Scientific African 3 (2019) e00072

Contents lists available at ScienceDirect

Scientific African

journal homepage: www.elsevier.com/locate/sciaf

Human T Cell Lymphotrophic virus infection among sexually active individuals in Nigeria: A cross sectional study

Babatunde Olusola[a], Adedayo Faneye[a,*], Yewande Nejo[a,b], Adewale Opayele[a], Solomon Bakarey[c]

[a] Department of Virology, College of Medicine, University of Ibadan, Ibadan, Nigeria
[b] Department of Biological Sciences, Bowen University, Iwo, Osun state, Nigeria
[c] Institute of Advanced Medical Research and Training, College of Medicine, University of Ibadan, Ibadan, Nigeria

ARTICLE INFO

Article history:
Received 3 January 2019
Revised 12 April 2019
Accepted 16 April 2019

Keywords:
Sexually transmitted infections
HTLV
Heterosexual transmission
Nigeria

ABSTRACT

Introduction: Human T Cell Lymphotrophic virus (HTLV) is endemic in many regions of the world including Nigeria but not ubiquitous. It has been shown to be causally associated with T cell leukaemia and other myelopathies. Heterosexual contact is the major route of HTLV transmission. STDs patients, pregnant women and other sexually active individuals have been shown to be at risk of HTLV infection. However, there is limited information on population mostly at risk in endemic countries like Nigeria. Here we determined the prevalence of HTLV I and II infection amongst three sexually active populations comprising of pregnant women, adults and teenagers as well as sexually transmitted infections (STI) clinic attendees.

Methods: Sera of 463 participants comprising 184 pregnant women, 82 adult, 103 teens and 94 individuals attending STI clinics in Nigeria were tested for HTLV I/II specific antibodies using ELISA technique.

Results: Overall, 17 (3.7%) individuals had antibodies to HTLV I/II. The infection was highest among persons attending STI clinics (11.7%) and lowest among pregnant women (0.5%). Reproductive age group (21–50years) was associated with HTLV I/II infection across both gender. STI clinic attendance (Odds ratio: 14.012; P-value = 0.018) and male gender (Odds ratio: 2.828; P-value < 0.05) were strong predictors of HTLV I/II infection.

Conclusions: HTLV infection is prevalent among sexually active persons in Nigeria. Individuals with STIs are at a higher risk of HTLV I/II infection. Individuals attending STI clinics should be routinely screened for HTLV infection to aid prevention and control efforts.

© 2019 The Authors. Published by Elsevier B.V. on behalf of African Institute of Mathematical Sciences / Next Einstein Initiative.
This is an open access article under the CC BY license.
(http://creativecommons.org/licenses/by/4.0/)

Abbreviations: ELISA, Enzyme Linked Immunosorbent Assay; HAM/TSP, HTLV- associated myeolopathy/tropical spastic paraparesis; HTLV, Human T cell Lymphotrophic virus; PCR, Polymerase Chain Reaction; STDs, sexually transmitted diseases; STIs, sexually transmitted infections.

* Corresponding author.
E-mail address: adedayoraji@yahoo.com (A. Faneye).

https://doi.org/10.1016/j.sciaf.2019.e00072
2468-2276/© 2019 The Authors. Published by Elsevier B.V. on behalf of African Institute of Mathematical Sciences / Next Einstein Initiative. This is an open access article under the CC BY license. (http://creativecommons.org/licenses/by/4.0/)

1. Introduction

Human T-lymphotropic virus types I and II (HTLV-I and II) are two closely related retroviruses in the *Deltaretrovirus* genus. They were identified about four decades ago and both share a number of biological characteristics in common. These include T cell lymphocyte tropism and about 65% nucleotide sequence similarity [1,2]. Both viruses can cause lifelong infections in infected individuals leading to an asymptomatic carrier state, although, a small percentage of infected persons develop clinical disease [3,4]. HTLV-1 has been associated with two severe human diseases: adult T-cell leukaemia/lymphoma (ATL) and HTLV-associated myelopathy/tropical spastic paraparesis (HAM/TSP). Other inflammatory conditions including arthropathy, uveitis, myositis and infective dermatitis [1,12,21–23,28].

