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Sero-epidemiology of Marburg virus amongst respondents in Sobi Area, Ilorin, Kwara State, Nigeria

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Abstract
Marburg virus (MV) disease is a hemorrhagic fever of public health importance. There is sparse information on its prevalence in Nigeria. This study was aimed at determining the serological epidemiology and molecular confirmation of MV amongst inhabitants of Sobi in Ilorin, Nigeria in order to forestall a potential outbreak of MV disease. Serological evaluation of collected blood samples from consenting participants was carried out using MELSIN ELISA kit for antibody detection. Structured questionnaire was used to collect risk factor data. This study revealed the serological presence of Marburg virus IgG (26.5%) and IgM (19.0%) in this locality($P<0.05$). MV IgG and IgM prevalence by evaluated risk factors were 12(23.5%) and 6(16.7%), 11(21.6%) and 9(25.0%), and 27(50.9%) and 13(34.2%) for presence of bats in vicinity, respondent's visitation to park/zoo and presence of trees in residential area respectively at varying statistical correlations. Consumption of sick animals, contact with dead animals and involvement in preparation of dead body for burial showed an IgG/IgM positivity of 4(7.7%)/2(5.4%), 3(5.8%)/4(10.8%) and 11(21.2%)/4(10.8%) respectively. Higher frequency of contact or closer proximity to known risk factors showed higher prevalence and bats within vicinity revealed to be more amongst respondent with tree in residential area than those closer to Sobi hill. Reduction of bat to human contact and hygienic practices in occupation/research involving animals should be encouraged.
Keywords: *Marburg virus, hemorrhagic fever, incidence, prevalence, risk factors.*

INTRODUCTION

Marburg virus (MV) first reported in 1967, in Marburg and Frankfurt, Germany and Belgrade, Yugoslavia (now Serbia) where laboratory workers were infected with a previously unknown infectious agent. All infected patients developed severe disease that progressed to a fatal outcome in seven of the cases. The source of infection was traced back to African green monkeys (*Chlorocebus aethiops*) that had been imported from Uganda and were shipped to all three locations. The pathogen was named Marburg virus after the city with the most reported cases. Marburg virus (MARV) was the first described member of the *filoviridae* Family which also includes *Ebolavirus* (Pigott *et al.,* 2014). Viruses within the family *filoviridae* are highly pathogenic and can cause viral hemorrhagic fever with a high case-fatality rate ranging between 23% and 90% (Kortepeter *et al*., 2011).

In 1975, there was an incidence of the disease for the first time outside a laboratory in a region now known as Zimbabwe followed by singular cases in the year 1980 and 1987 (Pigott *et al.,* 2014). But in 1998, there was a report of multiple cases within a single year with an outbreak totaling 154 cases, majority of which were fatal (128) in the vicinity of Durba, Demographic republic of Congo (Bausch *et al.,* 2006). Evidences gathered from that outbreak spanning till the year 2000 pointed to bat colonies inhabiting gold mines in the region as source of infection (Bausch *et al.,* 2006).

However, in 2004, a large outbreak occurred in Uige Province, Angola which was characterized with continued cases driven by subsequent human to human transmission instead of repeated introductions from the natural sources (Towner *et al.,* 2006). In comparison with those two large outbreaks, most recent outbreaks have been smaller (WHO, 2014). Bats have been reported as the origin of initial index cases and further identification of the virus in Rousettus aegyptiacus via serological and molecular surveys conducted in caves and mines also confirms it (Swanepoel *et al.,* 2007). Contact with wildlife generates a small number of index cases (Leroy *et al.,* 2011), however, widespread and sustained disease transmission can follow in rural community settings with a subsequent high mortality rate (Kortepeter *et al.,* 2011). Hence the need for better understanding of all transmission pathways and critical review and update of guidelines with regards to risk within communities. Nigeria has been listed to be the 7th country with highest risk to Marburg virus exposure which can be adduced to the environmental similarity to countries with reported zoonotic transmission of Marburg virus disease (Pigott *et al.,* 2014).

