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# Latent Toxoplasmosis and the Involvement in Road Traffic Accidents among a Sample of Jordanian Drivers

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**Abstract:** Road traffic accidents are considered significant problems on global level and associated with economic and social impacts. The relationship between latent toxoplasmosis and the involvement of road traffic accidents has received much attention by researchers and scientists all over the world. The objectives of the present study were to assess the prevalence of *T. gondii* IgG among the drivers involved in road traffic accidents and to examine the possible association between latent toxoplasmosis and the involvement of road traffic accidents. The study participants involved 13 persons who were arrested for being involved in road traffic accidents. A cross-sectional design was employed. A total of 200 participants from normal population were involved as a control group to compare *T. gondii* IgG of drivers. A questionnaire was constructed to collect data from all participants. A blood sample was withdrawn from each participant to assay *T. gondii* IgG and IgM. Study findings showed that prevalence of *T. gondii* IgG was 15.4% in study group and 12% in control group. The association of seroprevalance of *T. gondii* IgG between study and control groups was lacked ($p = 0.828$). On the other hand, there was a significant association between level of 0 IgG in both study and control groups ($p = 0.009$). All participants in study group were negative for *T. gondii* IgG. As a conclusion, The results of this study did not show a significant relationship between the seroprevalence of *T. gondii* IgG and the involvement of road traffic accidents whereas the level of *T. gondii* IgG was varied significantly between study and control group ($p = 0.009$). The researchers recommend to conduct more studies regarding latent toxoplasmosis with larger size and to involve both groups of drivers and victims. We also recommend to monitor all involved persons for positivity of RhD.

**Key words:** Road traffic accidents, latent toxoplasmosis, *T. gondii* IgG, *T. gondii* IgM, Jordan

## INTRODUCTION

Road traffic accidents have global impacts from social and economic aspects. Resulting injuries are considered as a cause of economic loss to victims and their families as well as their nations. Such economic loss is due to several aspects including the cost of treatment and decreased productivity associated with lacking productive persons either killed or became disabled. The impacts of road traffic accidents put a challenge on scientists to investigate whether biological factors may participate in the incidence of these accidents including latent toxoplasmosis.

Toxoplasmosis is caused by the obligate intracellular apicomplexan parasite *Toxoplasma gondii*. It causes tissue destruction to facilitate lytic parasite growth (Blader *et al*., 2015). From a clinical point of view, human toxoplasmosis has been shown to be asymptomatic in the majority inhabitants (Yolken and Torrey, 2008). Other studies pointed to changes in personality among infected people with latent toxoplasmosis (Flegr *et al*., 1996, 2000).

Flegr and Dama (2014) conducted a study to collect large volume of data regarding the seroprevalence of toxoplasmosis and to assess its roles in traffic accident-related deaths and disabilities in 87 countries. The results showed a significant relation of *T. gondi* is eroprevalence and traffic accident related disabilities. When researchers used regression to exclude the effects of confounding factors, the researchers observed the lack of this correlation. Furthermore, the prevalence of RhD negativity when was included with toxoplasmosis, the relationship was restored again. Taken together, the researchers concluded that asymptomatic latent toxoplasmosis has influences on public health.

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Ramirez *et al*. (2013a) conducted a study to explore the prevalence of anti-*Toxoplasma gondii* antibodies associated with traffic accidents in drivers from the metropolitan Guadalajara. Study participants included 159 drivers who were involved in traffic accidents and in 164 control drivers who had never been involved in accidents. Study findings did not show a significant relationship between the frequency of latent toxoplasmosis in study and control groups ($p = 0.70$). the findings showed that the titer of *T. gondii* IgG was significantly higher among traffic accident drivers than in controls ($p = 0.037$).

Kocazeybek *et al*. (2009) conducted a study to determine the prevalence of the latent toxoplasmosis among drivers who were either injured or died in traffic accidents in Istanbul and its suburbs. The researchers conducted their study because of the existence of the information that drivers who have latent toxoplasmosis have deteriorated reflexes as a consequence the parasitic cysts. These reflexes are deteriorated because the cysts induce changes in levels of neurotransmitters including the level of dopamine in the brain which, in turn, increases the response time of muscle and impacts the personality profile. Study sample included 218 (89.7%) non-fatal, 25 (10.3%) fatal cases. Control group included 191 (95.5%) male and 9 (4.5%) female subjects who had a traffic accident before but no history of toxoplasmosis were studied. Study findings showed a significant relationship between latent toxoplasmosis and traffic accidents ($p<0.0001$). Taken together, latent toxoplasmosis among drivers may increase the risk of being involved in traffic accidents.