Transmission of both HTLV-I and II requires the transfer of live infected T lymphocytes in breast milk, semen and blood. Sexual (homo and heterosexual), parenteral (blood transfusion, pricks and needles) as well vertical (trans placental and breastfeeding) transmission of HTLV are the three main routes of infection [6,9,10]. About 15–20 million people worldwide are infected with HTLV-I/II and the prevalence could be as high as 30% in endemic regions. High endemicity has been recorded in parts of Japan, Africa, Caribbean islands and South America [8,10]. Africa, with a population over 1.2 billion is a very large endemic area for HTLV infection [6,7].

The virus is unevenly distributed throughout the world even in endemic areas [13]. Studies have shown that clusters of high endemicity are always nearby areas where the prevalence of the virus is low [8,9,21]. Prevalence of this virus varies according to ethnic and social background as well as the geographical area. Specific risk groups such as commercial sex workers, STD patients, intravenous drug users and pregnant women also have varied prevalences globally [15,16,29].

In Nigeria, there are indications that HTLV is predominantly transmitted horizontally [17]. Previous studies in the country have reported high prevalence of the virus amongst commercial sex workers, STD patients and pregnant women. Some studies have also documented the presence of HTLV antibodies among children, students and blood donors but with a lower prevalence [3,5,14,15,17,18]. These studies investigated the groups separately across specific geographical regions. There is a need to investigate these sexually active groups across a wider geographical region in the country in order to determine population mostly at risk since the virus is geographically delineated [9]. It is also not clear if the prevalence of the virus is higher across all sexually active individuals compared to the general population.

Therefore, we investigated the prevalence of HTLV I and II infection amongst three sexually active groups: pregnant women, adults and teenagers as well as STD patients across 5 states in Nigeria to identify population mostly at risk.

2. Materials and methods

2.1. Study population

A total of 463 individuals within the age range of 15–60 years attending either sexually transmitted infection (STI) or antenatal clinics as well as those presenting at medical outpatients units of Bowen University Teaching Hospital, Ogbomosho, Oyo state ($n = 92$), Bowen University Hospital, Iwo, Osun state ($n = 92$), Federal Medical Centre, Ido-Ekiti, Ekiti state ($n = 94$), Primary Health Centre, Ogijo, Shagamu, Ogun State ($n = 92$) and Epidemiological Unit of the Ministry of Health, Jos, Plateau State ($n = 93$) who consented to participate in the study were enrolled between January 2014 and December 2015.

Ethical approval for this research was obtained from the University of Ibadan/ University College Hospital (UI/ UCH) Research and Ethics Committee (UI/EC/12/0387). Procedures were followed in accordance with the ethical standards of the committee and with the Helsinki Declaration of 1975, revised 2000. Written informed consent was obtained from each patient before participating in the study. Sexually active individuals aged 15–60 years attending aforementioned clinics that consented to participate in the study were randomly selected for this study while critically ill individuals were excluded.

2.2. Sample collection

About 5mls of blood sample was collected by venipuncture from each participant into anticoagulant (EDTA) bottles. Plasma samples were separated and transferred into labeled plain bottles which were then stored at −20 °C until testing.

2.3. Testing for HTLV I and II antibodies

Plasma samples were thawed and tested for HTLV I and II antibodies using ELISA kits by Wantai (Beijing wantai Biological Pharmacy Enterprise, Beijing, China) according to the manufacturer's instruction. The optical density of the plates was read using the Emax Endpoint Microplate Reader (Molecular devices, California, USA). Controls were read first before test samples and results were calculated based on cut off values, set as mean value of 3 negative controls + 0.12 O. D according to the manufacturer's instruction. Samples with equivocal results were retested and if afterwards remains equivocal were regarded as negative.

Table 1a
HTLV I/II seroprevalence across study groups.

		Anti-HTLV I/II		Total
		Negative (%)	Positive (%)	
Groups	Pregnant Women	183 (99.5)	1(0.5)	184
	Adults	80 (97.6)	2(2.4)	82
	Teens	100 (97.1)	3 (2.9)	103
	STI Clinic attendees	83(88.3)	11(11.7)	94
Total		446(96.3)	17(3.7)	463

P-value = 0.0001.

Table 1b
Distribution of HTLV I/II across age and gender.

