



Subtypes of the Human Immunodeficiency Virus Circulating in Professional Sex Workers Community: A Different Epidemiology

Elvis Tshunza Kateba¹, Berry Ikolango Bongonya^{1,2}, Erick Ntambwe Kamangu^{1,3*}

¹"Focus HIV/AIDS" Research Group, Kinshasa, Democratic Republic of the Congo

²Faculty of Medicine, Bel Campus Technological University, Kinshasa, Democratic Republic of the Congo

³Service of Molecular Biology, Department of Basic Sciences, Faculty of Medicine, University of Kinshasa, Kinshasa, Democratic Republic of the Congo

Email: *erick.kamangu@unikin.ac.cd

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Abstract

Background: HIV-1 has a genetic diversity that is very complex. Professional Sex Workers (PSW) have always been considered as a key population for Sexually Transmitted Infections around the world. They are often incriminated for transporting and introducing cosmopolitan subtypes into populations. **Objective:** The objective of this review was to present the different strains of Human Immunodeficiency Virus type 1 (HIV-1) which circulate in the population of Professional Sex Workers in Kinshasa, Democratic Republic of the Congo (DRC) and their evolution. **Methods:** Various publications related to the identification of the different variants of HIV-1 among PSW in Kinshasa-DRC were the subject of this literature review. The research for these different works on the different variants of type 1 HIV was done on the internet from websites using specific keywords. The search was limited to published work and abstracts presented from 2000 to date. The manuscripts were selected according to the relevance of the methodology, the results as well as the representativeness of the samples. The socio-demographic information of the populations studied, the measurement methods and the objectives were taken into account in the evaluation of the articles. **Results:** From 2000 to 2021, 2 works were documented carried out specifically on the PSWs for Kinshasa-DRC meeting the various selection criteria. In 2012, according to the IBBS, subtype A was dominant with 4 PSWs (30.8%), followed by subtypes G with 2 PSWs (15.4%) and C with 1 PSW (7.7%). In 2014, according to Kamangu NE *et al.*, the dominant subtype was K in 5 patients (25%), followed by subtypes A and G in 3 patients each (15%) and C in 2 patients (10%). **Conclusion:** It emerges from this work that this key population is a group

with complex and special epidemiology. The prevalence of wild subtypes has been declining over the years while recombinant subtypes are on the rise.

Subject Areas

HIV, Public Health

Keywords

Sub-Types, HIV-1, Professional Sex Worker, Kinshasa-DRC

1. Introduction

Human Immunodeficiency Virus type 1 (HIV-1) infection is one of the most highlighted epidemics of our time and remains a major public health problem around the world even though remarkable progress has been made in treatment and management [1]. Around 37.7 [30.2 - 45.1] million people are living with HIV across the world and Sub-Saharan Africa (SSA) is the most affected region, with two-thirds (67%) of those infected [1].

HIV-1 has a genetic diversity that is very complex. The subtype designations have been powerful molecular epidemiological markers for tracking the course of this epidemic. The different data indicate a disparate distribution and dominance of the different subtypes according to the countries and documented regions [2] [3]. Analysis of the genomic sequences of the viral strains of HIV-1 revealed that the virus is divided into 4 groups: the M (Major), the N (Non-M/Non-O), the O (Outlier) and recently the P.

Group M (Major) is the dominant group of the epidemic and especially in Central Africa. The distribution of this group in Africa and Democratic Republic of the Congo (DRC), in particular, is very heterogeneous; it follows a complex and specific algorithm. This distribution is very dynamic, evolving and unpredictable; it will continue to diversify as long as the virus is circulating. There is a very high genetic diversity of the M group in the sub-Saharan region of Africa [4].

Professional Sex Workers (PSW) and their clients have always been viewed as a key population for Sexually Transmitted Infections (STIs) around the world along with military and police, truck drivers, and men who have sex with men [5]. In 2020, these key populations (PSWs and their clients, gay men and other men who have sex with men, people who inject drugs, transgender) and their sexual partners accounted for 65% of all new HIV infections [6]. The World Health Organization (WHO) has since recommended close monitoring of these populations to control the spread of infection in an uncontrolled manner [5]. These key populations are often responsible for the high molecular diversity of HIV in general populations and are often incriminated for transporting and introducing cosmopolitan subtypes into populations [1] [5] [6].