There exists no record of incidence of Marburg virus hemorrhagic fever in Nigeria despite the presence bats which have been implicated as a possible host. Although, research on the virus is sparse reports on its member and diseases that could be transmitted by bats exists. There's need to ascertain the presence of the virus via detection of specific past and recent immunological markers amongst the populace which will provide a baseline data and also assist to better understand the scope of the risks to acquisition of Marburg virus disease.

MATERIALS AND METHODS

Study design/study site

This study was a hospital based cross-sectional study of consenting patients assessing Sobi Specialist Hospital, a reference hospital in Ilorin, Kwara State Nigeria that is located on 8030'N 4033'E /8.500°N 4.550°E. The focal point of this research is an area with close proximity to hills and cave which have been implicated as dwelling place for bats.

Study population

The inclusion criteria for selection were that, the patients; must be attending the hospital of study; reporting or showing signs of fever/febrile illness; must not be pregnant as at study period and must reside within or at close proximity to Sobi community. The respondent comprised of 200 patients who met the inclusion criteria at the general outpatient Department of Sobi Specialist Hospital. Ilorin, Kwara State.

Data collection

A well-structured questionnaire containing open and close ended questions was designed to obtain information from the patients. This was administered to patients after sensitization about the exercise and completion of informed consent form. The response to the questionnaire gave information about the socio-demographic profile and relevance of known risk factors to Marburg virus infection. Awareness of Marburg virus, and patient visitation to endemic areas or contact with infected individual and other risk factors associated to Marburg virus were enlisted.

Sample Collection and Separation

Sampling was from November, 2018 to July, 2019. Five milliliter (5 mL) of venous blood was collected aseptically from each subject into a sample bottle marked with a unique number that tallied with the number on their questionnaire. Blood samples were transported to the Department of Microbiology, University of Ilorin where the separation of serum was done by centrifugation at 1,600 revolutions per minute (rpm) for 5 minutes with a bench-top centrifuge. Serum samples were collected into plain prelabelled sample bottles and stored at -20°C. All kits were also refrigerated at 2-8°C.

Assay

The preserved sera were screened for Marburg virus Immunoglobulin G (IgG) and Immunoglobulin M (IgM) antibodies using the indirect qualitative enzyme immunoassay technique. The IgG results were expressed in international unit (IU) with calibration performed against reference standards of 5.0 and 10.0IU/mL, samples with Index values less than 0.5 are negative, greater than 1.1 are positive and samples that fall within the 0.5-1.1 are equivocal. The IgM assay was performed by an indirect ELISA assay. Analysis and interpretation of results was done according to the manufacturer's instruction (MELSIN Human Marburg Virus IgG and IgM Ab ELISA kit; CAT. NO: EKHU-1906840 and 1905) where samples were analyzed based on the following specification.

Test validity: the average of Positive control well ≥ 1.00; the average of Negative control well ≤ 0.15

Calculation of the Cut-off value (C.O.) = the absorbance value for of Negative control wells + 0.15.

Negative control**:** sample (Marburg Virus IgG /IgM Ab (MV IgG)) OD< Calculate Critical (CUT OFF), the result is Negative.

Positive control**:** sample (Marburg Virus IgG Ab (MV IgG/IgM)) OD≥ Calculate Critical (CUT OFF), the result is Positive.

Statistical analysis

The obtained assay results in relation to the compiled outcome of questionnaire were analyzed using Statistical Package for the Social Science (SPSS) version 21.0 software package to generate correlation/ cross-tabulations, Chi-square and p-value. The significance of the values was determined at $P<0.05$. Serostatus was also cross tabulated with evaluated risk factors.

Ethical Consideration

The approval for this study was granted by the Ethics Review Board of the Faculty of Life Sciences, University of Ilorin and the Ethical Review Committees of Ministry of Health Kwara state (Approval number: MOH/KS/EU/777/266). Informed consent was obtained from each patient and guardian/parent after a careful interpretation of the study.

RESULT

The highest recorded age was between 28-32 years with 54(27.0%) participants, followed by 23-27 years with 53(26.5%) participants. The age range 43-47 had the least record of 4(2.0%) followed by <18, >48, 38-42, 33-37 and 18-32 with 9(4.5%), 11(5.5%), 13(6.5%), 19(9.5%) and 34(17.0%) participants respectively. Of the 200 participants, three participants did not provide information about the age. The recorded standard error of mean was 0.118 with 1.663 standard deviation.

