



Prevalence of Old and New Torch Infection in Pregnant Women from Mombasa and Kisumu Counties in Kenya in 2017

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Abstract

Introduction: *Toxoplasma gondii*, Rubella, Cytomegalovirus (CMV) and Herpes simplex viruses, known briefly as TORCH are infectious agents that lead to the development of a maternal infection and may enter the intrauterine circulation at any gestational age increasing the risk of congenital malformations and abortion. Despite this, the testing for these infections is not commonly included in antenatal screenings nationwide in Kenya because it is quite costly and is also considered less prevalent in our population by obstetricians. It is mainly tested to confirm the cause of recurrent unexplained pregnancy losses in mothers with a bad obstetric history.

Objectives: Through this study, we aim to confirm the prevalence current and old TORCH infections in the pregnant women in two largely populated counties of Kenya. This would give us estimated of successful vaccination coverage of the MMR vaccine, the lowest age with exposure to the infections, and the possible benefit for conducting the test in all pregnant women. Also to identify possible biographic factors correlated with increased risk of positivity to infection in the population.

Methodology: Using stratified method of randomization and selection of centers, one of the largest centers with antenatal clinics (ANC) was chosen in each county and all their patients attending their ANC were screened for the infection using the *On-Site TORCH Panel Rapid Test* CTK Biotech, Inc. (San Diego, CA 92121, USA) with a specificity of between 85% and 97%. Positive results for IgM were verified using ELISA.

Results: There was extremely low prevalence of confirmed active infection of TORCH in the population (only 2 cases which did not have any complications in pregnancy as a result), but presence of old infection was at about 30% for *Toxoplasma*, 50% for Rubella and HSV-1, 20% for HSV-2 and 10% for CMV. There seems to be an interruption in effective Rubella vaccination around the year 1987 which would be worth investigating.

Conclusion: Testing pregnant women for TORCH is not of much benefit in pregnancy in Kenya due to low prevalence. However, the test can be used to screen populations at risk as is being conducted currently.

Keywords

Torch Infection, Pregnant Women, MMR Vaccine, Infectious Diseases, Rubella

Introduction

Toxoplasma gondii, Rubella, Cytomegalovirus (CMV) and Herpes simplex viruses, known briefly as TORCH are infectious agents that lead to the development of a maternal infection and may enter into intrauterine circulation at any gestational age causing congenital infections [1].

Toxoplasma gondii is an intracellular protozoa an agent of parasitic infection known as toxoplasmosis that is transmitted through contaminated food or water and undercooked meat. The incubation period is 5-23 days after ingesting the cysts. The infected women are usually asymptomatic, and during pregnancy, she may undergo pregnancy loss, stillbirth, and intrauterine malformations in the fetus [2,3].

Rubella virus is a single-strand RNA virus and it is the infectious agent of rubella (German measles). It is transmitted from person to person by tiny droplets in air and mother-to-child is through placental transfer. This disease lasts for 1-5 days and the incubation period is 2-3 weeks. It usually presents mild or asymptomatic infection in children and adults. However, virus may cross the placenta and could result in miscarriage, fetal death, or an infant with serious birth defects including hearing impairment, cataracts, and cardiac defects, collectively known as congenital rubella syndrome (CRS) [4].

Earlier studies have shown that in 20-50% of the patients who have this infection, it leads an asymptomatic course. In adults and children, the disease manifests itself with adenopathy and severe febrile rashes. If primary infection is contracted within the first three months, then the probability of onset of "Congenital Rubella Syndrome (CRS)" is increased. The risk of fetal infection is at its highest level during the first eleven weeks and after the thirty-six weeks of gestation [5].

CMV is a member of the Herpes viridae species, made up of deoxyribonucleic acid encased in a nuclear envelope and may remain as a latent microorganism inside host cells. It can affect 0.5-1% of all live births and it is the most frequently seen agent of congenital viral infections which may lead to sensorineural

deafness and mental retardation [6]. Human beings are the reservoir hosts for this virus, and the viruses are transmitted by direct contact with saliva, urine, and genital secretions. In pregnant women, the transmission is by direct contact with infected urine or saliva from young children or through sexual activity.

The incubation period of CMV infection ranges between 4 and 12 weeks. In neonates, the symptoms include intrauterine growth retardation, microcephaly with intracranial calcification, hepatosplenomegaly, jaundice, chorioretinitis, thrombocytopenic purpura, and anemia. The major childhood disabilities like loss of vision, hearing, and cognitive impairment are also due to CMV infection [7].

HSV is the most common sexually transmitted viral disease (STD) worldwide. HSV1 is transmitted during childhood by non-sexual contacts, while HSV2 is always transmitted sexually and is the major cause of genital herpes [8]. Incubation period of herpes ranges between 4 and 21 days. In more than 75 % of cases, primary genital HSV infection remains asymptomatic [9]. In newborns, this infection remains a major cause of morbidity and mortality. Genital herpes infection during pregnancy may lead to spontaneous abortion, prematurity, congenital, and neonatal herpes [10,11].

Previous studies have shown that prenatal infections accounts for up to 2-3% of all the congenital anomalies [12]. The spectrum of condition may be asymptomatic course and normally associated with malformations including chorioretinitis, hearing sequelae, hydrocephalus, mental and psychomotor disorders, miscarriages, sterility, congenital and intrauterine fetal loss [13]. The risk of vertical transfer increases with progression of gestational weeks whereas; the risk of infection leading to complex malformations decreases [14].

Detection of TORCH causative infections agent responsible for a very wide spectrum of malformations and gestational anomalies is of importance. However, the necessity of inclusion of TORCH infectious agents screening during pregnancy/antenatal programs is based on certain geographic region Seroprevalence studies conducted. The decision to be part of antenatal screening tests can be made possible once regional

prevalence studies have been conducted and economic evaluations of cost analysis performed [15,16].

In this study, the seroprevalence of TORCH group of infectious agents among patients who will attend selected antenatal clinics in Kisumu and Mombasa Counties high-end, middle class and low-end regions are evaluated.

Statement of the Problem:

The prevalence of TORCH among pregnant women in Kenya has always been assumed by experts to be very low due to low prevalence of malformations within the live births. Recent studies from different countries are showing that there is a variation of between 70% to as low as 8% of these infections amidst different populations.

Seroprevalence varies greatly with a variety of epidemiological factors such as geographical distribution, socioeconomic status, marital status and parity. There is no study done in Kisumu and Mombasa cities recently to identify the prevalence in our population. As a consequence of this, and in addition to the test cost per screening being very high at reputable institutions, the practice of regular antenatal screening for these diseases is very uncommon. Despite the posed teratogenic risk during pregnancy, there is no national screening test for TORCH infections are available during pregnancy in Kenya. Thus little is known on its epidemiological data that is necessary for health policy planners and care providers.