Various publications and review articles published and presented during

scientific conferences on the identification of the different variants of HIV type 1 in PSW in Kinshasa, Democratic Republic of the Congo (DRC) have made the subject of the literature review. However, there is little data on the molecular epidemiology of key populations in DRC and Kinshasa. Hence the objective of this literature review was to present the different strains of type 1 HIV circulating in the population of Professional Sex Workers in Kinshasa-DRC and their evolution.

2. Methods

2.1. Literature Review

The search for these different works on the different variants of HIV type 1 was carried out on the Internet from the following websites: 1) MEDLINE/Pub Med; 2) electronic POPLINE database of published documents; 3) Public access to data on conference documents; 4) Scientific report published on the Internet; 5) Google Scholar; 6) Cochrane Library. This online search was based on the following keywords: “HIV, subtype, Professional Sex Workers, Kinshasa, Democratic Republic of the Congo”, “genotype, HIV, Professional Sex Workers, Kinshasa, Democratic Republic of the Congo” and “strains of HIV among Professional Sex Workers in Kinshasa, Democratic Republic of the Congo”. Data were independently extracted by two authors and consolidated by a third author. A manual search was carried out to verify the articles found so as not to omit data.

2.2. Selection Criteria for Publications

The search was limited to published work and abstracts submitted from 2000 to 2021. The manuscripts were selected according to the relevance of the methodology, the results as well as the representativeness of the samples (**Figure 1**). The socio-demographic information of the populations studied, the measurement

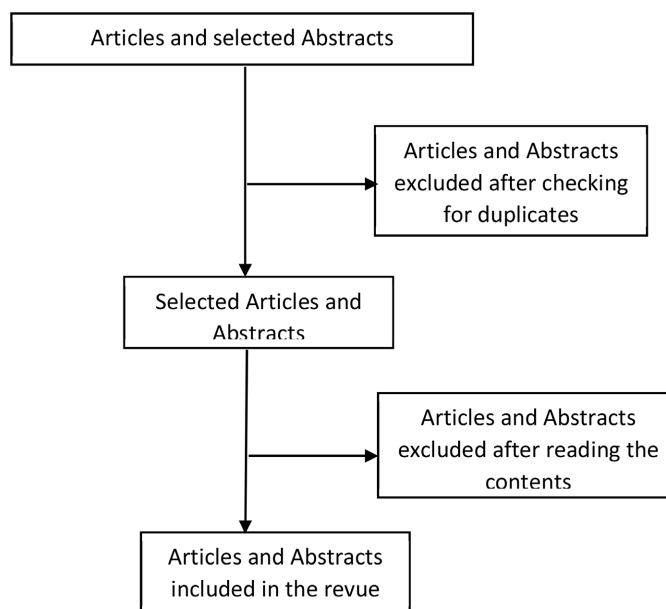


Figure 1. Diagram for identifying articles for inclusion in the review.

methods and the objectives were taken into account in the evaluation of the articles. Reading the various articles made it possible to exclude articles which did not directly concern strains of HIV-1 in the population of Professional Sex Workers in Kinshasa-DRC. Studies on general populations, migrant populations, and non-specific populations as well as studies without original data were not retained for this review. Works that did not present data for the different populations included were not retained either.

Microsoft Excel was used to present a linear trend line between the results of the two studies traces automatically based on the chart data. A linear equation and a coefficient of determination (R^2) were determined for each graph automatically using the program.

3. Results

From 2000 to 2021, several studies presented the molecular epidemiology of HIV-1 in our environment of different populations in a non-specific way [3] [7], nevertheless two studies were documented carried out mainly and exclusively on the Professionals Sex Workers (PSW) in Kinshasa-DRC, hence meeting the various selection criteria.

In 2012, the Integrated Biological and Behavioral Surveillance Survey on Human Immunodeficiency Virus and Sexually Transmitted Infections (IBBS 2012) revealed a heterogeneous geographic distribution of HIV-1 infections among PSWs across the country. Kinshasa was included in the IBBS survey with 13 PSWs, or 9.8% of the total cohort. Subtype A was dominant with 4 PSWs (30.8%), followed by subtypes G with 2 PSWs (15.4%) and C with 1 PSW (7.7%). Six PSs (46.1%) had CRF of which 1 (7.7%) had CRF02_AG [8].