The gender distribution of respondent was 173(86.5%) and 23(11.5%) for female and male, participants respectively. The statistical standard error of mean was 0.023 and 0.323 standard deviation.

The highest recorded number of participants are married 161(80.5%), the single respondent was 36(18.0%) while the least was amongst the divorce (0.5%). The recorded standard error of mean was 0.028 with 0.395 standard deviation. (Table 1)

Out of the 200 consenting participants, MV IgG prevalence of 53 i.e. 26.5% and MV IgM prevalence of 38 i.e. 19.0% was recorded for Marburg virus respectively. At chi square of 10.489 and p value of 0.001, of the 53 IgG positive subjects, 18 were IgM positive for Marburg virus (P=0.001) while 20 of the respondent with negative IgG result were IgM positive (10.0%) (Figure 1). To access the risk factors to Marburg virus infection in this locality, the following result were analyzed via the administered questionnaire.

Out of the 21 enrollee who reported to have close proximity with bats, monkeys or other animals, 4(8.0%) tested positive to Marburg virus IgG and only 1(2.8%) positivity was recorded for IgM. Only 32 participants had visited other countries out of which 10(19.2%) was positive for MV IgG while 5(13.2%) was positive for MV IgM and no statistical association was observed. Based on the presence of bats in vicinity, respondent's visitation to park/zoo and presence of trees in residential area of participants, the recorded sero-positivity for MV IgG and IgM were 12(23.5%) and 6(16.7%), 11(21.6%) and 9(25.0%), and 27(50.9%) and 13(34.2%) respectively. The recorded p-value for IgG and IgM respectively for each factor were 0.976 and 0.271, 0.359 and 0.830, and 0.321 and 0.002. Sero-prevalence in relation to respondent consumption of sick animals, contact with dead animals and been involved in preparation of dead body for burial showed an IgG/IgM positivity of 4(7.7%)/2(5.4%), 3(5.8%)/4 (10.8%) and 11(21.2%)/4(10.8%) respectively at 0.896/0.623, 0.528/0.443 and 0.010/0.891 statistical significance (P-value). (Table 2).

Out of the 108(57.4%) respondent that reported to have trees around the residential area, 31(70.5%) of them reported to have noticed bats within vicinity while 77(53.5%) reported otherwise (p=0.046). Vicinity of bats was highest amongst the group that are far away (17(38.6%)) from Sobi hill followed by very far (14 (31.8%)), close (8(18.2%)) and very close (5(11.4%)) respectively (p=0.313). (Table 3)

The relation of the associated symptoms to prevalence of MV ranged from abdominal pain (18(69.2%), nausea and loss of appetite (4 (15.4%)), throat pain/ swallowing difficulty (2(7.7%)) while diarrhea and conjunctivitis had 1 (3.8%) prevalence for Marburg virus IgG. For MV IgM, the highest was recorded for abdominal pain (9(64.3%)) and the least prevalence of zero for diarrhea. Caring for relatives with the symptoms showed a prevalence of 7(14.0%) and 2(5.6%) for MV IgG and IgM respectively. Respondent with recent history of fever had 14(26.9%) and 4(10.5%) prevalence of MV IgG and IgM respectively. Participants with eye coloration within that period had prevalence of 9(17.3%) and 5(13.2%) for IgG and IgM while presence of joint pain with the period had 18(36.0%) and 7(18.9%) prevalence respectively. (Table 4)