Justification:

The increased complications to the mother and fetus during or after pregnancy and birth are often caused by a wide array of pathogenic organisms mostly belonging to the TORCH group [toxoplasmosis, rubella, cytomegalovirus (CMV), and herpes simplex virus (HSV)] [17]. The potential effects of a TORCH infection in pregnancy are devastating even if the affected individuals represent a smaller proportion. Its clinical manifestations range from asymptomatic forms (90% of cases) to severe fetal damage that may include permanent hearing, vision loss, neurological impairment and, in rare cases, death due to abortion.

The deformities and congenital defects that can be encountered would lead to lifelong disability to the fetus. As far as prevention is concerned, in addition to health education campaigns, the serological screening of pregnant women has been proposed. However, there is no consensus in the scientific community concerning the implementation of screening and it is not recommended by any public health system despite its teratogenic effects because of its cost/benefit ratio. There is no published data concerning TORCH Seroprevalence in pregnant women in Kenya. This study will therefore aim at determining the Seroprevalence for TORCH infections among pregnant/asymptomatic pregnant women in Kisumu and Mombasa Counties.

Objectives

Broad Objective:

To investigate the Seroprevalence of TORCH group of infectious agents among patients who attend selected antenatal clinics in Kisumu and Mombasa Counties.

Specific Objectives:

1. To determine the distribution of demographic profile characteristics in pregnant women with TORCH infections at selected antenatal clinics in Mombasa and Kisumu Counties (high-end, middle class and low-end regions).
2. To evaluate serologically IgG and IgG + IgM antibodies against TORCH agents in pregnant women at selected antenatal clinics in Mombasa and Kisumu Counties (high-end, middle class and low-end regions).
3. To determine the effectiveness of the lifelong protection from the Rubella vaccine administered in the population in question
4. To consider the impact of HIV in the prevalence of TORCH within the two counties in Kenya

Methodology

This is a cross sectional study in the two counties of Mombasa and Kisumu where ethical and NACOSTI clearance was attained from MMUST Institutional Research and Ethics Committee (IREC), on provision of all requirements necessary to carry out the study. Informed consent was obtained from all pregnant

women prior to inclusion. The confidentiality of the subjects was ensured by assigning of serial numbers to the participants and data protected on encrypted codes.

Study Site:

Random selection of sites health facilities with antenatal clinics in Kisumu and Mombasa counties was used to generate a list that then was narrowed down to the site with the largest numbers in order to represent the population. Samples were collected at the site chosen within each county over a period of 2 months until the sample size required was attained.

Inclusion Criteria:

All consenting pregnant women residing and attending the selected antenatal clinics within the hospitals in Kisumu and Mombasa counties during the period of April 2017 to June 2017 were enrolled.

Exclusion Criteria:

The pregnant women who do not reside in the respective counties of study, and those who decline to consent for participation in the study were excluded.

Sample Size Determination:

The minimum sample size was determined using Fishers formula;

$$N = Z^2 PQ / D^2$$

The prevalence of TORCH infections (CMV) is at 0.77% [18]. The sample size will be determined as follows;

$$N = Z^2 PQ / D^2 \text{ Therefore, } N = \{1.96^2 \times (0.77 \times 0.23)\} / 0.05^2 = 272 \text{ Samples}$$

Where; N= Minimum sample size required; Z=Standard errors; P=Estimated prevalence of TORCH (CMV) infections= 0.77%; Q = 1-P= 1-0.1=0.9; D=Absolute precision = 0.05

Approximately 300 pregnant women were sampled for TORCH infections as per the above calculation.

Study Sample Type:

Structured questionnaires will be used to gather socio-demographic. The study subjects will be personally interviewed, counseled, and information regarding maternal age, gravida, religion, maternal education, maternal occupation, and family income

will be collected in a specially designed proforma. Two milliliter of blood were aseptically drawn by venipuncture into a tube containing clot activator. Blood samples were then transported to the laboratory. They were centrifuged and serum was separated. The levels of IgG and IgM was tested in all subjects using commercially available panel strips assembled in one cassette, *On-Site TORCH Panel Rapid Test* CTK Biotech, Inc. (San Diego, CA 92121, USA) according to manufacturer instructions.

According to the kit insert, in the case of rubella, an IgG anti-rubella virus titer ≥ 15 IU/mL produces a burgundy colored G1 test line. An IgG anti-rubella virus titer ≥ 250 IU/mL produces burgundy colored G1 and G2 test lines. Absence of any test lines (M, G, G1, or G2) suggests a negative result for that particular test strip. The strip in each cassette contains an internal control (C line) which should exhibit a burgundy colored line of the immunocomplex of the control antibodies regardless of color development on any of the test lines. If the C line does not develop, the test result for that test strip is invalid, and the specimen must be retested with another device. Each test is read independently. In cases where samples will test positive for both IgG and IgM, they will be further evaluated for the avidity of IgG antibodies. Quality controls both internally and externally were maintained through consistent random reassessment of specific results in comparison to ELISA methodology for the same sample at external labs.

Data Analysis:

The χ^2 test at 95 % CI were used for analysis of the difference in the TORCH seropositivity for IgG and IgM and its association between IgG, IgM seropositivity and maternal age, gravida, religion, maternal education, maternal occupation, and family income determined and a two-tailed p values less than 0.05 were considered statistically significant.

Results

What is the Prevalence of TORCH?

What is prevalence and how do we compute it? Prevalence is the proportion of a population who have a specific characteristic in our case the 5 different infections. We report prevalence as either lifetime

prevalence for IgG test and point prevalence for IgM test. To compute this, we are assuming that the randomly selected sample is representative of the population of interest.

Prevalence of IgG:

Table-1 below shows the lifetime prevalence/1,000 pregnant women in the population for both Mombasa and Kisumu and for all the 5 TORCH infections while **Fig-1** shows a grouped bar chart (by location) with prevalence on the y-axis. An additional question we can answer is whether there is a statistically significant difference in the prevalence between Mombasa and Kisumu. It turns out, assuming that the sample data is representative, the prevalences of CMV_G, HSV1_G and HSV2_G are significantly different (p-value <

0.05) between the two locations while RUB_G1 is borderline i.e. the p-value is very close but slightly higher than the cut-off for statistical significance.

Table-2 below shows the point prevalence/1,000 pregnant women in the population for both Mombasa and Kisumu and for all the 5 TORCH infections while **Fig-2** shows a grouped (by location) bar chart with prevalence on the y-axis. We can observe that there are very few positive cases and there is no difference between the two locations in the prevalence of the TORCH infections. The sample size of this study may have been insufficient to represent the number of active cases of TORCH in the population, though we will still look for the differences within the few we found.

