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Toxoplasmosis among Pregnant Women in Africa: A Systematic Review and Meta-Analysis

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Abstract

Toxoplasmosis in pregnancy may have serious consequences on the pregnancy outcome. Vertical transmission to the fetus may range from obstetrics complications such as abortion, intrauterine growth restriction, stillbirth to congenital malformations. This review aimed to assess the seroprevalence rate of toxoplasmosis in pregnant women in Africa so that a proper management policy can be initiated. Four databases that include Google Scholar, ScienceDirect, Scopus, and PubMed were searched for primary studies reported on the prevalence of toxoplasmosis among pregnant women in African countries. From the search, total of 39 studies were included for the study from 1980 to 2018. Total of 11986 pregnant women were the study participants in the included studies. By using the DerSimonian-Liard random effects method, the pooled prevalence of toxoplasmosis was estimated as 47% (95%CI=38.4% to 55.4%). Publication bias was assessed using Egger's test, 2.88 (95%CI= -8.8% to 14.5%) and it did not indicate any significant ($P = 0.619$) influence of the studies on the pool estimate. Again, the pooled estimates of toxoplasmosis among pregnant women in first, second and third trimesters were 29% (95% CI= 17.0% to 42.0%), 35.0% (95%CI= 27% - 43%) and 30.9% (95%CI= 22% - 41%), respectively. Pooled prevalence for risk factors such as 'contacts with cat', cat ownership and consumption of raw or poorly cooked meat were estimated at 50% (95% CI= 35% to 66%), 26.2% (95% CI=17.9% to 35.5%) and 43.3% (95% CI = 30% to 50%) respectively. This study estimates the overall prevalence of toxoplasmosis in pregnancy and some possible risk factors through which majority of pregnant women can be infected. Proper screening against this infection should be instituted in full capacity to curb the endemicity and consequences of the infection on the fetus.

Keywords: Toxoplasmosis, Pregnancy, Africa, Systematic review, Meta-analysis

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Toxoplasma gondii is widely spread zoonotic protozoan parasite that causes toxoplasmosis in human with varying degree of severity depending on the immune status of individual. Toxoplasmosis has a global distribution with variation in parasite genotype and or strain in circulation within the community. Up to date, between 30 to 65% of the world population were reported to be affected, though most of them do not show any sign of the disease but its presence constitutes a serious hazard on the health of the individuals (1). Africa is another region worst hit by toxoplasmosis due to its climatic factors and environmental conditions that significantly play a role in the continuous transmission of the parasite. For the past decade, high prevalence of toxoplasmosis was recorded among pregnant women, children, HIV-positive subjects and the general population. However, like other regions, the prevalence also shows a different pattern between the subjects and between and within countries (2). Human and other warm-blooded animals as well as birds are intermediate hosts to *T. gondii* while the feline cats are the definitive hosts.

T. gondii has three parasitic stages that include a rapidly dividing invasive tachyzoite, slowly dividing bradyzoite within a tissue cyst and the sporozoite protected within an oocyst floating in the environment with the potential of contaminating most of the vehicles of transmission such as water, soil, vegetable and fruits (2). The sporulated oocyst is transmitted through contaminated food, water, vegetable, and fruits. The rapidly replicating tachyzoite within the nucleated cells converts to a slowly replicating bradyzoite stage embedded within the deep tissues of the brain, heart muscles, skeletal muscles, retina, and placenta to form a tissue cyst. Therefore, bradyzoite can be transmitted through ingestion of tissue cyst contaminated meat and through placenta to a fetus in-utero and occasionally through organ transplant or blood transfusion (3). Pregnant women are among the high risk groups (4,5) and they can acquire infection through sporulated oocyst due to environmental exposure to soil, consumption of contaminated water, vegetable or fruit and through ingestion of poorly cooked or raw contaminated meat. Depending on the gestational age, immune system and the time frame of the infection, transmission of the replicating tachyzoite through the placenta to the growing fetus occurs with varying degree of consequences (6). Primary infection in a woman while pregnant, within the first or

second-trimester, results in spontaneous abortion, intrauterine growth restriction or stillbirth (3,7) whereas, infection in the third-trimester results in delivery of the normal baby. This is because at an early stage of pregnancy, the transmission of tachyzoites through the placenta in primary infection is less likely, but if it occurs, it is associated with a varying degree of clinical consequences whereas the rate of transmission in the third trimester is over 60.0% (8). This is probably due to strong immune control by the placenta at the early stage of the pregnancy (9).

