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Survey of toxoplasmosis, blood type, hematology, pregnancy and abortion in outpatient women.

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ABSTRACT

Hanoush Al-Fahdawi NH, Salih Al-Aloosi TA., Survey of toxoplasmosis, blood type, hematology, pregnancy and abortion in outpatient women Onl J Vet Res., 23 (7):666-674, 2019. Authors surveyed toxoplasmosis, blood types and hematology in 120, 15-48 year old women outpatients from various hospitals in Iraq from October 2016 to January 2017. Blood samples were typed and *Toxoplasma gondii* diagnosed by ELISA. We found overall incidence of 56.6% and no relation with age or locality. Those with 3 abortions were 91% positive to *T Gondii,* first trimester with abortion 60%. blood group B ~46% and group O ~31%. We found differences ($P < 0.03$) in differential count of leukocytes, PCV and MCHc but none with Hb, PLT, RBC and MCH between patients and controls.

Key Words: toxoplasmosis, blood types, hematology,m pregnancy, abortion, women.

INTRODUCTION

Toxoplasma gondii an obligate intracellular parasite induces a wide range of clinical symptoms related to immune status of patient (Norouzi et al., 2017; Olaniyan et al., 2019). (Smith, 2007). Toxoplasmosis causes abortion, congenital defects and blindness in acute or chronic forms (William and Demure, 2000). *T. gondii* can be carried by birds, mammals, and humans) (Dubey et al, 2007). In humans acute infection occurs by ingestion of parasite eggs (Al-Wattari, 2005) and tachyzoites in epithelial cells spread through blood and lymph and reach other tissues where they divide every 5-12 hours (Othman, 2004). Sixteen to 32 parasites can destroy host cells and in the chronic stage form cysts in brain,

retina, heart muscle and other muscles and are not readily visualized (Olaniyan et al., 2019. Robert-Gangneux and Dardé, (2012) found that chronic infection induces cellular immunity sufficient to break the cyst. Congenital toxoplasmosis may involve eyes, brain, kidneys, heart, liver, blood or spleen of offspring causing long term blindness, seizures, cerebral palsy, mental retardation and deafness (Jones, 2001).

Filisetti and Candolfi, (2004) reported that natural killer (NK) cells, macrophage and cytokines induce innate immunity against *T. gondii*. In the acute stages macrophages phagositize *T. gondii* (Wilson *et al*., 2008). We surveyed 120 outpatient women suspect with toxoplasmosis for presence of *T goondi* and possible correlations with blood type, hematology, pregnancy and abortion. Blood samples were taken from 60 normal women for comparison.

MATERIALS AND METHODS

Blood was taken from 120 women with a history of abortion and suspected toxoplasmosis and 60 healthy women aged 15-48 years. The samples were taken October 2016 to January 2017 at Obstetrics and Gynecology, Al-Nuaman hospital, Baghdad and The Teaching Al-Ramadi Hospital for Children and Gynecology, Iraq. Before collections, name, age, residency, occupation and number of abortions were recorded. Radial vein 2ml blood was taken in EDTA tubes for hematology (Henry and Davidson, 1974, Sood 1985) and 3ml serum for ELISA for toxoplasmosis (Engvall and Perlmann, 1971; Remington and Klein, 1976). Blood groups (Anti A, B and Anti-D slide tests were done as described by Issitt, (1985) and Anti- A, B, A+B and anti-D with a kit (Spinreact, Spain). Statistical diffreneces between means were determined by ANOVA and Duncan's multiple tests ($P < 0.05$) (Leech et al., 2011).

RESULTS

Results are shown below in Tables 1-9

Table 1. *T. gondii* and abortion.

Abortions	Patients		
	Tested	*T gondii*	%
None	32	13	40.6^{cd}
1	30	15	50^{c}
2	27	14	51.8^{c}
3	12	11	91.6^{a}
≥4	19	15	78.9^{ab}
Total	120	68	37.7
P < 0.004			

*different letters (a,b..ect) significant difference at P ≤0.05

Table 2. *T gondii* and trimester of pregnancy.

Pregnancy		Patients		
		Tested	*T Gondii*	%
Trimester of pregnancy	3 months	60	36	60[a]
	6 months	36	19	52.7[b]
	9 months	24	13	54.1[b]
	Total	120	68	37.7
	P < 0.002			

*different letters significant difference (P ≤ 0.05).

Table 3. Toxoplasmosis and blood group types.