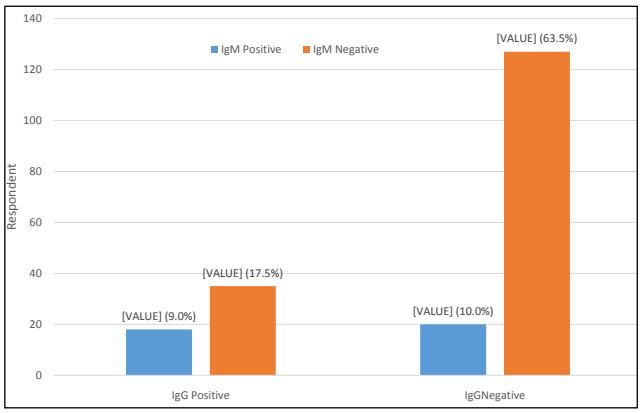

Figure 1: Prevalence of Marburg virus IgG and IgM amongst the respondent

Table 1: Demographic characteristics of respondent

		Respondent	Percentage	Standard error of mean	Standard deviation
Age	<18	9	4.6%	0.118	1.663
	18-22	34	17.3%		
	23-27	53	26.9%		
	28-32	54	27.4%		
	33-37	19	9.6%		
	38-42	13	6.6%		
	43-47	4	2.0%		
	>48	11	5.6%		
	Subtotal	197	100.0%		
Gender	Male	23	11.7%	0.023	0.323
	Female	173	88.3%		
	Subtotal	196	100.0%		
Marital Status	Single	36	18.2%	0.028	0.395
	Married	161	81.3%		
	Divorce	1	0.5%		
	Widow	0	0.0%		
	Subtotal	198	100.0%		
Marriage Type	Not Specify	0	0.0%	0.033	0.411
	Monogamous	122	78.7%		
	Polygamous	33	21.3%		
	Subtotal	155	100.0%		

Table 2: Marburg virus sero-positivity in relation to risk factors amongst respondent

		MV IgG Positive (%)	p-value	MV IgM Positive (%)	p-value	Total (%)
Occupational proximity to bats, Monkeys or other animals	Yes	4 (8.0)	0.390	1 (2.8)	0.072	21 (11.3)
	No	46 (92.0)		35 (97.2)		165 (88.7)
Research involving animals	Yes	2 (3.9)	0.919	1 (2.7)	0.620	8 (4.2)
	No	49 (96.1)		36 (97.3)		184 (95.8)
Have you visited other Country	Yes	10 (19.2)	0.496	5 (13.2)	0.566	32 (16.2)
	No	42 (80.8)		33 (86.8)		165 (83.8)
Bats in the Vicinity	Yes	12 (23.5)	0.976	6 (16.7)	0.271	45 (23.7)
	No	39 (76.5)		30 (83.3)		145 (76.3)
Visitation to Park	Yes	11 (21.6)	0.359	9 (25.0)	0.830	51 (26.4)
	No	40 (78.4)		27 (75.0)		142 (73.6)
Trees around Resident	Yes	27 (50.9)	0.321	13 (34.2)	0.002*	110 (56.7)
	No	26 (49.1)		25 (65.8)		84 (43.3)
Consumption of Sick animal	Yes	4 (7.7)	0.896	2 (5.4)	0.623	14 (7.3)
	No	48 (92.3)		35 (94.6)		178 (92.7)
History of Contact with Dead Animal	Yes	3 (5.8)	0.528	4 (10.8)	0.443	15 (7.8)
	No	49 (94.2)		33 (89.2)		178 (92.2)
History of Preparation of Dead Body for Burial	Yes	11 (21.2)	0.010*	4 (10.8)	0.891	22 (11.5)
	No	41 (78.8)		33 (89.2)		170 (88.5)
	Total	**52 (100.0)**		**37 (100.0)**		**192 (100.0)**

*p<0.05 is statistically significant

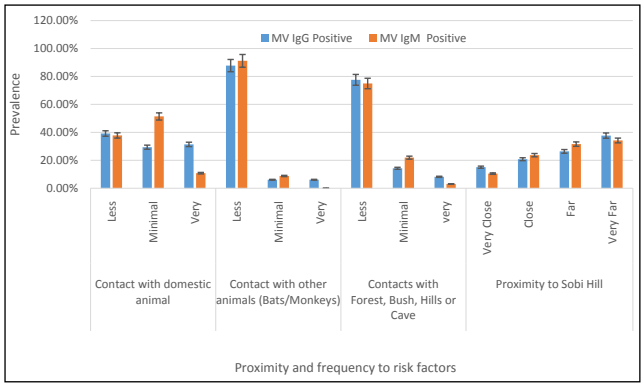

Figure 2: Percentage positivity of Marburg virus based on frequency and proximity to risk factors

Table 3: Bats in vicinity in correlation to trees around residential area and proximity to Sobi hill.