Table-1:

	Mombasa	Kisumu	Chi-square test p-value
	(/1,000 people)	(/1,000 people)	
TOXO_G	326.5	318.5	0.881
RUB_G1	510.2	401.2	0.056
CMV_G	122.4	31.8	0.003**
HSV1_G	557.8	394.9	0.004**
HSV2_G	231.3	82.8	0.00034***

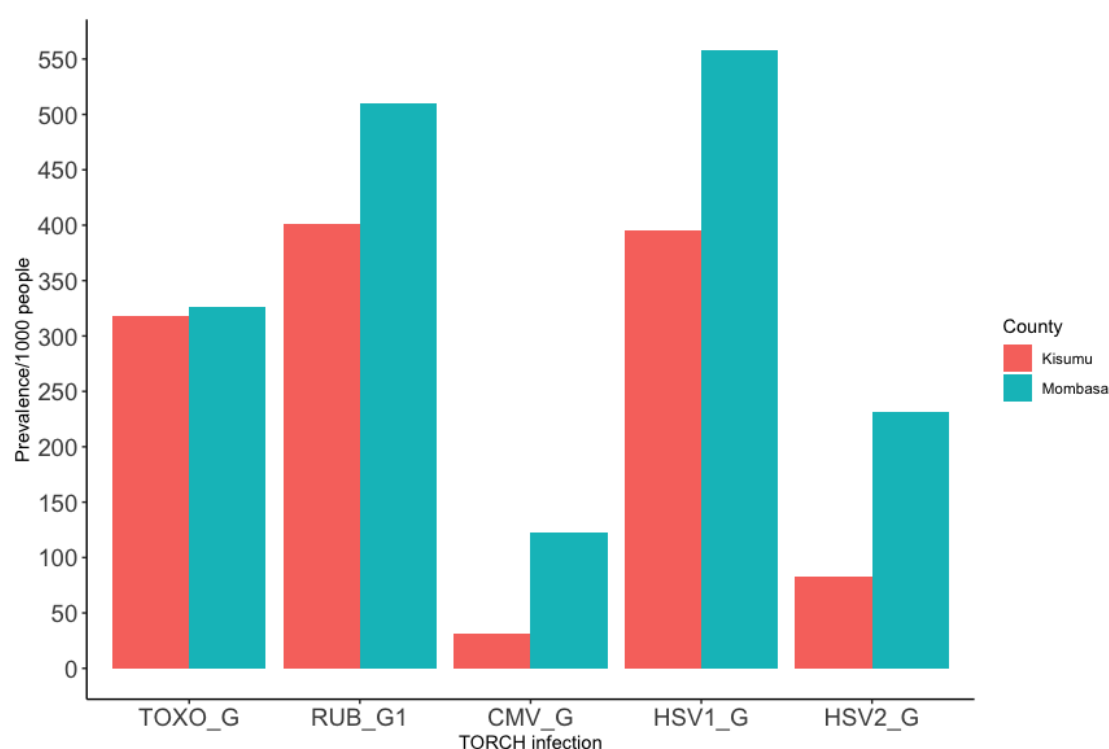


Fig-1:

Table-2:

	Mombasa	Kisumu	Chi-square test p-value
	(/1,000 people)	(/1,000 people)	
TOXO_M	0	0	N/A
RUB_M	6.8	0	0.3
CMV_M	6.8	0	0.3
HSV1_M	0	6.37	0.33
HSV2_M	6.8	0	0.3

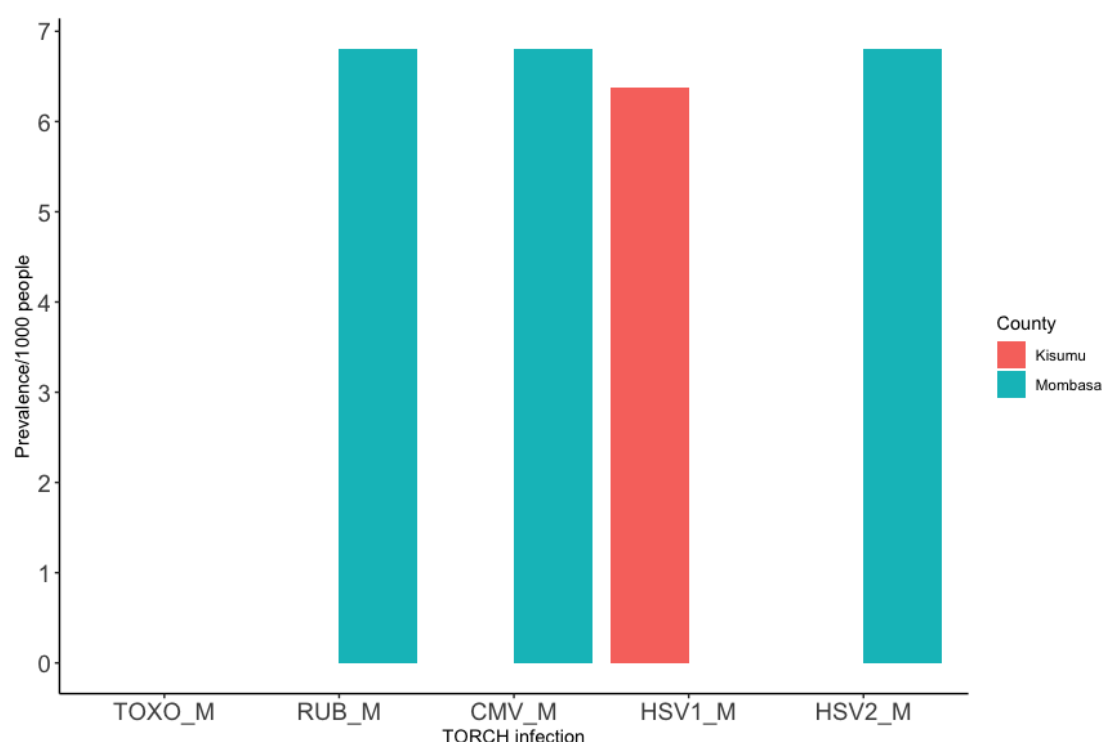


Fig-2:

What is the Prevalence of RUB_G1 by Age and County?

Table-3 below shows the lifetime prevalence/1,000 people in the population for both Mombasa and Kisumu by age while **Fig-3** shows a grouped bar chart (by age) with the same data. The sample size in each age class is shown by (n) in the table. We have grouped the ages in 5 yearly age classes from 15 years to 35 years and all individuals older than 35 years have been pinned into >35 years' age class. The prevalence of RUB_G1 is higher in Mombasa compared to Kisumu among the 25-30 years old and the difference is more than what we would expect by chance with a p-value < 0.05. Now, this is an interesting observation and one worth a little more investigation. Another reason it is epidemiologically significant is because the crude

estimates in **Table-1** indicate that there is no difference in RUB_G1 prevalence if you look across all the age groups, but a statistically significant difference is observed when we stratify by age.

One would expect to see a significant difference in the prevalence for age groups >35. However, the sample size in this class is not sufficient to detect any difference in prevalence.

What is the Prevalence of TOXO_G by Age and County?

Table-4 below shows the lifetime prevalence/1,000 people in the population for both Mombasa and Kisumu by age while **Fig-4** shows a grouped bar chart (by age) with the same data. The sample size in each

age class is shown by (n) in the table. None of the differences in prevalence across the age groups are significant between Mombasa and Kisumu.