Flegr *et al*. (2009) conducted a study to investigate the increased incidence of traffic accidents and for protective effect of RhD positivity in 3890 military drivers. Study findings showed that there was increased risk of traffic accidents in persons with latent toxoplamosis. The results also showed that there was a strong protective effect of RhD positivity against the risk of traffic accidents posed by latent toxoplasmosis.

Flegr *et al*. (2002) conducted a study to compare the seroprevalence of toxoplasmosis in persons injured in traffic accidents with the seroprevalence of toxoplasmosis in general population living in the same area. Study sample included 146 persons involved in traffic accidents and 446 persons from normal populations. Study findings showed a significant difference in seroprevalence between those in traffic accident and control group from general population ($p<0.0001$).

**Study objectives:** We conducted this study to assess the frequency of *T. gondii* IgG and IgM among drivers involved in road traffic accidents and to explore the association of latent toxoplasmosis with the involvement of road traffic accidents.

## MATERIALS AND METHODS

**Study design:** This was a cross-sectional study to collect data from a selected sample of inmates in the Correctional and Rehabilitation Centers in Jordan who were arrested on road traffic accidents related events.

**Study setting:** The current study was conducted in the Correctional Rehabilitation Centers CRC in Jordan.

**Study sample:** Study Sample included 13 males involved in road traffic accidents.

**Study procedure:** We obtained the approval to conduct this study from the Institutional Review Board of Jordan University of Science and Technology and Public Security Directorate. Participants were invited to participate in the study and after their verbal approval they were selected and asked to signing a consent form.

Interested participants received a summary about the study and their rights to participate voluntary without any obligations or threatens and they have the right to withdraw from the study without being exposed to any adverse reaction. Participants were informed that their names will not be written and their data will not be accessed by any person except the research team. After that, participants filled the study questionnaire which included paragraphs for demographic variables and other paragraphs concerning their incidences. A blood sample was collected from each participant to assess for *T. gondii* IgG and IgM. Each participant was coded to seal his identity and this code was used for his descriptive data and blood sample.

**Assessment of toxoplasmosis:** Blood samples were tested for the positivity of IgM and IgG against *T. gondii* using ELISA technique. Standardized cutoff points for seropostivity were:

- IgM: Negative in range of 0-0.9; positive > 0.9
- IgG: Negative in range of 0-2.9; positive >2.9

Control group included 200 participants from normal population.

## RESULTS AND DISCUSSION

**General characteristics of study participants:** As shown in Table 1, study included 13 participants of whom the mean age was 32.92+7.45 years, annual income was 6800 +11870 JD. About 39% of them were arrested, about 23% of incidences occurred in the street. Out of 13 participants, 12 (92.3%) were Jordanians. About 62% of participants were married and about 69% had children. The majority of participants had low educational level secondary (61.5%) and primary (15.4%). Almost more than half of participants had jobs during the incidence.

**Frequency and distribution of *T. gondii* IgG and IgM among study participants:** As shown in Table 2, 2 participants (15.4%) out of 13 were positive for *T. gondii* IgG and all participants (100%) were negative for *T. gondii* IgM. Among control group (N = 200), 12% were positive for *T. gondii* IgG and 9% were positive for *T. gondii* IgM.

**The levels of *T. gondii* IgG and IgM for test group and control group:** As shown in Table 3, the level of *T. gondii* IgG in study group was 3.19+5.85 and that for control group was 1.98+1.14. On the other hand, the level of *T. gondii* IgM in study group was 0.29+0.14 and that for control group was 0.41+0.27.

**The relationship between levels of *T. gondii* IgG and IgM between study and control groups:** As shown in Table 4, we examined the effect of latent toxiplasmosis on road traffic accidents using t independent test. The results indicated the existence of positive association between study and control group (p = 0.009). No positive association was found between the level of *T. gondii* IgM between study and control groups (p = 0.516).

**The relationship between the frequency of *T. gondii* IgG and IgM and study variables:** As shown in Table 5, using Chi-Square test, we examined possible relationships between *T. gondii* IgG and IgM and study variables. The results did not show any significant relationship between *T. gondii* IgG and study variables (p>0.05 for all variables). On the other hand, the results for *T. gondii* IgM could not be established because all cases were negative.