Infection acquired before conception is not likely to be transmitted to the fetus but vertical transmission can occur in immunocompromised women with chronic *T. gondii* infection, but its prevalence was reported to be low especially if it is being managed with Spiramycin (8). Apart from obstetrics complications and congenital abnormalities that can manifest in the neonate, many congenitally infected newborns are likely to develop severe illnesses such as retinochoroiditis, blindness and mental disorders later in life.

Although, many studies reported the prevalence of toxoplasmosis among pregnant women in various parts of Africa, the current review aims at determining the weighted prevalence in African sub-population of pregnant women in view of possible action by authorities to intensify campaign on preventive measures to minimize mother-to-child transmission and proper management of congenital toxoplasmosis.

Methods

2.1 Search strategy

This systematic review and meta-analysis were designed to evaluate the prevalence of toxoplasmosis among pregnant women in Africa. This study was reported according to the Preferred Reporting Items for Systematic review and Meta-Analyses (PRISMA) guidelines (Figure 1). Published articles that are available online and reported in English were searched from four prominent databases Google Scholar, Science Direct, Scopus, and PubMed. The search identified studies that were published on the prevalence of toxoplasmosis among pregnant women from January 1980 to December 2018. The literature was searched using medical subject headings (MeSH) terms such as "Prevalence", "Seroprevalence", "*Toxoplasma gondii*", "*T. gondii*" "toxoplasmosis", "pregnancy", "Pregnant women", "Antenatal women", "Africa". The terms were used in combination using Boolean operators such as "AND" and "OR".

2.2 Study selection

Published cross-sectional studies based on serological detection of anti-*Toxoplasma gondii* antibodies among pregnant women in Africa were included in this review. All the included articles were reported in English and that contain information about study area and subjects,

Figure 1. Flow chart describing the study processes

sample size, prevalence of toxoplasmosis among pregnant women during antenatal period in different parts of Africa. The searched articles were screened for title and abstract. The full text articles available in literature were considered for eligibility assessment. Out of the 42 full text articles assessed for eligibility, 39 were considered for the review and meta-analysis (Figure 1). The quality of the eligible primary studies (Table 1) was assessed using the Newcastle quality assessment checklist for cross-sectional study (9). The authors discussed and resolved all discrepancies on the exercise.

2.3 Data extraction

All articles assessed for inclusion were studied. Article information such as authors name, publication year, study design, period of the study, sample size, number of participants, prevalence of toxoplasmosis, diagnostic method and country of the study were extracted carefully using Microsoft excel. Data was collected on risk factors for toxoplasmosis such as cat ownership, contact with cats, consumption of raw or poorly cooked meat, consumption of vegetables, source of water and residence of the subjects. Available data on complications such as abortion and stillbirth were collected in this study.

2.4 Statistical analysis

Data from all eligible primary studies were entered into Microsoft Excel then exported into the trial version of StatsDirect statistical software (www.statsdirect.com) to compute the point estimate for each included study. The Forest plot was used to estimate the effect size and confidence interval (CI) for the primary studies and the total seroprevalence. Indices of heterogeneity (I^2 and Cochrane Q statistics, p-value <0.05) were used to assess the heterogeneity between the studies. Publication bias was evaluated using Egger's tests.

Table 1: Assessment of study bias based on Newcastle Ottawa Scale; Maximum score is 5