Table-3:

Age group	Mombasa	Kisumu	Chi-square test p-value
	/1,000 people (n)	/1,000 people (n)	
15-20	0 (3)	304.34 (23)	0.264
20-25	400 (20)	421 (64)	0.863
25-30	638.89 (36)	413.04 (46)	0.042*
30-35	522.72 (44)	473.68 (19)	0.721
>35	477.27 (44)	200 (5)	0.238

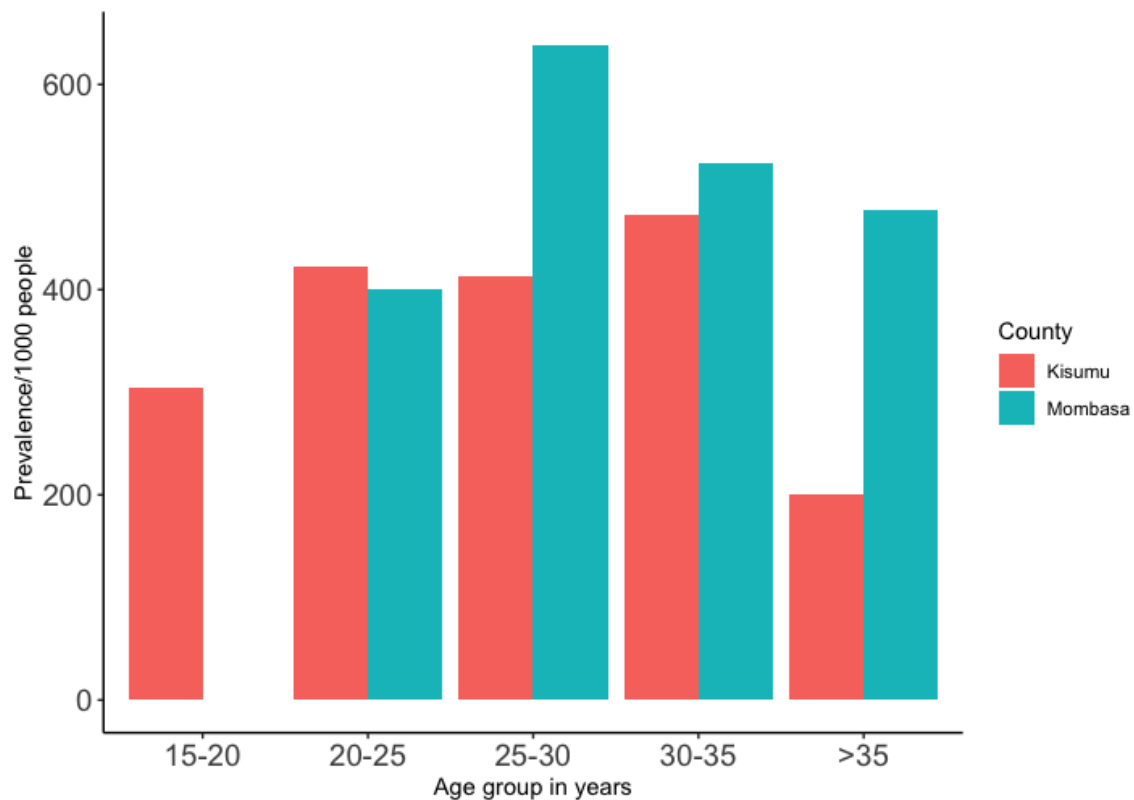


Fig-3:

Table-4:

Age group	Mombasa	Kisumu	Chi-square test p-value
	/1,000 people (n)	/1,000 people (n)	
15-20	333.33 (3)	260.87 (23)	0.79
20-25	350 (20)	343 (64)	0.959
25-30	277.78 (36)	369.57 (46)	0.38
30-35	409.09 (44)	210.53 (19)	0.129
>35	272.72 (44)	200 (5)	0.727

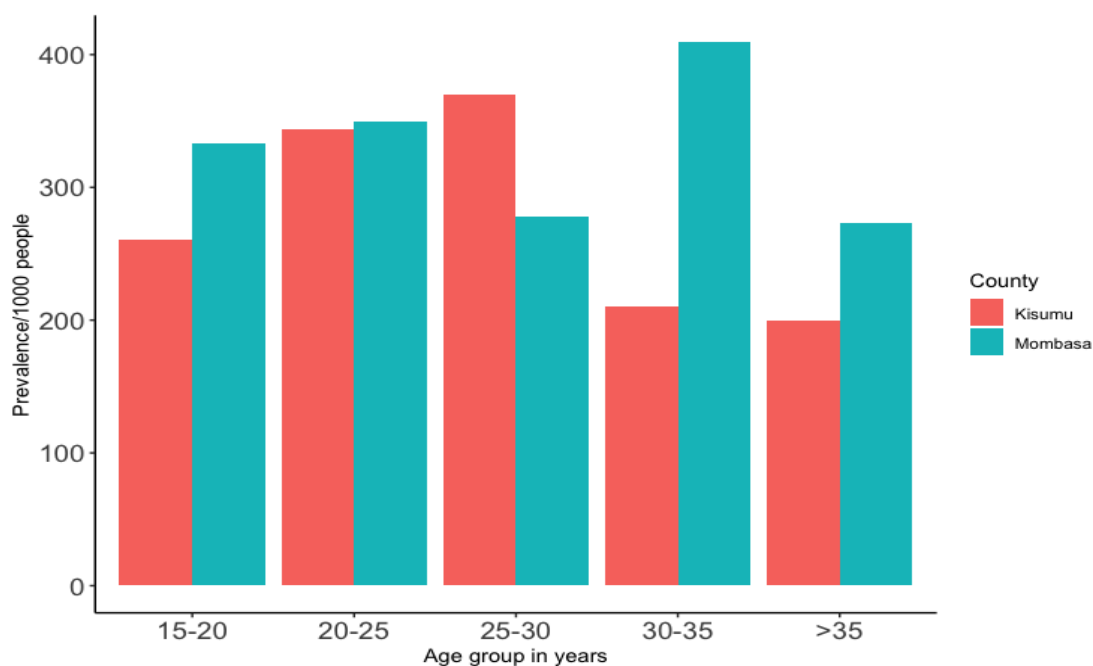


Fig-4:

Table-5:

Age group	Mombasa	Kisumu	Chi-square test p-value
	/1,000 people (n)	/1,000 people (n)	
15-20	0 (3)	86.96 (23)	0.595
20-25	100 (20)	31.25 (64)	0.2
25-30	138.89 (36)	21.74 (46)	0.043*
30-35	227.27 (44)	0 (19)	0.023*
>35	22.73 (44)	0 (5)	0.733