		Patients						
		Tested	*T Goondii*	%		Tested	*T gondii*	%
Blood group	A	45	18	40[ab]	A+	26	11	42.3[b]
					A-	19	7	36.8[c]
	B	39	18	46.1[a]	B+	21	8	38[bc]
					B-	18	10	55.5[a]
	AB	34	13	38.2[b]	AB+	20	6	30[cd]
					AB-	14	7	50[ab]
	O	62	19	30.6[bc]	O+	43	12	27.9[d]
					O-	19	7	36.8[c]
Total		180	68	37.7		180	68	37.7
P value 0.035								

*Different letters significant difference (P ≤ 0.05).

Table 4. Mean ± SD hematology in women with or without *T gondii.*

Group		RBC 10^6/µL	PCV %	MCV fL/RBC	PLT 10^3/µL	Hb g/dL	MCH pg/RBC	MCHc g/dL
Pregnant controls	30	4.30±.39[a]	34.91±4.74[b]	81.59±7.37[a]	260.14±75.32[a]	11.85 ± 2.04[a]	27.74±3.75[a]	33.78±2.04ab
Healthy controls	30	4.64±.46[a]	39.11±2.82[a]	84.75±6.41[a]	200.94±88.73[a]	12.94 ± 1.32[a]	28.27±2.94[a]	33.24±1.62[ab]
Infected with IgG	29	4.47±.97[a]	39.06±5.34[a]	90.3±7.6[a]	249.80±56.32[a]	12.81 ± 2.33[a]	28.25±1.75[a]	32.10±3.25[b]
Uninfected abortive	42	4.48±.43[a]	37.45±3.93[ab]	85.14±7.91[a]	226.58±77.76[a]	12.33 ±1.70[a]	28.02±3.61[a]	32.85±1.99[ab]
Infected with IgM & IgG	23	4.31±.41[a]	37.47±4.89[ab]	87.64±5.64[a]	248.91±45.96[a]	12.96 ±1.79[a]	30.39±2.16[a]	34.35±1.52[a]
Infected with IgM	26	4.59±.36[a]	39.38±3.90[a]	85.13±5.89[a]	254.00±81.28[a]	12.57 ±1.28[a]	28.40±3.27[a]	32.71±1.64[ab]
Total	180	4.47± .50	37.76±4.28	180.47±941.	234.34±76.15	12.52 ±1.73	28.35±3.21	33.13±2.06

*Different letters significant difference (P ≤ 0.05).

Table 5. Mean ± SD total and differential WBC (%) in women with or without *T goondi*.

Group	N.	White cells *10^3/µL	Neutrophils	Eosinophils	Basophils	Lymphocytes	Monocytes
Pregnant controls	30	9.78±2.44[ac]	68.23±5.83[b]	1.71±0.97[a]	1.05±1.84[a]	23.44± 5.34[b]	5.14±1.25ac
Healthy controls	30	6.80±1.57[b]	47.07±17.17[a]	2.60±3.67[a]	2.09± 77.42[a]	32.46± 12.91[a]	5.97±2.57[ab]
Infected with IgG	29	10.19±3.32[a]	70.53±9.74[b]	1.76± 1.46[a]	.87± .71[a]	20.84± 9.11[b]	4.25±1.61[c]
Uninfected abortive	42	9.10±2.80[ac]	67.81±11.23[b]	2.06±1.72[a]	.77± .42[a]	23.57±9.77[b]	5.77±1.65[abc]
Infected with IgM & IgG	23	10.27±2.77[a]	70.62±6.05[b]	2.03±1.36[a]	.56±.25[a]	21.77±4.91[b]	5.03±1.32[ac]
Infected with IgM	26	7.96±2.46[bc]	64.24±10.99[b]	1.60±1.35[a]	.83± .32[a]	27.18±9.40[ab]	7.02±2.27[b]
Total	180	8.90±2.79	64.29±13.95	2.03±2.05	5.82± 34.12	25.07±9.99	5.60±1.93

*Different letters significant difference (P ≤ 0.05).

Table 6. Incidence of Toxoplasma in women by age.

Patients			
Age.	Tested	Positive	%
< 20	30	12	40.0[ab]
20-29	62	27	43.5[a]
30-39	47	17	36.1[b]
≥ 40	41	12	29.2[c]
Total	180	68	37.7
P value 0.008			

*Different letters significant difference (P ≤ 0.05).