Study	Country	Selection		Comparability		Outcome		Scores
		Sample Representativene	Sample size	Diagnostic Procedure	Study design	Prevalence	5(+)	
1.	(7)	Ethiopia	+	+	+	+	+	5
2.	(11)	Ethiopia	+	+	+	+	+	5
3.	(12)	Ethiopia	+	+	+	+	+	5
4.	(13)	B/Faso	+	+	+	+	+	5
5.	(14)	DR Congo	+	+	+	+	+	5
6.	(15)	Ethiopia	-	+	+	+	+	4
7.	(16)	Zambia	-	+	+	+	+	4
8.	(17)	Ethiopia	-	+	+	+	+	4
9.	(18)	Ethiopia	+	+	+	+	+	5
10.	(19)	B/Faso	-	+	-	+	+	3
11.	(20)	Rwanda	-	+	+	+	+	4
12.	(21)	Ethiopia	+	+	+	+	+	5
13.	(22)	Nigeria	-	+	-	+	+	3
14.	(23)	Mozambique	-	+	-	+	+	3
15.	(24)	Ethiopia	+	+	+	+	+	5
16.	(25)	Nigeria	-	+	+	+	+	4
17.	(26)	Ethiopia	-	+	+	+	+	5
18.	(27)	Nigeria	-	+	+	+	+	4
19.	(28)	Nigeria	-	+	+	+	+	4
20.	(29)	Nigeria	+	+	+	+	+	5
21.	(30)	B/Faso	-	+	+	+	+	4
22.	(31)	Egypt	+	+	+	+	+	5
23.	(32)	Sudan	-	+	+	+	+	4
24.	(33)	Sao tome	-	+	+	+	+	4
25.	(34)	Nigeria	-	+	+	+	+	4
26.	(35)	Ivory cost	+	+	+	+	+	5
27.	(36)	Tanzania	-	+	+	+	+	4
28.	(37)	Cameroon	-	+	+	+	+	4
29.	(38)	Cameroon	-	+	+	+	+	4
30.	(39)	Nigeria	-	+	+	+	+	4
31.	(40)	Benin	-	+	-	+	+	3
32.	(41)	B/Faso	-	+	-	+	+	3
33.	(42)	Nigeria	-	+	+	+	+	4
34.	(43)	Egypt	-	+	+	+	+	3

3. Results

3.1 Characteristics of the included studies and pooled prevalence of toxoplasmosis among the pregnant women

Of all the 14363 studies searched from the literature, 14299 studies were excluded based on duplicate, language other than English, title and abstract that are not relevant to the research question. Of the 64 abstracts assessed for eligibility, only 42 full-text articles were available and out of which 39 records were eligible for the systematic review and meta-analysis (Figure 1). Table 2 presents the included studies based on the country of the study, sample size, antibody detected (IgG, IgM or both), and estimated prevalence. The total number of pregnant women that participated in the included studies is 11986. The highest number of included studies were from Ethiopia and Nigeria. Of all the included studies, 59% used ELISA for serological detection of anti-toxoplasma antibodies among the

pregnant women. All the included studies reported the IgG⁺ anti-toxoplasma antibody while only 13 studies reported the prevalence of the IgM⁺ antibodies and eight studies reported both IgG⁺ and IgM⁺ antibodies. Among all the included studies, the minimum sample size was 43 subjects from Ethiopia (24) and the maximum sample size was 781 subjects from Democratic Republic of Congo (14). The highest prevalence reported by the included studies was 88.6% by Endris et al (15) from Ethiopia and the lowest prevalence was 12.2% from Rwanda (20).

However, in this study, the weighted estimated prevalence of toxoplasmosis among the pregnant women is 47% (95% CI = 38.4% to 55.4%) using random-effect model (Figure 2.2). The review indicated a heterogeneity (Figure 2.1) among the included studies (I^2 98.9 %, $Q = 3,433$, $df = 38$, $P < 0.0001$). Egger's test, 2.88 (95% CI = -8.8% to 14.5%) revealed no publication bias

Table 2. Characteristics of included studies based on screening method and overall prevalence for each country

