosis serology and the risk of autistic offspring [11,12]. *T. gondii* tachyzoites may infect different types of brain cells in the cerebellum, which in turn control signalling pathways and signal transduction mechanisms involved in a variety of functions such as cell apoptosis, immune cell maturation, and antimicrobial effector functions, connecting the parasite to the development of apoptosis in neural progenitor cells via an endoplasmic reticulum stress mechanism [13,14].

Thus, the objective of the present study was to study a possible relationship between *T. gondii* infection via determining the sero-positivity rate of anti *T. gondii* antibodies (IgG and IgM) in Iraqi autistic children using chromatographic immunoassay (Toxo-rapid test).

Materials and Methods

Using sterile 3mL syringes approximately 3mL of peripheral blood was drawn from 30 autistic children from the Autism Centre of the Children's Hospital of Kerkuk, and 15 healthy children, whose parents showed an interest in this study. The blood samples were put in Gel tubes, then centrifuged (3,000 rpm, 5min). By a micropipette, 250 microliters of each child's serum were taken into 1mL polypropylene tubes, each with its own number on; meanwhile, the tubes were frozen at -20 until testing. The necessary data of each child were recorded with a specific number. Name, date of birth, and blood group were recorded. A chromatographic immunoassay (Toxo rapid test) was used to determine IgG and IgM of *Toxoplasma gondii* in children's serum. Following thawing the serum for less than 10 min, the provided pipette was used to pipe approximately 3 drops of the serum from a polypropylene tube. Then added to the cassette for both IgG and IgM sides. Time was recorded for subgroups of samples, counting for 10min to show a positive or negative result. Then, recorded and analysed using google sheets that helped to determine the results faster, counting the positive and negative ones as well as the sample percentage.

Result and Discussion

The results of IgG and IgM are listed in the table below, which shows the link between the percentages of parasite 13.3% in autistic children with significant differences ($p \leq 0.01$) in comparison with control. The frequency of the parasite in control children was very low. Apparently, the autistic children are more likely to be infected with the *Toxoplasma* protozoan than the normal control. Ingestion of oocysts by human or/and other warm-blooded animals is one of the common routes of infection [15]. Children can easily be exposed to oocysts e.g. by consuming unwashed vegetables, contaminated water, or by handling the cat litter or even by an infected cat or via an hygienic or a careless mother [16,17]. Although cats can also be infected by ingesting oocysts, they are much less sensitive to oocyst infection than are intermediate hosts [18]. In addition, the immune system of children is less well developed than adults that make them more susceptible than adults with well-developed immune system. De-worming the cats against the parasite deems necessary than keeping the children, at various ages, off the children. Teaching mothers via regular education courses being organised by local health authorities deems so pivotal everywhere to avoid babies and young children contaminated. Such high susceptibility of young children to the parasite is similar to the rapid growth of the parasite *in vitro* in the absence of immunity [19].

Due to the softness of nervous system, the parasite can easily move around, infect the brain system cells (neurons, microglia) during the acute stage of infection, and then persist primarily in the neurons [20]. The attraction of both CD4+ and CD8+ T lymphocytes in the brain during parasite infections leads to the release of chemokines and cytokines in response to the parasitic illnesses [21]. The levels of cytotoxic T-cells in the brain grow during the first week of infection, but the CD8+ T-cells in the brain remain at low levels as parasitemia levels drop, moving from acute to chronic [22]. When *T. gondii* tachyzoites reaches the nervous system it can infect a range of brain cells in the cerebellum, which control signalling pathways and signal transduction mechanisms involved in a variety of tasks including cell death, immune cell maturation, and antimicrobial effector functions causing impairment in their communications, loss of co-ordination and consequent behaviour disturbance [23]. These behavioural changes may be caused by manipulation activity of the parasite aiming to increase the probability of its transmission from an intermediate to a definitive host [24]. The CD8+ T-cells play a critical role in *T. gondii* defence immunity, which will consequently, be apoptosed. Infectious agents can cause psychosis both directly, by affecting neurons and brain structures, and indirectly, by the activation of a microbe-specific immune response and the subsequent release of neurotoxic factors [25,26].

Children	Number of IgG (+)	Number of IgM (+)
Healthy Children (n=15)	1 (6.67)	0 (0%)
Autistic children (n=30)	4 (13.3%)	1 (3.33%)

Table 1: A comparison between normal and autistic children of *T. gondii* infection.

This result is consistent with many other previous researches [27-29]. There is a significant relationship between maternal infection

in the first months of pregnancy and its effect on the foetal central nervous system, abortion and autistic behaviours in their infants.

Conclusion

The hygienic measurements are important in avoiding any unexpected exposure to *T. gondii* which leads to toxoplasmosis that can cause personality and behavioural changes in chronically infected people, including slower reaction times and psychomotor performance, a lower intelligence quotient, and aggression/ impulsivity traits as well as autism.

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