Age (Years)	Male		Female		Total	
	+Ve (%)	−Ve	+Ve (%)	−Ve	+Ve (%)	−Ve
<20	2 (4.7)	40	0	68	2 (1.8)	108
21–30	3 (12)	22	1(0.7)	140	4 (2.4)	162
31–40	3 (11.5)	23	5(4.4)	107	8 (5.8)	130
41–50	2 (11.7)	15	1(5)	19	3(8.1)	34
>50	0	7	0	5	0	12
Total	10 (8.5)	107	7(2.0)	339	17 (3.7)	446
P value	0.001[a]				0.297[b]	

[a] Level of significance: male/female.
[b] Level of significance: age groups.

2.4. Statistical analysis

Data were analyzed by Statistical Package for the Social Sciences (SPSS) version 21. Variables including age, sex and category were analyzed using non-parametric tests such as chi square test and binary logistic regression. Results were presented using descriptive statistics. Statistical significance was set at $P < 0.05$.

3. Results

3.1. STI clinic attendees had the highest prevalence of HTLV I/II among study participants

Three hundred and forty-six (74.7%) participants were females. The mean age ± SD of the study participants was 34 ± 2 years. A total of seventeen (3.7%) out of the 463 sera tested for HTLV I/II specific antibodies were positive. Attendees of STI clinic had the highest prevalence (11.7%) as shown in Table 1a.

3.2. Reproductive age group and male gender were associated with HTLV I/II infection

There was a significant difference in the prevalence of HTLV I/II antibodies positivity among the groups studied ($P = 0.0001$). Male participants had a significantly higher seroprevalence of HTLVI/II as shown in Table 1b (8.5%; $P = 0.001$). The highest prevalence of HTLV I/II antibody seropositivity were found among reproductive age groups (21–40 years) (Table 1b).

3.3. STI clinic attendees had the highest odds of infection

Attendance at STI clinic had the highest odds of infection when compared with gender and study groups (14.012; $P = 0.018$) (Table 2a).

Among female participants only, STI clinic attendees still had the highest odds of infection (12.470; $P = 0.026$) (Table 2b).

4. Discussion

From this study, an overall prevalence of 3.7% for HTLV I and II antibodies among the three sexually active groups investigated (Pregnant women, Teens and STI clinic attendees) was observed. The infection was highest among persons attending STI clinics (11.7%) and lowest among pregnant women (0.5%). This information is important for the control of the infection in areas where the virus is endemic like Nigeria.

The rates found in this study are much lower than 11.5% reported by [15,20]. Also, the rates observed in this study is lower than 16.7% and 5.1% reported among pregnant women and teenagers respectively in Ibadan by [5,21]. The differences

Table 2a
Gender and group distribution of HTLV I/II prevalence among the study population.

Variable	Prevalence	Odds ratio	*P*-value (use confidence interval)
Gender			
Male	8.5%	2.828	0.05*
Female	2.0%	a	
Category			
Pregnant Women	0.5%	b	
Adults & Teens	2.7%	3.093	0.094#
STI Clinic Attendees	11.7%	14.012	0.018+

a: reference group.
b: reference group.
* Level of significant difference in odds ratio between Male/Female.
# Level of significant difference in odds ratio between Adults & Teens/Pregnant Women.
+ Level of significant difference in odds ratio between STI Clinic Attendees/Pregnant Women.

Table 2b
Prevalence of HTLV I/II among female participants.

Female gender	Prevalence	Odds ratio	*P*-value
Category			
Pregnant Women	0.5%	a	
Adults & Teens	1.0%	4.186	0.324#
STI Clinic Attendees	8.8%	12.470	0.026*

a: reference group.
* Level of significant difference in odds ratio between STI Clinic Attendees/Pregnant Women.
# Level of significant difference in odds ratio between Adults & Teens/Pregnant Women.

observed in the rates may be due to the geographical delineation associated with HTLV as studies have shown high prevalence of HTLVI/II in Ibadan [11,22]. Furthermore, Olaleye et al.[20] used different methods for HTLV detection which included western blotting and PCR. These methods are more sensitive than ELISA used in our study. However, the prevalence observed in our study is comparable to the report from Enugu, eastern Nigeria, where HTLV I prevalence of 0.5% was reported among pregnant women in 2010 [16].