No (%)		Bats in the Vicinity			p-value
		Yes (%)	Total (%)		
Trees around Resident	Yes	77 (53.5)	31 (70.5)	108 (57.4)	0.046*
	No	67 (46.5)	13 (29.5)	80 (42.6)	
Proximity to Sobi Hill	Very Close	20 (14.2)	5 (11.4)	25 (13.5)	0.313
	Close	25 (17.7)	8 (18.2)	33 (17.8)	
	Far	35 (24.8)	17 (38.6)	52 (28.1)	
	Very Far	61 (43.3)	14 (31.8)	75 (40.5)	
	Total	**141 (100.0)**	**44 (100.0)**	**185 (100.0)**	

*P<0.05 is statistically significant

Table 4: Marburg virus positivity in correlation to symptoms history of the respondent

		IgG Positive (%)	P value	IgM Positive (%)	P value	Total (%)
Exhibited the following symptoms in past 3weeks	Conjunctivitis	1 (3.8)	**0.193**	1 (7.1)	**0.258**	13 (12.6)
	Nausea and Loss of Appetite	4 (15.4)		1 (7.1)		24 (23.3)
	Throat pain/Swallowing Difficulty	2 (7.7)		3 (21.4)		11 (10.7)
	Abdominal Pain	18 (69.2)		9 (64.3)		51 (49.5)
	Diarrhea	1 (3.8)		0 (0.0)		4 (3.9)
Have you cared for someone of with stated symptoms	Yes	7 (14.0)	**0.982**	2 (5.6)	**0.107**	26 (13.9)
	No	43 (86.0)		34 (94.4)		161 (86.1)
History of Fever within past 2 weeks	Yes	14 (26.9)	**0.395**	4 (10.5)	**0.002***	61 (31.6)
	No	38 (73.1)		34 (89.5)		132 (68.4)
Eye Coloration with the fever period	Yes	9 (17.3)	**0.590**	5 (13.2)	**0.719**	29 (15.0)
	No	43 (82.7)		33 (86.8)		164 (85.0)
Joint Pain within the Fever Period	Yes	18 (36.0)	**0.594**	7 (18.9)	**0.005***	74 (39.2)
	No	32 (64.0)		30 (81.1)		115 (60.8)
	Total	50 (100.0)		37 (100.0)		189 (100.0)

*P<0.05 is statistically significant

DISCUSSION

This is a randomized study to determine the prevalence of Marburg virus immunological markers amongst the populace residing around Sobi area and also attending the hospital. Sobi and it environ was of research interest due to the presence of the Sobi hill which could cause colonization of bats which has been identified as the major reservoir of Marburg virus. Transmission of Marburg virus disease was initially based on prolonged exposure to caves or mines that are inhabited by colonies of the host bat known as the *Rousettus* bat. In recent times, human to human transmission through broken skin, mucous membrane, contact with blood, secretion (bodily fluids) and organs of infected people referred to as direct route or via contact with surfaces and materials such as beddings and clothing contaminated with fluids are more pronounced. Route of transmission has also been proposed to influence fatality by enhancing severity and deterioration (WHO, 2017).

The risk factors to the acquisition of Marburg virus which included proximity to known host or reservoir of the virus such as bats and monkeys, visitation to other country of previous outbreaks, consumption of sick animals, contact with dead animals, preparation of dead body for burial amongst others were evaluated amongst the respondent to evaluate statistical correlation. The highest record was obtained with the presence of trees around resident while the least was with research involving animals. This result can however be linked to the socio-economic data of the respondent as indicated in the occupation and the residential areas which is usually characterized by trees which are grown for several reasons such as for shade, ventilation or edible fruit purposes. Fruit Bat is a very large category of bat and thus the range and description of their habitat and range is always generalized. It's generally safe to say that fruit bats inhabit most areas of tropical and semi-tropical areas of the Earth which are warm enough to have fruits and/or flowers all year long (Stefan, 2019). Since most trees around residential areas often falls in to this category, attraction of birds such as bats is thus not far-fetched. Findings also suggests that the risk of contact with bats increases due to migration, changes in ecological niche and human intrusion in to their habitat which increases proximity to woodlands. Apart from Marburg virus, Hendra and Nipah virus are other example of viruses that could also be transmitted (Walsh, 2017). Treatment of tree could be encouraged to restrict colonization of residential trees.