Road traffic accidents are considered very important on global level and associated with economic loss either in the form of lacking people and their therapeutic cost

Table 1: General characteristics of study participants (N = 13)

| Variables | Values (N, %) |
|---|---|
| Age (M±SD) | 32.92±7.45 |
| Annual income (M±SD) (JD) | 6800 +11870 |
| **Gender** | |
| Males | 13 (100) |
| Females | 0 (0) |
| **Sentencing** | |
| Arrested | 5 (38.5) |
| Condemned | 1 (7.7) |
| Missing | 7 (53.8) |
| **Place of incidence** | |
| Work | 1 (7.7) |
| Street | 3 (23.1) |
| Missing | 9 (69.2) |
| **Nationality** | |
| Jordanian | 12 (92.3) |
| Non-Jordanian | 1 (7.7) |
| **Marital status** | |
| Married | 8 (61.5) |
| Single | 4(30.8) |
| Divorced | 1 (7.7) |
| **Having children** | |
| Yes | 9 (69.2) |
| No | 4 (30.8) |
| **Educational level** | |
| Primary | 2 (15.4) |
| Secondary | 8 (61.5) |
| Diploma | 2 (15.4) |
| Missing | 1 (7.7) |
| **Having work during incidence** | |
| Yes | 7 (53.8) |
| No | 2 (15.4) |
| Missing | 4 (30.8) |

Table 2: Frequency and distribution of *T. gondii* IgG and IgM among study participants

| Variables | Values (N, %) |
|---|---|
| **IgG (test)** | |
| Positive | 2 (15.4%) |
| Negative | 11 (84.6%) |
| **IgM (test)** | |
| Positive | 0 (0.0%) |
| Negative | 13 (100%) |
| **IgG (control)** | |
| Positive | 24 (12%) |
| Negative | 176 (88%) |
| **IgM (control)** | |
| Positive | 18 (9%) |
| Negative | 182 (91%) |

Table 3: The levels of *T. gondii* IgG and IgM for test group and control group

| Variables | Mean | SD |
|---|---|---|
| IgG-study | 3.19 | 5.85 |
| IgG-control | 1.98 | 1.14 |
| IgM-Study | 0.29 | 0.14 |
| IgM-control | 0.41 | 0.27 |

Table 4: The relationship between levels of *T. gondii* IgG and IgM between study and control groups (independent t-test)

| Variables | Sum of squares | df | Mean square | F-value | p-values |
|---|---|---|---|---|---|
| IgG-testIgG-control | 411.349 | 11 | 37.40 | 7189 | 0.009 |
| IgM-testIgM-control | 0.223 | 11 | 0.2 | 1.91 | 0.516 |

Table 5: The relationship between the frequency of *T. gondii* IgG and IgM and study variables (chi-square test)

| Variable | IgG (p-value) | IgM (p-value) |
|---|---|---|
| Sentence | 0.624 | - |
| Nationality | 0.657 | - |
| Marital status | 0.772 | - |
| Having children | 0.522 | - |
| Place of incidence | - | - |
| Educational level | 0.549 | - |
| Working during incidence | 0.391 | - |
| Age | 0.299 | - |
| IgG-control | 0.828 | - |

(WHO, 2015). This problem has led scientist and researchers to think of biological roles as possible causes of road traffic accidents. Of these biological aspects is the infection of toxoplasmosis (Flegr *et al*., 1996; Blader *et al*., 2015).

The relationship between latent toxoplasmosis and involvement of road traffic accidents is not well established and variations in the outcomes of studies have put challenges on scientists to conduct more studies. In the light of these variations, we conducted this study to assess the frequency of latent toxoplasmosis and the involvement of road traffic accidents.

The results of the present study showed that the frequency of *T. gondii* IgG was 15.4% which was slightly higher than that of control group 12%. No significant association was found between the seroprevalence of *T. gondii* IgG and the involvement of road traffic accidents ($p = 0.828$). As mentioned above, the relationship of seroprevalence of *T. gondii* IgG and the involvement of road traffic accidents is varied among studies. Some studies pointed to a strong relationship between latent toxoplasmosis and the involvement of road traffic accidents (Flegr *et al*., 2002; 2009; Kocazeybek *et al*., 2009). Our results support other studies that showed the lack of association between latent toxoplasmosis and the involvement of road traffic accidents (Ramirez *et al*., 2013b; Flegr and Dama, 2014).

When the level (titer) of *T. gondii* IgG is compared between study and control group, a significant association was obtained ($p = 0.009$). This finding supports the biological role of *T. gondii* in the involvement of road traffic accidents. We agree with the findings by Ramirez *et al.* (2013) who reported that there was no association between latent toxoplasmosis and the involvement of road traffic accidents ($p = 0.70$) whereas the titer of *T. gondii* IgG between study and control group was significant ($p = 0.037$).

## CONCLUSION

The results of this study did not show a significant relationship between the seroprevalence of *T. gondii* IgG and the involvement of road traffic accidents, whereas the level of *T. gondii* IgG was varied significantly between study and control group ($p = 0.009$).

## RECOMMENDATIONS

We recommend to conduct more studies regarding latent toxoplasmosis with larger size and to involve both groups of drivers and victims. We also recommend to monitor all involved persons for positivity of RhD.

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