DISCUSSION

Table 1 lists toxoplasmosis and number of abortions showing that women with 3 or more abortions 91.6% tested positive and with 1 to 2 ~50% and none 40.6% (P < 0.05). Al-Hussien (2016) found that women with high IgM levels could suffer 3 or more miscarriages (10.71%) compared with other groups. Kreem, (2012) reported high incidence (80.6%) in women with single or repeated abortions. In Jordan, Abu-Madi et al., (2010) found that women with 3 to 7 miscarriages were twice as likely to test seropositive for *T. gondii* compared with women with normal pregnancies. In contrast, Saif *et al*., (2014) reports that women with 1 abortion had higher anti-toxoplasma antibodies when not pregnant (46.15 %) or pregnant (50%). Othman, (2004) also found that higher seropositive in pregnant women with history of one abortion (55.17%) compared with 2-4 (50%) or 5-8 (33.33%). We surmise that higher incidence occurred in women with 3 abortions as they may be infected before the first pregnancy, as well as 2nd and 3rd time after abortion and do not get tested for treatment (Karem, 2007; Kreem, 2012).

We found similar incidence (~53-60%) for toxoplasma during all trimesters (Table 2). Our results contrast with Al-Ubbyde, (2004) who reported 76% or Al-Azawi, (2015) 73.6% during the 1st trimester. During the 3rd trimester, Al-Hussein et al., (2016) reported ~88% but Sefah-Boakye, (2015) only 9.73% and Al-Hussien et al, (2016) only 11.4% and 1.3% in 2nd and 3rd trimesters. Norouzi *et al.,* 2017) reported significant association between seropositivity and 2nd trimester, a finding replicated by Al-khafaji *et al.,* (2011). Al-Azawi, (2015) maintains that toxoplasmosis is more severe during the 1st months of pregnancy since 10-20% fetuses may be infected inducing spontaneous abortions. According to Al-Hussien et al., (2016), in most cases, women abort at end of 1st trimester or beginning of the 2nd

Results on Table 3 suggest highest prevalence of *T gondii* in women with blood group B (46.1%) and lowest with O type (30.6%) (p<0.05) with B- 55.5% and O+ and AB+ only 27.9% and 30%. AL-Taei, (2015) found 37% in patients with B type and lowest in type AB. AL-Ghezy, (2012) found 32-35% type B or 0 incidence in women with toxoplasma that had aborted. Al-Shikhly (2010) reported 30.6% in females with B type. Abdullhussein, (2017) found that AB blood types has high seropositivity to anti-*Toxoplasma* Abs. Kolbekova,

(2007) suggested a relationship between ABO groups and anti-T. gondii antibodies. AL-Taei, (2015) maintained that antigen B on RBC surface may be a receptor for *T. gondii.*

Our findings showed no differences in RBC, PCV, MCV, Hb, MCH or platelets between any cohort (Tables 4) However we did find higher (P ≤0.05) MCHC in infected women with IgM & IgG (34.35±1.52) but lower in infected women with IgG (32.10±3.25) compared with other groups. Generally Hb was higher in controls (12.94 ± 1.32g/L) but lower in healthy pregnant women (11.85 ± 2.04g/L). Ali, (2011) reported no differences in RBC but found reduced PCV in pregnant or aborting women. Al-Jabiry, (2010) reported reduced RBCs, Hb, PCV during 3rd trimester compared with non-pregnant women. Al- Abaas *et al*., (2015) found decreased Hb and RBCs in patients with *T gondii*. Al - Delamy, found no effect on platelets. Hematology might not change in pregnant infected women with toxoplasmosis as (Husain and Abdulatef, 2014). Possibly reduced Hb in infected women may be due to iron loss (Javadj et al., 2010).

As expected, we found increased WBC in infected women (Table 5) with ~10 10^3/µL in IgG and IgG & IgM compared with controls ~7 10^3/µL or women infected with IgM 7.96±2.46 10^3/µL). Lymphocytes were higher (P 0.05) in controls (32.46±12.91) and infected women with IgM was (27.18±9.40*%*) whereas monocytes were increased in infected women IgM (7.02±2.27%) but lower in infected women with IgG (4.25±1.61%) compared with others groups. Neutrophils were higher in controls (47.07± 17.17) compared with other groups of women but we found no differences with basophil and eosinophils.