In 2014, Kamangu NE *et al.* carried out a study on PSW's population and their partners at the Matongo Sexually Transmitted Infections Care Center (IST-Matonge) in Kinshasa-DRC. Twenty (20) patients were included in the study. The dominant subtype in this population was K in 5 patients (25%), followed by subtypes A and G in 3 patients each (15%), subtypes C, J and U in 2 patients each (10%), subtype H in 1 patient (5%) and CRF02_AG in 2 patients (10%) [9].

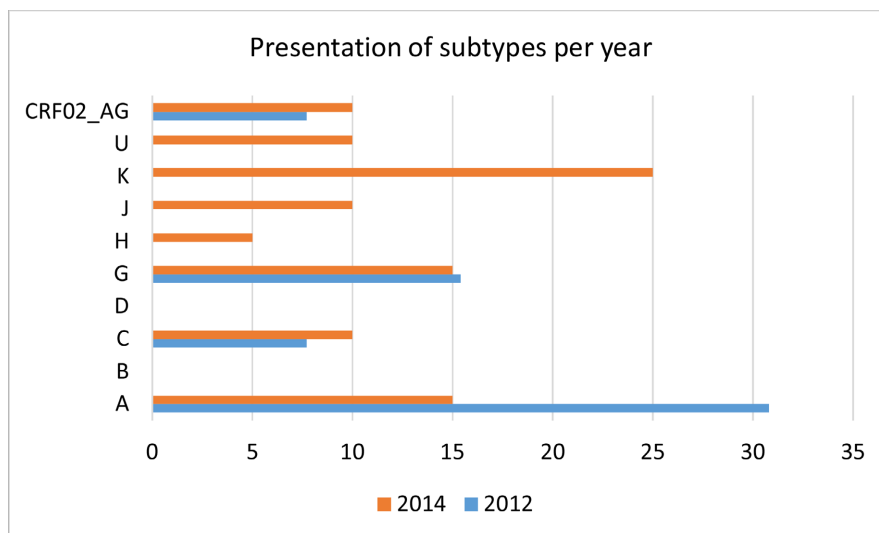
Table 1 shows all the data mentioned above. **Figure 2** shows the different HIV-1 subtypes for the two studies. The linear equations as well as the coefficients of determination (R^2) were presented for each of the strains through the two studies. **Figure 3** shows the evolution of the different subtypes with the different trends.

4. Discussion

The objective of this literature review was to present the different strains of HIV type 1 that circulate in the population of Professional Sex Workers (PSW) in Kinshasa, Democratic Republic of the Congo, and their evolution from 2000 to 2021. During this period, many studies have been published presenting the molecular

Table 1. Frequencies of HIV-1 subtypes by study.

HIV-1 Subtypes	Frequencies (%)		Total proportion (%)	IC 95%
	2012	2014		
Total patient (n)	13	20	33	
A	30.8	15.0	18.2	(6.0; 33.3)
B	0	0	0.0	(0.0; 21.2)
C	7.7	10.0	9.1	(3.0; 27.3)
D	0	0	0.0	(0.0; 9.1)
G	15.4	15.0	15.2	(0.0; 15.2)
H	0	5.0	3.0	(3.0; 27.3)
J	0	10.0	6.1	(0.0; 15.2)
K	0	25.0	15.2	(0.0; 21.2)
U	0	10.0	6.1	(6.0; 33.3)
CRF02_AG	7.7	10.0	9.1	(6.0; 33.3)
CRFs	46.1	10.0	18.2	(0.0; 21.2)

**Figure 2.** Presentation of subtypes per year.

epidemiology of HIV-1 in different populations in specific and non-specific manner in Kinshasa and the Democratic Republic of the Congo. According to the criteria selected for this review, two studies were documented carried out mainly and exclusively on the populations of PSW for Kinshasa-DRC meeting the various selection criteria.