Since HIV and HTLV share similar route of transmission, it is possible that the reduced prevalence documented in our study when compared to studies carried out over a decade ago is a result of the control efforts targeted at HIV prevention and control. More so, findings of recent studies from Nigeria show that HTLV prevalence remains low in the general population [3,10,17]. The prevalence observed amongst adults and teens (2.7%) in this study is close to the overall prevalence of 3.7%. These individuals give a better picture of happenings in the general population.

Higher infection rates with HTLV I/II were recorded among male participants in our study, this observation is worrisome considering the fact that HTLV-1 is transmitted more efficiently from males to females [24]. Male gender has been shown to be associated with a higher susceptibility to viral infections. Recently, studies have identified hormonal as well as sex chromosomal differences as causes for this [25–27]. Reproductive age group (21–50 years) had the highest prevalence of HTLV. The burden of infection accumulated with increasing age. This is not surprising since sexual involvements are highest within these age groups. This observation is in agreement with previous studies [4,5,14]. Our findings confirm the fact that sexually active individuals are at a higher risk of HTLV infection.

Although the three groups are sexually active, participants with STDs had the highest rates of HTLV I/II infection and are over fourteen times more likely to be infected with HTLV compared to other sexually active persons. Data from our study agrees with previous studies that have been carried out in Nigeria where HTLV have been noted to have high rates of occurrence among STD patients [14]. This might be due to the fact that HTLV transmission is enhanced by sexually transmitted diseases such as syphilis, chancroid and HSV-2 that cause ulcers and mucosal ruptures on the genitals [19].

5. Conclusions

This study has shown that male gender and especially persons with STDs are at a higher risk of HTLV infection. Focused interventions for STD clinic attendees are hereby advised to control HTLV infection in the country. Male spouses of women seeking ante-natal care should also be counselled and screened for HTLV infection. It is important to increase awareness of HTLV infection with emphasis on safe sexual practices since there are currently no vaccines. There is a need to introduce routine screening and control programs for these high risk groups so as to curb the spread of the virus.

Summary table: What is known about this subject:

- About 15–20 million people worldwide are infected with HTLV-I/II and the prevalence could be up to 30% in endemic regions (=125 characters).
- Heterosexual contact is the major route of HTLV transmission (=62 characters).
- There is limited information on population mostly at risk in endemic countries like Nigeria (=93 characters).

What this paper adds:

- HTLV infection is prevalent among sexually active persons in Nigeria with higher burden among males (=103 characters).
- Individuals with STIs are at a higher risk of HTLV I/II infection (=71 characters).
- Focused interventions for STD clinic attendees are hereby advised so as to control HTLV infection (=99 characters).

Summary sentence: This work represents an advance in biomedical science because it shows that individuals with STIs have the highest risk of HTLV infection. This information is important for prevention and control of the virus. (= 207 characters).

CRediT authorship contribution statement

Babatunde Olusola: Data curation, Project administration, Formal analysis, Resources, Writing - original draft. **Adedayo Faneye:** Data curation, Project administration, Formal analysis, Resources, Writing - original draft. **Yewande Nejo:** Data curation, Project administration, Formal analysis, Resources. **Adewale Opayele:** Data curation, Project administration, Formal analysis, Resources. **Solomon Bakarey:** Data curation, Formal analysis, Resources.

Conflicts of interest

None.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-for profit sectors.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.sciaf.2019.e00072.