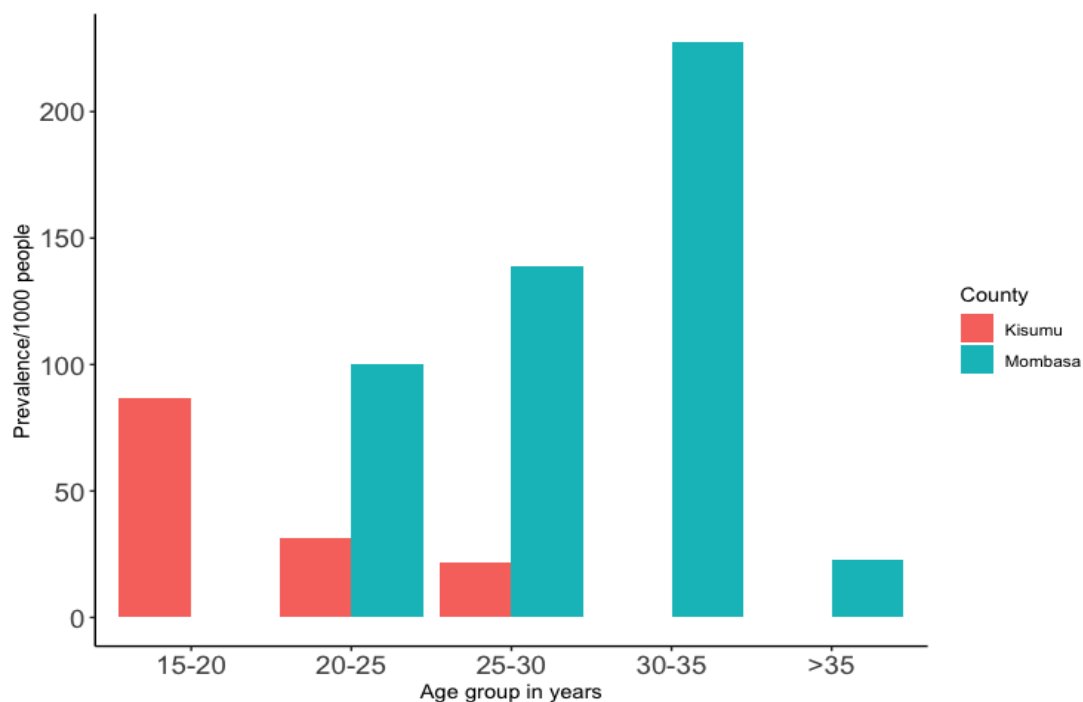


Fig-5:

What is the Prevalence of CMV_G by Age and County?

Table-5 below shows the lifetime prevalence/1,000 people in the population for both Mombasa and Kisumu by age while **Fig-5** shows a grouped bar chart (by age) with the same data. The sample size in each age class is shown by (n) in the table. Note that there is a statistically significant difference between Mombasa and Kisumu of prevalence in the age groups 25-30 and 30-35.

What is the Prevalence of HSV1_G by Age and County?

Table-6 below shows the lifetime prevalence/1,000 people in the population for both Mombasa and Kisumu by age while **Fig-6** shows a grouped bar chart

(by age) with the same data. The sample size in each age class is shown by (n) in the table.

What is the Prevalence of HSV2_G by Age and County?

Table-7 below shows the lifetime prevalence/1,000 people in the population for both Mombasa and Kisumu by age while **Fig-7** shows a grouped bar chart (by age) with the same data. The sample size in each age class is shown by (n) in the table. Both age groups 15-20 and 20-25 have a significant difference between the two counties. However, we should interpret the p-value for age group 15-20 with caution given that only 3 people in this age group were sampled from Mombasa.

Table-6:

Age group	Mombasa	Kisumu	Chi-square test p-value
	/1,000 people (n)	/1,000 people (n)	
15-20	333.33 (3)	304.35 (23)	0.918
20-25	500 (20)	343.75 (64)	0.209
25-30	500 (36)	456.52 (46)	0.696
30-35	568.18 (44)	473.68 (19)	0.49
>35	636.36 (44)	600 (5)	0.873

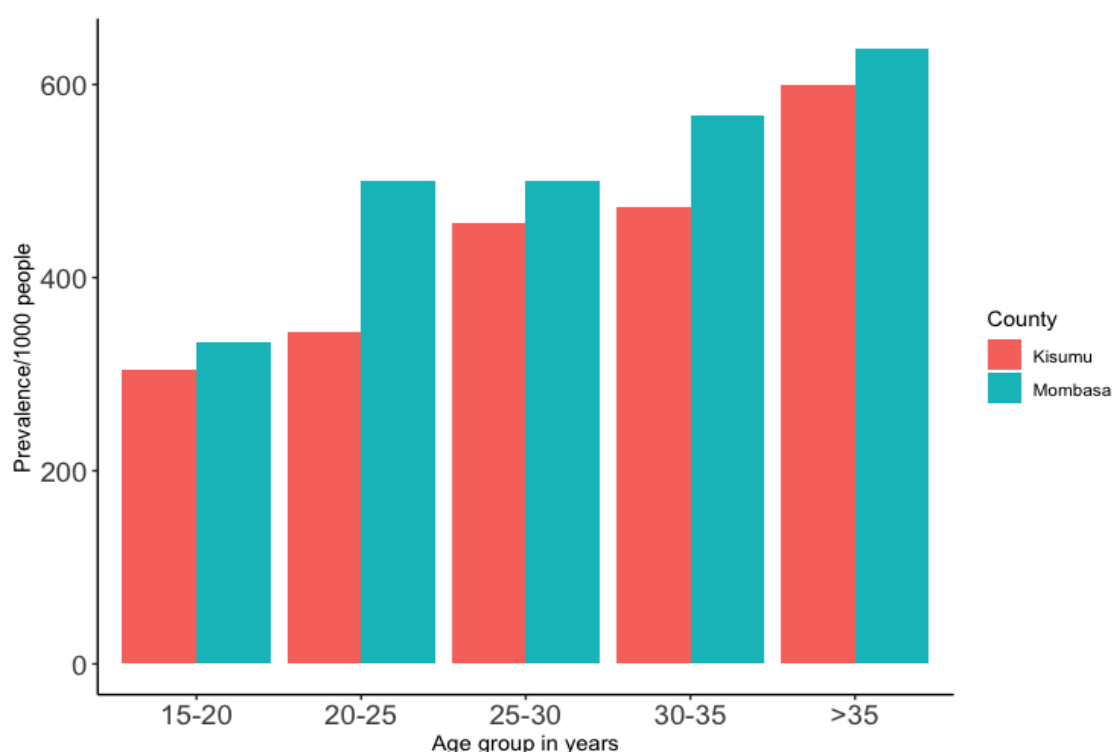


Fig-6:

Table-7:

Age group	Mombasa	Kisumu	Chi-square test p-value
	/1,000 people (n)	/1,000 people (n)	
15-20	333.33 (3)	0 (23)	0.004*
20-25	250 (20)	78.13 (64)	0.038*
25-30	222.22 (36)	86.96 (46)	0.085
30-35	272.72 (44)	157.89 (19)	0.326
>35	181.81 (44)	200 (5)	0.921