	Country	Subjects(n)	IgG+ (n, %)	IgM+ (n, %)	IgG+ and IgM+ (n, %)	Overall prevalence	Method	References
1.	Benin	211	113(53.6%)	--	--	113(53.6%)	ELISA	(40)
2.	Benin	283	85(30.0%)	1(0.4%)	--	86(30.4%)	ELFA	(46)
3.	B/Faso	336	85(25.3%)	--	--	85(25.3%)	ELISA	(41)
4.	B/Faso	316	98(31.1%)	--	--	98(31.1%)	ELISA	(13)
5.	B/Faso	182	37(20.3)	7(3.8)	--	44(24.2)	ELISA	(19)
6.	B/Faso	348	121(34.7%)	--	--	121(34.7%)	ELISA	(30)
7.	Cameroon	110	69(62.7%)	--	3(2.7%)	72(65.5%)	ELISA	(38)
8.	Cameroon	327	254(77.7%)	--	3(0.9%)	257(78.6%)	ELISA	(37)
9.	DR Congo	781	627(80.3%)	17(4.4%)	--	644(84.7%)	ELFA	(14)
10.	DRSTP	499	375(75.2%)	--	--	375(75.2%)	LAT	(33)
11.	Egypt	323	209(64.7%)	--	9(2.8%)	218(67.6%)	ELFA	(31)
12.	Egypt	693	209(30.2)	--	--	209(30.2%)	ELFA	(43)
13.	Ethiopia	232	191 (82.3)	--	7(3.0)	198(85.3)	ELISA	(11)
14.	Ethiopia	384	71(18.5%)	--	--	71 (18.5%)	LAT	(12)
15.	Ethiopia	385	341(88.6%)	--	--	341(88.6%)	LAT	(15)
16.	Ethiopia	288	246(85.4%)	--	--	246(85.4%)	LAT	(17)
17.	Ethiopia	401	96(23.9%)	--	--	96(23.9%)	EIA	(18)
18.	Ethiopia	210	159(75.7%)	--	--	159(75.7%)	LAT	(21)
19.	Ethiopia	201	163(81.1%)	5(2.5%)	--	168(83.6%)	ELISA	(7)
20.	Ethiopia	263	180(68.4%)	--	--	180(68.4%)	LAT	(26)
21.	Ethiopia	43	33(76.7%)	4(9.3%)	--	37(86.0%)	DAT	(24)
22.	Ghana	93	35(37.6%)	--	--	35(37.6%)	ELISA	(47)
23.	Ivory Coast	385	226(58.7%)	--	--	226(58.7%)	ELFA	(35)
24.	Morocco	128	54(42.1%)	--	5(3.9%)	59(46.0%)	ELISA	(48)
25.	Mozambique	150	27(18.0%)	1(0.7%)	--	28(18.7%)	ELISA	(23)
26.	Nigeria	374	109(29.1%)	3(0.8%)	--	112(29.9%)	LAT	(34)
27.	Nigeria	90	20(22.2%)	--	--	20(22.2%)	ELISA	(22)
28.	Nigeria	360	144(40.0%)	26(7.2%)	6(1.7%)	176(48.9%)	ELISA	(44)
29.	Nigeria	391	119(30.4%)	67(17.1%)	--	186(47.6%)	ELISA	(25)
30.	Nigeria	173	48(27.7%)	--	--	48(27.7%)	LAT	(27)
31.	Nigeria	400	112(28.0%)	--	--	112(28.0%)	ELISA	(28)
32.	Nigeria	273	84(30.8%)	9(3.3%)	--	93(34.1%)	ELISA	(42)
33.	Nigeria	377	135(35.8%)	--	--	135(35.8%)	ELISA	(29)
34.	Nigeria	288	123(42.4%)	33(11.5%)	33(11.5)	189(65.6%)	ELISA	(39)
35.	Rwanda	384	37(9.6%)	10(2.6%)	--	47(12.2%)	ELISA	(20)
36.	Sudan	487	166(34.1%)	--	--	166(34.1%)	ELISA	(32)

Note: n= number, %=percentage

($P=0.619$) to influence the pooled estimate of toxoplasmosis.

3.2 Prevalence of toxoplasmosis among pregnant women in different trimesters

Some of the included study reported the stratification of the participants based the trimester. From 23 studies, 3508 pregnant women were within the first trimester. Twenty-one studies had 1367 participants in second trimester while 20 studies had 1351 participants in third trimester. The pooled prevalence of toxoplasmosis for each category of trimester stage was estimated using the random effect analysis. The pooled prevalence

estimates for toxoplasmosis among pregnant women in first trimester was 29.0% (95%CI= 17.0% - 42.0%) the I^2 test indicated high heterogeneity (I^2 98.6 % $Q=1,551$, $df=22$, $P<0.0001$) (Figure 4A and 5A). The pooled prevalence estimates for toxoplasmosis among pregnant women in second trimester was 35.0% (95%CI= 27% - 43%) the I^2 test indicated high heterogeneity (I^2 95.9% $Q=536$, $df=20$, $P<0.0001$) (Figure 3.1 and 3.2). The pooled prevalence estimates for toxoplasmosis among pregnant women in the third trimester was 30.9% (95%CI= 22% - 41%) the I^2 test indicated high heterogeneity (I^2 97.5 % $Q=869$, $df=19$, $P<0.0001$) (Figure 3.1 and 3.2).

Figure 2.1. Forest plot diagram showing the overall seroprevalence of toxoplasmosis among pregnant women in Africa.