The prevalence of Marburg virus in this location was noticed to be 26.5% amongst participants that had been initially exposed to the virus and thus the presence of immunoglobulin G in the assayed serum samples while the samples that exhibited recent or current infection which was detected by the presence of immunoglobulin M of Marburg virus had a prevalence of 19.0%. The optical densities were noticed to be generally low which suggest past exposure or inherited herd immunity. Few of the respondents had both immunoglobulins i.e. MV IgG and MV IgM after assays which suggest either a secondary exposure or recovery due to a recent infection or re-infection prior to sample collection. Although, unanswered questions have been raised regarding the relationship between human immunity and diseases outbreaks, viral load has been proven to be an important marker for survival (Mohan *et al.*, 2016). Several potential animal reservoirs or alternative hosts were reported such as pig (Barrette *et al*., 2009), suggesting that human outbreaks may involve incidental exposures to infected animals while the events that trigger cycles of human infections are not clearly understood, human-to-human disease transmission through direct physical contact with infected body fluids is still the most challenging route (CDC, 2014; WHO, 2017).

Reports revealed that after the initial crossover of virus from host animal to humans, transmission occurred through person-to-person contact which may happen in several ways: direct contact to droplets of body fluids from infected persons, or contact with equipment and other objects contaminated with infectious blood or tissues (CDC, 2014). Types of occupation such as mine workers or cave related jobs has been reported to contribute to the risk of infection in the past outbreaks.

Amongst the evaluated risk factors to MV infection, visitation to other country, presence of bats in vicinity, consumption of sick animals, history of contact with dead animals and history of dead body preparations for burial had higher immunoglobulin prevalence over participants that responded negative to such questions and thus suggests their relevance as risk factors. Other evaluated factors such as occupational proximity to bats, monkeys or other animals, research involving animals, park visitations and trees around residential area had lesser prevalence. A research by Ogawa *et al*. (2015) on fruit bats migrating in Africa to determine the prevalence of multiple specie of Filovirus revealed the presence of filovirus-specific immunoglobulin G antibodies in 71 of 748 serum samples collected from migratory fruit bats (*Eidolon helvum*) in Zambia during 2006-2013 using an enzyme-linked immunosorbent assay based on the viral glycoprotein antigens. Interestingly, the transition of filovirus species causing outbreaks in Central and West Africa during 2005-2014 seemed to be synchronized with the change of

the serologically dominant virus species in these bats. The data further suggest the introduction of multiple species of filoviruses in the migratory bat population and pointed to the need for continued surveillance of filovirus infection of wild animals in sub-Saharan Africa, including hitherto non-endemic countries. (Ogawa *et al*., 2015).

The proximity and frequency to certain risk factors such as contact with animals (bats, monkeys and others) and proximity to Sobi hill to enable an evaluation of any potential risk been posed by the location revealed a fluctuating prevalence where less to minimal contact had higher prevalence of MV immunoglobulin as opposed to respondent with higher frequency. Furthermore, the proximity to Sobi hill also had increased prevalence across very close to very far. This factor revealed not to be a pronounced risk factor to MV infection in this location which is in contrary to research. Analysis of the possible reasons adduced to presence of bats in vicinity as reported by respondent showed that, at a significant statistical level, presence of tree around the residential area could have influenced the outcome and likewise the proximity to Sobi hill which had no significant p value but with higher prevalence. Since fruit bats are known to be drawn to trees with flowers, nectars and fruits, the type of trees in residential area could have influence the type of birds been attracted. There have been report about caves around hills as a risk factor to Marburg virus infection where male patient with a recent travel history including a visit to Kitum Cave in Kenya's Mount Elgon National Park was infected and died while the doctor who attempted resuscitation recovered and also of a Danish boy that also visited a cave in Kenya and got infected (CDC, 2008; Masfique *et al*., 2011; Knust *et al*., 2012; PHE, 2017). Although the prevalence in relation to Sobi hill was low, further studies to map the specie of bats within the location and serological evaluation of the Marburg virus are important.