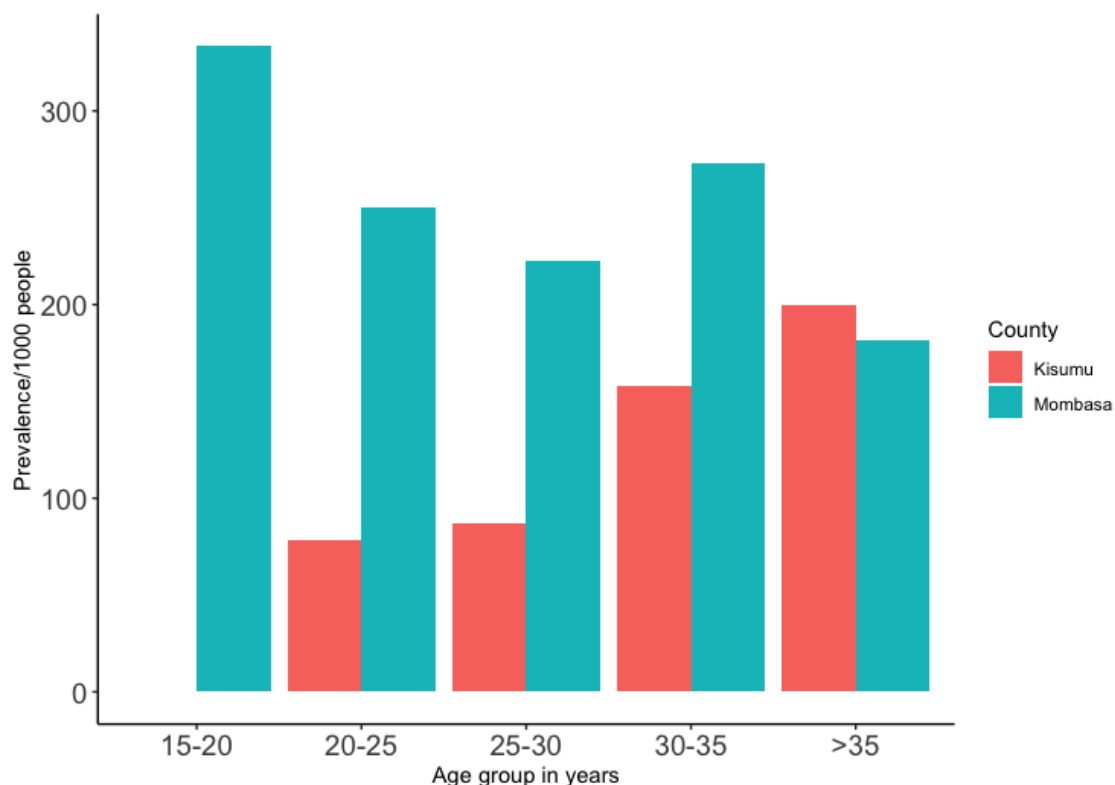


Fig-7:

Multi-variate analysis – TOXO_G:

In **Table-8**, we present the multi-variate regression analysis with TOXO_G as the response variable i.e. the variable dependent on the covariates presented in the table. I will explain how to interpret the table using one of the co-variables, in this case age group, and then the other follow a similar format. For this analysis, I have excluded 4 individuals from the data because they had NULL values of PMTCT reported. (PMTCT 0= unknown, 1= positive for HIV, 2 = negative for HIV).

We have classified the age groups into 5 age classes. The age class with the odds ratio = 1 is the reference age class and this applies to all the other variables too. – the first one in the class is always the reference class.

Odds ratio represents the relative likelihood (relative to the reference class) of being positive for TOXO_G given the feature in question. e.g. An individual in age group 20-25 is **1.474** times more likely to be positive for TOXO_G compared to an individual in age class 15-20 (reference class) while someone in age class 25-30 is **1.453** times more likely compared to one is 15-20. **Table-8** implies that the risk of TOXO_G increases with age up to 35 years and then the risk decreases for individuals older than 35 years since odds ratio for age group >35 is **0.99** implying individuals in 15-20 age class are **1.01** (1/0.99) times more likely to be positive for TOXO_G. We should note that none of these changes in risk of TOXO_G by age is significant given a) lack of statistical significance see p-values in the last

column and b) the wide odd ratio 95% confidence intervals (they all span both sides of 1) reported in the third column. You can interpret all the other covariates in this manner.

In fact, it turns out that none of the association with all the covariates is significant from the multi-variate analysis.

Table-8: Multivariate analysis for TOXO_G

Covariate	Odds Ratio	95% CI	p-value
Parity			
0	1	-	-
1	0.696	0.284 – 1.23	0.42
2	1.108	0.421 – 2.973	0.83
3	0.749	0.221 – 2.537	0.64
4	0.918	0.208 – 3.989	0.91
5	1.116	0.138 – 8.384	0.91
6	1.18E-07	0 – 1.4e70	1
Education level			
None	1	-	-
Primary	0.849	0.298 – 5.44	0.85
Secondary	0.69	0.111 – 4.726	0.69
Tertiary	0.605	0.958 – 4.228	0.59
PMTCT (HIV status)			
0	1	-	-
1	2.545	0.433 – 21.18	0.32
2	1.352	0.246 – 10.72	0.74
No.of partners			
0	1	-	-
1	0.852	0.216 – 5.135	0.85
2	1.14	0.352 – 22.54	0.93
Never disclosed	0.72	0.115 – 4.857	0.72
Unknown	1.354	0.164 – 11.70	0.77
Age group			
15-20	1	-	-
20-25	1.474	0.511 – 4.721	0.48
25-30	1.453	0.456 – 3.162	0.53
30-35	1.462	0.403 – 5.7	0.56
>35	0.979	0.22 – 4.53	0.97
Marital status			
Divorced	1	-	-
Married	1.00E+07	2.52e-205 – 2.52e205	0.99
Single	1.02E+07	2.62e-205 – 2.62e205	0.99
Widow	1.04	3.76e-15 – 5.19e14	0.99
County			
Kisumu	1	-	-
Mombasa	0.871	0.831 – 1.438	0.74

Multi-variate analysis – RUB_G1:

Table-9 below shows the results for the multi-variate analysis for RUB_G1. A quick note: being in the age group 25-30 is associated with being **3.422** more likely to be positive for RUB_G1 compared to the reference group (15-20) with a p-value < 0.05

implying that this result more likely than by chance. Having 2 partners is associated with being over **8** times more likely to have RUB_G1 (compared to being single) although the statistical significance is borderline.