Al-Abaas *et al*., (2015) and Al-Ghezy, (2012) reported similar findings with WBCs in patients with *Toxoplasma gondii* compared with controls. Ajeel, (2012), however reported reduced WBC but in infected rats. In the main, most authors found little or no differences in WBC, lymphocyte, basophils, eosinophils, monocyte, neutrophils between *T gondii* patients and controls (Al-Delamy, 2002; Al-Mosawi, 2014). We expected an increase in WBC, IgM and IgG to be induced by infection by T. gondii, as reported by others (Al- Abaas *et al*., 2015) and (Al-Ghezy, 2012). In chronic infections, tachyzoites do not replicate and cysts may not elicit immunity, symptoms or changes in WBC (Al-Jabiry, 2010).

We found most infection in 20-29 year olds accounting for 43.5% and least in those 40 or older (Table 6). Our results replicate those of Al-Ghezy, (2012); Al- Dahmoshi *et al*., (2013); Sefah-Boakye, (2015); Imam *et al*., (2016); Al-Hussien *et al*., (2016) and (Norouzi *et al*., (2017) in Iraq. Mohammadi *et al*., (2015) reported highest incidence in 28-33 year olds, but no significant differences amongst them whereas Kreem, (2012) at 40-49 years. Prevalence of *T. gondii* may increase with age (Matowicka-Karna *et al*., 2009). In our study, the high prevalence in young adult women, may be due to frequent exposure to infective stages of the parasite (Imam *et al*., 2016). We found no differences in *T gondii* infection between rural or urban women (both ~38%). Similar findings have been published (Othman, 2004); (A'aiz, 2010); Al-(Saadii, 2013); (Darweesh *et al*., 2018).

REFERENCES

A'aiz, N.N. (2010). Genotyping Analysis To Determine The Lineages Types Of *Toxoplasma gondii* With Study Of Autoantibodies Production. Ph. Thesis. College of Science. University of Kuffa. Iraq.

Abbas, S. K. (2005). Histopathological and Immunological studies for Umblical cord & Placenta in Toxoplasmosis In Fected Women. Ph. Thesis. College of Science. Al-Mustansiriyah University. Iraq.

Abdullhussein, H. S. (2017). Serological and Immunological Study of Toxoplasmosis in Heart Disease Patients. M.Sc. Thesis. College of Science. University of Thi Qar. Iraq.

Abu-Madi, M.A., Behnke, J.M. and Dabritz, H.A., 2010. Toxoplasma gondii seropositivity and co-infection with TORCH pathogens in high-risk patients from Qatar. *The American journal of tropical medicine and hygiene*, *82*(4), pp.626-633.

Al-khafaji, A. A., Al-Hilaly, H. A., & Al-Shimmery, M. N. (2011). Seroprevalence of cytomegalovirus and toxoplasmosis in cases of miscarriages women in Al-Diwaniyah province. *Al-Qadisiah Medical Journal*, *7*(11), 160-168

Ajeel, N. F. (2012). Modulation of the Immune Response in Swiss White Mice Infected with Experimental Toxoplasma gondii by the Lipopolysaccharide Extracted From Escherichia coli and studying its Effect on Different tissue organs. PhD. Thesis. College of Education. University of Tikrit. Iraq.

Al - Delamy , L. H.(2002). Epidemiological , immunological and pathological study on the parasite causing toxoplasmosis in females of ninevah governorate and follow- up study on the effect of some drugs on patents. M. Sc. Thesis. The College of Science. University of Mosul. Iraq.

Al- Abaas, H. A., Al- Abaas, M. KH., Al- Abaas, S. KH., & Mutab, A. KH. (2015). Mesurment of IgG& IgM and some hematology parameters in infected women with toxoplasma I Al-Najaf City. Jornal of Babal university, 23(1), 454-460.

Al- Dahmoshi, H. O., Al-Mammori, R. T., ShareefHasanain, K. I., & Al-Khafagee Noor, S. K. (2013). Study of IL-8 and IL-17 levels among certain group of Repeated Spontaneous Abortion Women with or without Toxoplasmosis, Iraq. *International Research Journal of Biological Sciences*, *2*(8), 37-41

Al- Nasiri A.R. & Daoud, I.S. (2011). The changes in some haematological tests among women infected with Toxoplasma gondii in Baji / Salahaldin Province. Tikrit University of Pure Sciences, *17*(3):34-37.