References

[1] B.J. Poiesz, F.W. Ruscetti, A.F. Gazdar, P.A. Bunn, J.D. Minna, R.C. Gallo, Detection and isolation of type C retrovirus particles from fresh and cultured lymphocytes of a patient with cutaneous T-cell lymphoma, Proc. Natl. Acad. Sci. USA 77 (Dec (12)) (1980) 7415–7419. cited 2019 Apr 7Available from http://www.ncbi.nlm.nih.gov/pubmed/6261256 .
[2] G.W. Lowis, W.A. Sheremata, A. Minagar, Epidemiologic features of HTLV-II: serologic and molecular evidence, Ann. Epidemiol. 12 (Jan (1)) (2002) 46–66. cited 2019 Apr 7Available from http://www.ncbi.nlm.nih.gov/pubmed/11750240 .
[3] G. Tanaka, A. Okayama, T. Watanabe, S. Aizawa, S. Stuver, N. Mueller, et al., The clonal expansion of human T lymphotropic virus type 1–infected T cells: a comparison between seroconverters and long-term carriers, J. Infect. Dis. 191 (Apr (7) (2005) 1140–1147. cited 2019 Apr 7Available from http://www.ncbi.nlm.nih.gov/pubmed/15747250 .
[4] A.O. Udeze, M.B. Odebisi-Omokanye, A. Faneye, B.A. Olusola, O. Ogunsemowo, C. Iwuoha, et al., Serological detection of human T-cell lymphotropic virus types I and II among pregnant women in Ilorin, Nigeria, J. Immunoass. Immunochem. (2018).
[5] F.A. Proietti, A.B.F. Carneiro-Proietti, B.C. Catalan-Soares, E.L. Murphy, Global epidemiology of HTLV-I infection and associated diseases, Oncogene 24 (39) (2005) 6058–6068. Available from http://www.nature.com/doifinder/10.1038/sj.onc.1208968%5Cnhttp://www.ncbi.nlm.nih.gov/pubmed/16155612 .
[6] D.F. Roucoux, E.L. Murphy, The epidemiology and disease outcomes of human T-lymphotropic virus type II, AIDS Rev. 6 (2004) 144–154.
[7] E.L. Murphy, B. Wang, R.A. Sacher, J. Fridey, J.W. Smith, C.C. Nass, et al., Respiratory and urinary tract infections, arthritis, and asthma associated with HTLV-I and HTLV-II infection, Emerg. Infect. Dis. 10 (1) (2004) 109–116.
[8] H.H. Biswas, Z. Kaidarova, G. Garratty, J.W. Gibble, B.H. Newman, J.W. Smith, et al., Increased all-cause and cancer mortality in HTLV-II infection, J. Acquir. Immune Defic. Syndr. 54 (3) (2010) 290–296.
[9] D.F. Roucoux, B. Wang, D. Smith, C.C. Nass, J. Smith, S.T. Hutching, et al., A prospective study of sexual transmission of human T lymphotropic virus (HTLV)–I and HTLV-II, J. Infect. Dis. 191 (May (9)) (2005) 1490–1497. cited 2019 Apr 7Available from http://www.ncbi.nlm.nih.gov/pubmed/15809908 .
[10] M.S.S. Namen-Lopes, M.L. Martins, P.C. Drummond, R.R. Lobato, A.B.F. Carneiro-Proietti, Lookback study of HTLV-1 and 2 seropositive donors and their recipients in Belo Horizonte, Brazil, Transfus Med. 19 (Aug(4)) (2009) 180–188. [Internetcited 2019 Apr 7Available from http://doi.wiley.com/10.1111/j.1365-3148.2009.00932.x .
[11] G. González-Alcaide, J.M. Ramos, C. Huamaní, M.C. de, V. Soriano, Human T-lymphotropic virus 1 (HTLV-1) and human T-lymphotropic virus 2 (HTLV-2): geographical research trends and collaboration networks (1989-2012), Rev. Inst. Med. Trop. Sao Paulo 58 (2016) 11.
[12] D.U. Gonçalves, F.A. Proietti, J.G.R. Ribas, M.G. Araújo, S.R. Pinheiro, A.C. Guedes, et al., Epidemiology, treatment, and prevention of human T-cell leukemia virus type 1-associated diseases, Clin Microbiol. Rev. 23 (Jul (3)) (2010) 577–589.
[13] J.M. Fox, N. Mutalima, E. Molyneux, L.M. Carpenter, G.P. Taylor, M. Bland, et al., Seroprevalence of HTLV-1 and HTLV-2 amongst mothers and children in Malawi within the context of a systematic review and meta-analysis of HTLV seroprevalence in Africa, Trop. Med. Int. Health 21 (3) (2016) 312–324.
[14] F. Percher, P. Jeannin, S. Martin-Latil, A. Gessain, P.V. Afonso, A. Vidy-Roche, et al., Mother-to-child transmission of HTLV-1 epidemiological aspects, mechanisms and determinants of mother-to-child transmission, Viruses 8 (2016).
[15] D.O. Olaleye, L. Bernstein, Z. Sheng, C.C. Ekweozor, X.Y. Li, J. Sullivan-Halley, et al., Type-specific immune response to human T cell lymphotropic virus (HTLV) type I and type II infections in Nigeria, Am. J. Trop. Med. Hyg. 50 (Apr (4)) (1994) 479–486.