Table-9: Multivariate analysis for RUB_G1

Covariate	Odds Ratio	95% CI	p-value
Parity			
0	1	-	-
1	0.592	0.249 – 1.384	0.23
2	0.601	0.231 – 1.537	0.29
3	0.562	0.174 – 1.783	0.33
4	0.797	0.189 – 3.36	0.76
5	0.135	0.0058 – 1.289	0.12
6	1.549	0.106 – 41.20	0.75
Education level			
None	1	-	-
Primary	7.077	0.92 – 150.71	0.1
Secondary	7.561	0.939 – 164.78	0.094
Tertiary	4.431	0.544 – 96.78	0.21
PMTCT (HIV status)			
0	1	-	-
1	1.042	0.177 – 7.079	0.96
2	1.149	0.209 – 7.391	0.87
No. of partners			
0	1	-	-
1	2.061	0.378 – 12.35	0.4
2	8.216	0.405 – 278.9	0.18
Never disclosed	2.158	0.354 – 14.29	0.4
Unknown	2.089	0.247 – 18.06	0.49
Age group			
15-20	1	-	-
20-25	1.848	0.668 – 5.559	0.25
25-30	3.422	1.128 – 11.25	0.03*
30-35	2.895	0.844 – 10.62	0.09
>35	2.476	0.608 – 10.63	0.21
Marital status			
Divorced	1	-	-
Married	3.05E+05	1.28e-56 – 1.28e56	0.98
Single	3.49E+05	1.37e-56 – 1.37e56	0.98
Widow	4.06E+05	7.52e-39 – 2.9e158	0.98
County			
Kisumu	1	-	-
Mombasa	1.541	0.692 – 3.462	0.29

* Statistically significant

Multi-variate analysis – CMV_G:

Table-10 below shows the results for the multi-variate analysis for CMV_G. A couple of results here are significant but the one I will highlight is county. Living in Mombasa is associated with being 232 (p-

value 0.000062) times more likely to be positive for CMV_G compared to Kisumu. You are also 55 (1/0.018) times less likely to be positive for CMV_G if you are >35 years old compared to 15-20 years old (p-value 0.04).

Table-10: Multivariate analysis for CMV_G

Covariate	Odds Ratio	95% CI	p-value
Parity			
0	1	-	-
1	6.942	1.223 – 53.01	0.04*
2	6.174	0.881 – 55.42	0.08
3	77.79	5.609 – 1575.5	0.0021*
4	80.53	3.585 – 2245.3	0.0062*
5	7.69E-07	2.08e-65 – 2.08e65	0.99
6	2.28E-05	0 – 2.21e112	0.99
Education level			
None	1	-	-
Primary	3.58E+08	6.21e-65 – 1.31e186	0.99
Secondary	1.03E+08	1.19e-66 – 1.19e66	0.99
Tertiary	3.41E+08	3.66e-59 – 3.66e59	0.99
PMTCT (HIV status)			
0	1	-	-
1	1.14E+07	2.05e-62 – 1.43e250	0.99
2	6.93E+07	1.25e-61 – 8.73e250	0.99
No. of partners			
0	1	-	-
1	0.476	0.039 – 11.85	0.57
2	74.17	0.91 – 9405.7	0.05*
Never disclosed	3.288	0.172 – 115.7	0.45
Unknown	5.28E-07	2.28e-71 – 2.28e71	0.99
Age group			
15-20	1	-	-
20-25	1.473	0.131 – 48.16	0.77
25-30	0.69	0.053 – 24.48	0.79
30-35	0.579	0.037 – 22.01	0.71
>35	0.018	0.00025 – 1.2	0.04*
Marital status			
Divorced	1	-	-
Married	0.018	2.55e-116 – 8.9e110	0.99
Single	0.036	2.3e-111 – 2.2e109	0.99
Widow	0.54	5.3e-111 – 8.4e111	0.99
County			
Kisumu	1	-	-
Mombasa	232.27	21.2 – 4639.3	0.000062*

* Statistically significant

Multi-variate analysis – HSV1_G:

variate analysis for HSV1_G.

Table-11 below shows the results for the multi-

Table-11: Multivariate analysis for HSV1_G

Covariate	Odds Ratio	95% CI	p-value
Parity			
0	1	-	-
1	1.46	0.606 – 3.58	0.4
2	2.411	0.909 – 6.603	0.08
3	4.704	1.396 – 16.62	0.013*
4	6.379	1.442 – 30.2	0.016*
5	2.43	0.238 – 20.34	0.41
6	9.616	0.621 – 278.1	0.11
Education level			
None	1	-	-
Primary	6.137	0.936 – 55.21	0.07
Secondary	14.01	1.973 – 135.3	0.01*
Tertiary	10.9	1.539 – 106.1	0.02*
PMTCT (HIV status)			
0	1	-	-
1	2.151	0.276 – 48.56	0.52
2	2.129	0.293 – 46.72	0.52
No. of partners			
0	1	-	-
1	2.976	0.528 – 18.48	0.21
2	3.623	0.11 – 75.84	0.41
Never disclosed	4.854	0.765 – 33.8	0.09
Unknown	4.002	0.472 – 36.05	0.2
Age group			
15-20	1	-	-
20-25	1.45	0.52 – 4.3	0.48
25-30	1.383	0.447 – 4.51	0.57
30-35	1.387	0.396 – 5.06	0.61
>35	1.351	0.322 – 5.816	0.68
Marital status			
Divorced	1	-	-
Married	1.51E-07	0 – 1.05e71	0.98
Single	3.27E-07	0 – 2.28e71	0.98
Widow	9.51E-08	4.5e-160 – 1.8e-31	0.98
County			
Kisumu	1	-	-
Mombasa	3.556	1.536 – 8.531	0.003*

* Statistically significant

Multi-variate analysis – HSV2_G:

variate analysis for HSV2_G.

Table-12 below shows the results for the multi-

Table-12: Multivariate analysis for HSV2_G

Covariate	Odds Ratio	95% CI	p-value
Parity			
0	1	-	-
1	0.319	0.101 – 0.973	0.04*
2	0.633	0.197 – 2.05	0.44
3	0.232	0.041 – 1.157	0.08
4	8.10E-15	0 – 2.11e33	0.99
5	0.856	0.061 – 10.15	0.9
6	4.624	0.269 – 143.4	0.3
Education level			
None	1	-	-
Primary	0.766	0.051 – 24.76	0.85
Secondary	0.823	0.05 – 29.75	0.9
Tertiary	0.798	0.047 – 29.47	0.88
PMTCT (HIV status)			
0	1	-	-
1	2.07E+07	2.3e-138 - 2.3e138	0.99
2	2.32E+07	2.75e-56 - Inf	0.99
No. of partners			
0	1	-	-
1	0.14	0.014 – 0.974	0.05*
2	1.91E-08	0 – 1.8e94	0.99
Never disclosed	0.107	0.0084 – 1.011	0.06
Unknown	0.218	0.0066 – 3.357	0.31
Age group			
15-20	1	-	-
20-25	3.181	0.413 – 73.79	0.34
25-30	4.705	0.575 – 112.1	0.22
30-35	7.914	0.864 – 197.3	0.11
>35	5.832	0.511 - 162	0.2
Marital status			
Divorced	1	-	-
Married	4.58E+07	0 – Inf	0.99
Single	5.25E+07	0 – Inf	0.99
Widow	1.88E+15	9.72e-189 - Inf	0.99
County			
Kisumu	1	-	-
Mombasa	1.547	0.503 – 5.06	0.46