Figure 2.2. Funnel plot indicating the heterogeneity of the included studies

3.3 Prevalence of toxoplasmosis among pregnant women with history of association with cats

This study assessed the possible risk of exposure to cats focusing on either close contact with cats or ownership of cats. Only nine studies reported 629 pregnant women with history of contact with cats and has a pooled prevalence of toxoplasmosis of 50% (95% CI= 35% to 66%). Heterogeneity among the studies was assessed to be high with $I^2=96.7\%$ (95% CI= 95.6% to 97.4%, $Q=240.4$, $df=8$, $P<0.0001$) Figure 4. For the cat ownership, only 15 studies among the included studies reported the risk of toxoplasmosis among the pregnant that own cats. From these studies, the total number of pregnant women that owns cats is 765. The pooled prevalence of toxoplasmosis among the pregnant women with history of cat ownership is 26.2% (95% CI=17.9% to 35.5%). The studies showed high heterogeneity ($I^2= 96.7\%$ (95%CI=96.0% to 97.3%,

$Q=427$, $df=14$, $P<0.0001$) Figure 4.1 and 4.2.

Figure 3.1. Funnel plots indicating the heterogeneity of the primary studies in different trimesters

3.4 Prevalence of toxoplasmosis among pregnant women with history of consumption of raw or poorly cooked meat

This review determined the pooled prevalence of toxoplasmosis related to consumption of raw or poorly cooked meat as reported by 19 primary studies among pregnant women. One thousand two hundred and forty pregnant women that were reported to be reactive to anti-toxoplasma antibody had history of consumption of raw or poorly cooked meat. The pooled prevalence of toxoplasmosis in this group of pregnant women is 43.3% (95% CI = 30% to 50%). There is a high heterogeneity among the studies with $I^2=98.7\%$ (95% CI= 98.5% to 98.8%, $Q=1381$, $df=18$, $P<0.0001$) Figure 5.

3.4 Discussion

Toxoplasmosis in pregnancy can have a devastating consequence during pregnancy period on the fetus, the newborn and in later stage of life. Reports indicated that prevalence of toxoplasmosis among pregnant women in Africa ranges from 25.3% to 75.2% (6). This is probably due to the endemicity of the infection because of the climatic and environmental conditions suitable for the survival of the *T. gondii* oocyst and availability of the transmission vehicles as well as lack of proper preventive policies in many of the African cities. In view of the forgoing, this review identified studies that reported seroprevalence studies from different parts of Africa. Thirty-nine eligible studies were obtained from available databases such as Google Scholar, ScienceDirect, Scopus, and PubMed. Eleven thousand nine hundred and eighty-six (11986) pregnant women participated in the eligible studies out of which 5347 were IgG reactive that accounts for 44.5% prevalence. This finding is higher than 36.5% reported by Bigno *et al* (49) which may probably be due to differences in inclusion and exclusion criteria for both reviews. The stratification of the pregnant women based on gestational age was reported by some of the eligible studies to include 3508 pregnant women in first trimester, 1367 in the second trimester and 1351 in the third trimester. The risk of transplacental transmission

Figure 3.2. Forest plot diagram showing the overall seroprevalence of toxoplasmosis among pregnant women in (a) First trimester, (b) Second trimester and (c) Third trimester.

Figure 4.1. Funnel plots for cat contact (A) and cat ownership (B)

of *T. gondii* is more pronounced in the third trimester because of the maturity of the placenta and low immunity (6,50).

Risk factors of toxoplasmosis are many but may differ from one region to another which reflects on the variation in prevalence between and within localities. Cats, being the definitive hosts of *T. gondii*, spread the oocyst along with feces to contaminate soil, water, and food substances that become the source of infection to humans (51). Thus, many studies reported that cat ownership, contact with cats as well as handling cat litter boxes are associated with *T. gondii* infection (3, 28,42,52). Although contact with cats is commonly disputed as a direct risk of infection (53), the risk is higher among those that had history of close contact with cats, which may be related to handling of cat litters (54,55). Again, contact with contaminated soil (56) with *T. gondii* oocyst as detected in many of schools play grounds (57) may result in childhood toxoplasmosis (58) as well as infection in pregnancy among women with history of ingestion of soil (59).

In this review, 629 pregnant women were reported by nine studies to have history of close contact with cats.

The pooled prevalence of toxoplasmosis among these pregnant women was 50.3% (95% CI= 35% to 66%). Furthermore, 15 studies reported 765 pregnant women who had history of cat ownership with pooled prevalence of toxoplasmosis at 26.2% (18% to 36%). In these two cases, it appears that the pooled prevalence among those with history of close contact with cats doubles the prevalence of toxoplasmosis among those with history of cat ownership. For all the two risks of contracting toxoplasmosis, the transmission of the infection is via the contact with cat litters (53) or contaminated soil that further contaminates vegetables, fruits, and water that were reported to be the sources of infection (52, 59, 60). Therefore, the habits of handling cat litters and soil should be of concern among pregnant women to ensure prevention of infection transmission and that adequate information on the longevity of the oocyst in the environment and its mode of dispersals should be disseminated to pregnant women at least during antenatal period.