Al-Azawi, N.S.(2015). A THESIS SUBMITTED TO THE COLLEGE COUNCIL OF SCIENCE, UNIVERCITY OF TIKRIT AS PARTIAL FULFILLMENT OF TH REQUIREMENTS FOR THE DEGREE OF PROFESSOR DECTORATE

Al-Ghezy S.J. (2012). Diagnostic study of *Toxoplasma gondii* and Cytomegalovirus in pregnant and aborted Women with some Epidemiological and Immunity parametery in Thi-Qar Province-Iraq. Thesis College of Education of pure science .University of Thi-Qar.Iraq.p150

Al-Hussien, E. F. A., Nassir, N. F., & Kadhim, A. (2016). Study of Prevalence and Some Immunological Characteristics of Toxoplasma gondii Infections in Pregnant Women. *Journal of University of Babylon*, *24*(2), 526-533

Ali, A.H. (2011). Study of physiological and biochemical parameters in blood and amniotic fluid in pregnant women at delivery in Tiktit city. M.Sc. Thesis. College of Science. Tikrit University. Iraq.

Al-Jabiry, A.A. (2010). Study of Hematological ,Biochemical Parameters and Oxidant-Antioxidant Status of Pregnant Women in Thi-Qar Governorate. M. Sc. Thesis. College of Education. Thi-Qar University. Iraq.

Al-Kaysi, A. M and N. M. Ali, (2010). Serological and biochemical study of HB, HC, HIV and toxoplasmosis infection among blood donors in Iraq.Egypt J. Comp. Path. and Clinic, Path. 23(1) :1-9.

AL-Mosawi, R. A. (2014). Diagnostic and epidemiological study of *T.gondii* for student of Thi –Qar university by ELISA and Real- Time PCR techniques M.Sc. Thesis. College of Science. *University of Baghdad.Iraq.*

Al-Musawy, I. M. J. Z. (2015). Detection of Toxoplasma gondii among women at Babylon governorate. *Journal of University of Babylon*, *23*(2), 610-616

Al-Saadii, S.H.M. (2013). The effect of toxoplasmosis on the level of some male sex hormones in samples from National blood center/Baghdad. M.Sc. Thesis. College of Science. *University of Baghdad*. Iraq.

AL-Taei, N. H. (2015). Serological and immunological study to the prevalence of Toxoplasmosis among sewage workers, farm workers and sellers of fruits and vegetables in Thi-Qar province – Iraq. MSc. Thesis. College of Sciences. Thi-Qar University. Iraq.

AL-Ubbyde, G. T. (2004). *Toxoplasmosis is in pregnant women and its relastion with some parameters in* nenavah governarate. M.Sc. Thesis. College of Sciences. University of Mosul. Iraq.

Atmaca, N., ÇinarM, G.B., KabkÇli, R., GazyaĞci, A.N., Atmaca, H.T. and Canpolat, S. (2015). Evaluation of oxidative stress, hematological and biochemical parameters during Toxoplasma gondii infection in gerbils. Ankara Üniv Vet FakDerg. 62:165-170.

Cook, A. J. C.; Gilbert, R. E.; Buffolano, W. (2000). Source of *Toxoplasma* infection in pregnant women: European multicentre case control study. Br. Med. J., 321:142-147.

Darweesh, N. H., Hussein, R. A., Salman, S. T., & Shaker, M. J. (2018). Immunological and Molecular study of Toxoplasma gondii from aborted women in Diyala/Iraq. *Sci. J. Med. Res*, *2*(6), 75-82

Dubey, J. P. (2007). The History and life cycle of *Toxoplasma gondii*. In Weiss, L. M. and Kim, K. *Toxoplasma gondii*, 1nd edn. Elsevier, London.: 777pp.

Filisetti, D. and Candolfi, E. (2004). Immune response to *Toxoplasma gondii*. Ann 1st super sanita 40(1):71-80.

Franco, R.S., Puchulu-Campanella, M.E., Barber, L.A., Palascak, M.B., Joiner, C.H., Low, P.S. and Cohen, R.M. (2013). Changes in the properties of normal human red blood cells during in vivo aging. Am J hematol. 88(1):44-51.

Gürkan, E., Başlamişli, F., Güvenç, B., Bozkurt, B., & Ünsal, Ç. (2003). Immune thrombocytopenic purpura associated with Brucella and Toxoplasma infections. *American journal of hematology*, *74*(1), 52-54

Henry, J. B. and Davidson, I. (1974) . Clinical diagnosis by laboratory methods. Saunders Company . London .

Husain, J. H., & Abdulatef, Y. (2014). Seroepidemological study on infected women by Toxoplasma gondii in Al-Ramadi City. *International Journal*, *2*, 343-347.