* Statistically significant

PS: PMTCT STATUS IS INTERPRETED AS 0= UNKNOWN, 1=POSITIVE AND 2=NEGATIVE FOR HIV INFECTION IN MOTHERS

Conclusions

Active TORCH infections were very rare in the pregnant women, specifically toward HSV1, CMV and Rubella. HSV2 and Toxoplasma did not have any active cases. The detected cases when followed up did not have any complications due to their infections. The sample size may not have been sufficient to confidently give a comment more on this. As far as the exposure to infection screened through IgG, it was interesting to find that CMV was least prevalent, and the HSV-1 was most prevalent (about 5 times more prevalent than CMV). The prevalence of Rubella IgG would be an indicator to the effectiveness of the vaccine coverage through MMR vaccine in the area, so it can give a rough estimate on the practice of child vaccination in the area up to the age of 18 months at least – since this is when the MMR vaccine boosters are given as per KEPI. An interesting finding of a maximum prevalence at the age of around 25-35 years compared to one third of the same prevalence at younger ages brings about a query on the vaccination methods of late in comparison the those about 30 years ago. A look into possible cold chain breakages and attitude changes in the population regarding vaccination is warranted from this. Multiple sexual partners seem to be a strong predisposing factor for exposure to CMV exposure in the group.

Overall, though there were no clinical implications in terms of fetal health from the cases found or significant numbers with active infection during pregnancy, the screening for TORCH may still be recommended in our population for the deductions we got and for the fact that we can prevent potential damage to a fetus. Age, and mother's HIV infection status did not seem to effect the prevalence of exposure to the illnesses, and that gives us an indication that TORCH infections exposure seem to occur before or around the age of 20.

Limitations

Testing kits used were qualitative and not the gold standard recognized method for testing for the disease, and thereby there was a small window of possibility of some of the negative tests to have been positive. Sampling was conducted using stratification method due to limitation of resources otherwise multiple

centers may have been involved in conducting the same study to improve representation of the population by the results.

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Conflict of Interest

The authors have read and approved the final version of the manuscript. The authors have no conflicts of interest to declare.

References

- [1] Karacan M, Batukan M, Cebi Z, Berberoglugil M, Levent S, Kir M, Baksu A, Ozel E, Camlibel T. Screening cytomegalovirus, rubella and toxoplasma infections in pregnant women with unknown pre-pregnancy serological status. *Arch Gynecol Obstet*. 2014 Dec;290(6):1115-20. [PMID: [25027818](#)]
- [2] Jones J, Lopez A, Wilson M. Congenital toxoplasmosis. *Am Fam Physician*. 2003 May 15;67(10):2131-38. [PMID: [12776962](#)]
- [3] Jones JL, Lopez A, Wilson M, Schulkin J, Gibbs R. Congenital toxoplasmosis: a review. *Obstet Gynecol Surv*. 2001 May;56(5):296-305. [PMID: [11333376](#)]
- [4] Verma R, Khanna P, Chawla S. Rubella vaccine: new horizon in prevention of congenital rubella syndrome in the India. *Hum Vaccin Immunother*. 2012 Jun;8(6):831-33. [PMID: [22495120](#)]
- [5] Jahromi AS, Kazemi A, Manshoori G, Madani A, Moosavy SH, Seddigh B. Seroprevalence of Rubella virus in women with spontaneous abortion. *Am J Inf Dis*. 2011;7:16-19.
- [6] Gibson CS, MacLennan AH, Goldwater PN, Haan EA, Priest K, Dekker GA; South Australian Cerebral Palsy Research Group. Neurotropic viruses and cerebral palsy: population based case-control study. *BMJ*. 2006 Jan 14;332(7533):76-80. [PMID: [16399770](#)]
- [7] Al-Hareth Z, Monem F, Abdel Megiud N. Is low birth weight a risk indicator for congenital cytomegalovirus infection? *J Infect Dev Ctries*. 2009 Nov 5;4(1):44-47. [PMID: [20130378](#)]
- [8] Workowski KA, Levine WC. Sexually transmitted

diseases treatment guidelines 2002. Centers for Disease Control and Prevention. MMWR Recomm Rep. 2002 May 10;51(RR-6):1-78. [PMID: 12184549]

[9] Ural SH, Grove MK, O'Connell NG. Genital herpes in pregnancy. United States: Medscape; 2020 Oct 15. Available from:

<https://emedicine.medscape.com/article/274874-overview>

[10] Biswas D, Borkakoty B, Mahanta J, Walia K, Saikia L, Akoijam BS, Jampa L, Kharkongar A, Zomawia E. Seroprevalence and risk factors of herpes simplex virus type-2 infection among pregnant women in Northeast India. BMC Infect Dis. 2011 Nov 23;11:325. [PMID: 22111810]

[11] Kimberlin DW. Neonatal herpes simplex infection. Clin Microbiol Rev. 2004 Jan;17(1):1-13. [PMID: 14726453]

[12] Yamamoto R, Ishii K, Shimada M, Hayashi S, Hidaka N, Nakayama M, Mitsuda N. Significance of maternal screening for toxoplasmosis, rubella, cytomegalovirus and herpes simplex virus infection in cases of fetal growth restriction. J Obstet Gynaecol Res. 2013 Mar;39(3):653-57. [PMID: 23107457]

[13] Patel KK, Shrivastava G, Bhatambare G, Bajpai T.

Antenatal detection of Ig M and Ig G antibodies to Toxoplasma gondii in a hospital from central India. Int J Health Sys and Disaster Man. 2014;2:133-35.

[14] Feldman DM, Keller R, Borgida AF. Toxoplasmosis, Parvovirus, and Cytomegalovirus in Pregnancy. Clin Lab Med. 2016 Jun;36(2):407-19. [PMID: 27235921]

[15] Dimech W, Arachchi N, Cai J, Sahin T, Wilson K. Investigation into low-level anti-rubella virus IgG results reported by commercial immunoassays. Clin Vaccine Immunol. 2013 Feb;20(2):255-61. [PMID: 23254301]

[16] Vauloup-Fellous C, Grangeot-Keros L. Humoral immune response after primary rubella virus infection and after vaccination. Clin Vaccine Immunol. 2007 May;14(5):644-47. [PMID: 17344342]

[17] Stegmann BJ, Carey JC. TORCH Infections. Toxoplasmosis, Other (syphilis, varicella-zoster, parvovirus B19), Rubella, Cytomegalovirus (CMV), and Herpes infections. Curr Womens Health Rep. 2002 Aug;2(4):253-58. [PMID: 12150751]

[18] Maingi Z, Nyamache AK. Seroprevalence of Cytomegalo Virus (CMV) among pregnant women in Thika, Kenya. BMC research notes. 2014 Dec;7(1):1-5.