The tissue cyst embedded in the meat of most intermediate hosts such as the sheep, goats, cattle, pigs, and many other food animals including chickens, harbors a slowly replicating bradyzoite that reactivates to a rapidly invasive tachyzoite (2). Thus, ingestion of raw or poorly cooked meat that harbors the tissue cysts has an attendant risk of contracting the infection (51). Increase in consumption of meat and preference were reported to differ between communities (7,61,62). High prevalence of toxoplasmosis has been detected among food animals and poultry from different countries in Africa (63,64,65,66). The prevalence of toxoplasmosis among food animals poses a risk of zoonotic transmission to humans if their meat products are poorly processed or consumed in raw form. Thus, pregnant

Figure 4.2. Forest plots for cat contact (A) and cat ownership (B)

Figure 5. Forest plot showing the pooled prevalence of toxoplasmosis among subjects with history of consumption of raw or poorly cooked meat

women with history of consuming raw meat as a culture in some parts of Africa (11) or poorly cooked meat are at higher risk of getting the infection. In this review, however, 1240 pregnant women reported to have history of consumption of raw or poorly cooked meat had 43.3% (95% CI= 30% to 50%) pooled prevalence of toxoplasmosis.

Even though many other studies disputed the possibilities of transmitting the infection through meat consumption despite taken it raw or poorly cooked (7,67,68) other studies reported strong association between meat consumption and toxoplasmosis across the globe (32). For the fact that meat sourced from food animals can harbor a tissue cyst, its availability for transmission depends on several factors that differ from one community to another which include the cultural differences, eating habits, meat of preference, and purchasing capability (16, 69). More interestingly, however, outbreak of toxoplasmosis was reported to be associated with consumption of raw or poorly cooked meat from pig, mutton, lamb and beef (70,71).

Although, the greater the severity of sequelae of toxoplasmosis in the fetus or newborn points at earlier transmission during gestation, transmission during the

Table 3. Pooled prevalence in different trimesters and risk factors of toxoplasmosis

Category	No. of studies	Prevalence (95% CI)	I ² (95% CI)	Heterogeneity test		Egger's test	
				Q	P	t	P
1 st trimester	23	29.0 (17 - 42)	98.6% (98.4 - 98.7)	1551	<0.0001	8.25	0.151
2 nd trimester	21	35.0 (26 - 43)	95.9% (95.1 - 96.5)	536	<0.0001	7.50	0.015
3 rd trimester	20	30.9 (22 - 41)	97.5% (97.1 - 97.8)	869	<0.0001	9.70	<0.0001
Cat contact	9	50.3 (35 - 66)	96.7% (95.6 - 97.4)	240	<0.0001	-9.95	0.149
Cat ownership	15	26.2 (18 - 36)	96.7% (96.0 - 97.3)	427	<0.0001	9.81	0.0019
*Meat	19	43.3 (30 - 50)	98.7% (98.5 - 98.8)	1381	<0.0001	8.53	0.0021

*consumption of poorly cooked or raw meat, Q=Cochran Q
P = p values

late gestational period is associated mainly to alteration of the function of the immune cells with majority of the neonates appearing normal at birth (50). The efficiency of placenta as a natural barrier to infection is more pronounced during the first trimester that resulted in minimal cases but with heavy consequences on the fetus (2). Major abnormalities include abortion, hydrocephalus, deafness, seizures, mental retardation and sensory and motor abnormalities. Congenital infection involving the retina may present with microphthalmia, strabismus, cataract, optic neuritis, uveitis, retinchoroiditis, and retinal necrosis that may lead to blindness.

3.5 Conclusion

Findings of this systematic review and meta-analysis indicate that toxoplasmosis is highly prevalent in African countries with no adequate measures to halt its spread. Effective screening of mothers and neonate is necessary to prevent mother to child transmission and to halt progression of the disease among the new born to prevent development of late sequelae in later life. Hence, more effort should be made to disseminate information focusing on risk factors and prevention strategies for control of the disease especially among pregnant women, children and immunocompromised patients.

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Declaration of competing interest

Authors declared that there is no competing interest

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