General symptoms of the Filovirus infection revealed from outbreak cases includes fever, chills, headache, myalgia, and anorexia which may be followed by abdominal pain, sore throat, nausea, vomiting, cough, arthralgia, diarrhea, and pharyngeal and conjunctival vasodilatation. Patients were noticed to be dehydrated, apathetic, and disoriented. They may develop a characteristic, non-pruritic, maculopapular centripetal rash associated with varying degrees of erythema, which desquamates by day five or seven of the illness. Hemorrhagic manifestations develop at the peak of the illness, and are of prognostic value. Bleeding into the gastrointestinal tract is the most prominent, besides petechial and hemorrhages from puncture wounds and mucous membranes (Kortepeter *et al*., 2011; Knust *et al*., 2012; Nyakarahuka *et al*., 2016). In this study, participants that exhibited the following symptoms; conjunctivitis, nausea and loss of appetite, throat pain, abdominal pain and diarrhea within three weeks prior to sample collection had IgG and IgM prevalence of 3.8 and 7.1%, 15.4 and 7.1%, 7.7 and 2.4%, 69.2 and 64.3%, and 3.8% and 0.0% respectively. Furthermore, history of fever within two weeks prior to sample collection, noticeable eye coloration and joint pain within the fever period also followed similar trend of lower IgG and IgM prevalence.

However, the statistical significance for primary infection detected via IgM sero status amongst the respondent was significant for fever history and joint pain during fever period. It can be construed that some of the associated symptoms for MV infection were not evident of its infection and thus such manifestation could have been from other infections such as malaria. Based on the large gap of gender difference within the study participants, the increase record of abdominal pain could have been most adduced to the female subjects that often experience pain during their cycle or due to other stomach disorder.

The resulting symptoms for Filovirus have been generally considered as the consequence of pathogenicity where clinical and biochemical findings support anatomical observations of extensive liver involvement, renal damage, changes in vascular permeability, and activation of the clotting cascade. Visceral organ necrosis is the consequence of virus replication in parenchymal cells. However, no organ is sufficiently damaged to cause death. Fluid distribution problems and platelet abnormalities has been revealed to indicate dysfunction of endothelial cells and platelets. The shock syndrome in severe and fatal cases seems to be mediated by virus-induced release of humoral factors such as cytokines (Heinz and Han-Dieter, 1996: Nyakarahuka *et al*., 2016: PHE, 2017, WHO, 2017). Filovirus glycoproteins carry a presumably immunosuppressive domain, and such immunosuppression has been observed in infected monkeys. Host defense in humans and monkeys, revealed an extensive disruption of the Para follicular regions in the spleen and lymph nodes that contain the antigen-presenting dendritic cells but the rise in non-neutralizing antibodies indicates cell mediated immunity as mediator for recovery (Heinz and Han-Dieter, 1996: Nyakarahuka *et al*., 2016: PHE, 2017, WHO, 2017).

This study has revealed the serological presence of Marburg virus IgG and IgM in this locality which could have resulted from exposure to the virus, its risk factors or transfer of immunity that could occur vertically. Marburg virus is known to persist in immune privileged sites such as testicles, eyes, placenta, amniotic fluid, fetus and breast milk in some people that have recovered or been exposed directly or indirectly to the virus. While the reason for this phenomenon has not yet been fully understood, relapse of mild symptomatic illness could occur in the absence of re-infection. It is therefore recommended that reduction of bat to human contact via fumigation of residential trees to discourage bat colonies, reduction of human to human transmission via hygienic practices and safer sex and adequate prevention practice in occupation or research involving potential risk factors such as the reservoir or with other animals such as pigs be encouraged to limit spread of the virus. Further research to map the specie of bats in this location and a serological study on the prevalence of Marburg virus amongst the bat will shed more light on the genetic diversity of the virus, the difference in virulence or pathogenicity and further understanding of immune response to facilitate diagnostic methods, therapeutics and vaccines development. Additionally, molecular epidemiology and confirmation is also required to ascertain strain distribution by location of the virus.

Conflict of interest

None

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