[16] R. Onoh, P. Ezeonu, C.E. Nonyelu, N.I. Ugwu, G.O. Ibegbulam, C.S. Anigbo, et al., Seroprevalence and correlates of human T-cell lymphoma/leukemia virus type 1 antibodies among pregnant women at the University of Nigeria Teaching Hospital, Enugu, Nigeria, Int. J. Womens Health 6 (2014) 849–855. InternetAvailable from http://www.dovepress.com/seroprevalence-and-correlates-of-human-t-cell-lymphomaleukemia-virus-t-peer-reviewed-article-IJWH .
[17] D.O. Olaleye, O.O. Omotade, Z. Sheng, A.A. Adeyemo, G.N. Odaibo, Human T-cell lymphotropic virus types I and II infections in mother-child pairs in Nigeria, J. Trop. Pediatr. 45 (2) (1999) 66–70.
[18] I. Durojaiye, A. Akinbami, A. Dosunmu, S. Ajibola, A. Adediran, E. Uche, et al., Seroprevalence of human T lymphotropic virus antibodies among healthy blood donors at a tertiary centre in Lagos, Nigeria, Pan Afr. Med. J. 17 (2014) 301.
[19] R. Onoh, A. Okoye, G.O. Ibegbulam, N.I. Ugwu, C.S. Anigbo, C.E. Nonyelu, Seroprevalence of human T-cell lymphoma/leukemia virus type-1 (HTLV-1) antibodies among blood donors at Enugu, Nigeria, J. Blood Med. 6 (Jan) (2015) 31.
[20] O.D. Olaleye, C.C. Ekweozor, Z.L. Li, I.E. Opala, Z. Sheng, T.N. Onyemenem, et al., Human T-cell lymphotropic virus types I and II infections in patients with leukaemia/lymphoma and in subjects with sexually transmitted diseases in Nigeria, Arch. Virol. 141 (2) (1996) 345–355.
[21] J.C. Forbi, A.B. Odetunde, Human T-cell lymphotropic virus in a population of pregnant women and commercial sex workers in South Western Nigeria, Afr. Health Sci. 7 (3) (2007) 129–132.
[22] A.E. Okoye, O.G. Ibegbulam, R.C. Onoh, N.I. Ugwu, C.S. Anigbo, C.E. Nonyelu, Seroprevalence of human T-cell lymphoma/leukemia virus type-1 (HTLV-1) antibodies among blood donors at Enugu, Nigeria, J. Blood Med. 6 (2015) 31–36.
[23] C. Iyalla, A.O. Ejele, D.A. Okoh, E. Igbigbi, Seroprevalence study of HTLV-1 and 2 in prospective blood donors and pregnant women in Port Harcourt, Nigeria, Afr. J. Infect. Dis. 9 (2) (2015) 57–60.
[24] W. Kajiyama, S. Kashiwagi, H. Ikematsu, J. Hayashi, H. Nomura, K. Okochi, Intrafamilial transmission of adult T cell leukemia virus, J. Infect. Dis. 154 (5) (1986) 851–857.
[25] S. Ghosh, R.S. Klein, Sex drives dimorphic immune responses to viral infections, J. Immunol. 198 (2017) 1782–1790.
[26] A. Ruggieri, S. Anticoli, A.D. Ambrosio, L. Giordani, M. Viora, The influence of sex and gender on immunity, infection and vaccination, Ann. 1st Super Sanita 52 (2) (2016) 198–204.
[27] M.G. Torcia, L. Nencioni, A.M. Clemente, L. Civitelli, I. Celestino, D. Limongi, et al., Sex differences in the response to viral infections : TLR8 and TLR9 ligand stimulation induce higher IL10 production in males, PLoS One 7 (6) (2012) 1–8.
[28] A.F. Fleming, R. Maharajah, M. Abraham, A.G. Kulkarni, S.R. Bhusnurmath, R.A. Okpara, et al., Antibodies to HTLV-I in Nigerian blood-donors, their relatives and patients with leukaemias, lymphomas and other diseases, Int. J. Cancer 38 (Dec (6)) (1986) 809–813.
[29] A. Paiva, J. Casseb, Sexual transmission of human T-cell lymphotropic virus type 1, Rev. Soc. Bras. Med. Trop. 47 (2014) 265–274 p..