Imam, N.F., Esra'a, A.A. and Attia, A.A., 2016. Seroprevalence of Toxoplasma gondii among pregnant women in Almadinah Almunawwarah KSA. *Journal of Taibah University Medical Sciences*, *11*(3), pp.255-259.

Jones, C. D.; Okhravi, N.; Adamson, P.; Tasker, S. and Lightman, S. (2000). Comparison of PCR detection methods for B1, P30, and 18s rDNA genes of *T.gondii* in aqueous humor. Invest. Ophthalmol. Vis. Sci., 14(3): 634-644.

Kolbekova P.; E. Kourbatova; M. Novotan and J. Flegr (2007). New and old risk Factors for Toxoplasma gondii infection prospective cross sectional study among military personnel in the Czech Republic.Clin Microbiol Infect, 13(10):1012-1017.

Kreem. S.M., (2012). Seroprevalence of Toxoplasmosis in humans and goats in Al-Hali city. MSc. Thesis. College of Veterinary Medicine. University of Baghdad. Traq.

Mahmood, O.I. (2016). Effect of Toxoplasmosis on hematological, biochemical and immunological parameters in pregnant women in Tikrit city, Iraq. Tikrit J Pure Sci. 21(3): 24-27.

Matowicka-Karna, J., Dymicka-Piekarska, V., & Kemona, H. (2009). Does Toxoplasma gondii infection affect the levels of IgE and cytokines (IL-5, IL-6, IL-10, IL-12, and TNF-alpha)?. *Clinical and Developmental Immunology*, *2009.*

Miller, C.; Boulter, N.; Ikin, R. and Smith, N. (2007). The immunobiology of the innate response to *Toxoplasma gondii*. International Journal for Parasitology, 39 : 23–39.

Mohammadi, A., Shojaee, S., Salimi, M., Zareei, M., Mohebali, M., & Keshavarz, H. (2015). Seroepidemiological study of toxoplasmosis in women referred to Arak Marriage Consulting Center during 2012–2013. *Iranian journal of public health*, *44*(5), 654.

Norouzi, L. Y., Sarkari, B., Asgari, Q., & Khabisi, S. A. (2017). Molecular evaluation and seroprevalence of toxoplasmosis in pregnant women in Fars province, Southern Iran. *Annals of Medical and Health Sciences Research*, *7*(1), 16-19

Olaniyan, M. F., Afolabi, T., & Idume, N. O. (2019). Relationship between parasitic infection of Toxoplasma gondii, IL-2, TNF-α tryptophan and CD4+ count. *Journal of Nature and Science of Medicine*, *2*(2), 64

Othman, N.F.(2004). Seroprevalence study of Toxoplasma gondii among pregnant women in Kirkuk City. MSc. Thesis. College of Medicin. University of Tikrit. Traq.

Robert-Gangneux, F. and Darde, ML. (2012). Epidemiology of and diagnostic strategies for toxoplasmosis. Clin Microbiol Rev; 25(2): 264-296.

Saif, N., Al Ameeri, G., Alhweesh, M., Alkadasi, M., & Zaid, A. A. (2014). Seroprevalence of toxoplasmosis in pregnant women in Taiz-Yemen. *Int J Curr Microbiol App Sci*, *3*, 680-90

Sefah-Boakye, J. (2015). *Seroprevalence of toxoplasma Gondii infection among pregnant women in the Ashanti region of Ghana: evidence from the Manhyia district Hospital, Kumasi*(Doctoral dissertation)

Sood et al .(1981) : The indian journal of path and micro,,24

Williams K (2000) *Toxoplasmosis*.Up to Date INC. www.uptodate.com.

Wilson, D.C.; Matthews, S. and Yap, G.S. (2008). IL-12 signaling drives CD8+ T cell IFN-γ production and differentiation of KLRG1+ effector subpopulations during Toxoplasma gondii Infection. J. Immunol., V. (180): Pp. 5935-5945.

Al-Wattari, I.T.(2005). Seroprevalence of *Toxoplasma gondii* antibodies among unmarried women of childbearing age in Mosul. M.Sc. Thesis. College of Medicine. University of Mosul. Iraq.

Remington, J.S., Klein, J.O., (1976). Infectious disease of the fetus and newborn infant. Sanders, Philadelphia, London, Toronto.

Engvall, E., Perlmann, P., (1971). Immunochemistry 8, 871- 874 .

Leech, N. L., Barrett, K. C. and Morgan, G. A. (2011). IBM SPSS for Intermediate statistics. 4th ed. Taylor and Francis Group . LLC. USA.