In 2012, for Kinshasa, samples from 13 PSWs were sequenced for HIV-1 through the Integrated Biological and Behavioral Surveillance Survey on Human Immunodeficiency Virus and Sexually Transmitted Infections (IBBS 2012). Subtype A was dominant with 4 PSWs (30.8%), followed by subtypes G with 2

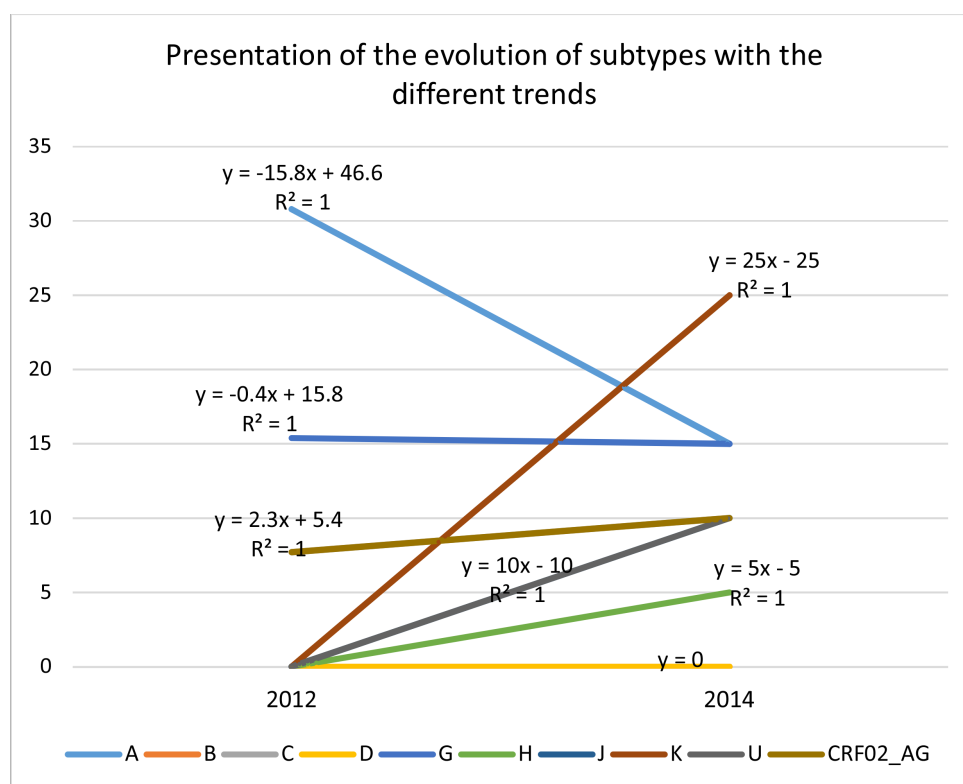


Figure 3. Presentation of the evolution of subtypes with the different trends.

PSWs (15.4%) and C with 1 PSW (7.7%). Six PSWs (46.1%) had Circulating Recombinant Forms (CRFs) of which 1 (7.7%) had CRF02_AG [8]. The wild subtypes H, J and K have not been identified on this population while some non-specific recombinant forms have been found. The high prevalence of subtypes A and G in this population is justified by the historical presence of these subtypes in the epidemiology of this infection in our environment [7] [10]. The subtype A has been mostly found in the population, followed by subtypes C, D and G in different frequencies [11].

In 2014, in a population of PSWs and their partners followed at the Matongo Sexually Transmitted Infections (STI-Matonge) treatment center in Kinshasa, samples from 20 patients were sequenced for HIV-1. The dominant subtype in this population was the subtype K in 5 patients (25%), followed by subtypes A and G in 3 patients each (15%), subtypes C, J and U in 2 patients each (10%), subtype H in 1 patient (5%) and CRF02_AG in 2 patients (10%) [9]. The same year, Kamangu NE *et al.* worked on a heterogeneous population of 153 treatment-naïve HIV positive patients across the 4 districts of Kinshasa. In this population, subtype A was predominant with 22.9% followed by CRF02_AG (11.1%), subtypes C (9.8%), G (9.8%), K (9.8%), D (7.8%), J (5.9%), U (5.2%), F (3.9%), CRF01_AE (3.3%) and subtype B (2%) [12]. These data confirm the molecular difference within the populations.

Through these data, it emerges that the PSWs breed strains of HIV-1 which are different from the general population infected with the same virus. In 2012,

only 3 wild strains (A-30.8%, G-15.4% and C-7.7%) were found in this specific population while 46.1% are recombinant forms. The other wild strains (B, D, F, H, J and K) were not found in that population. In 2014, almost all strains were present in this specific population but in a very different order and prevalence. The K subtype which was dominant in the PSW population comes fifth in the general population.

Attached **Figure 3** shows the prevalence of the different strains by year of study as well as the evolution trends of these strains compared to the two years. This figure shows inequality in the prevalence of subtypes in the same specific population in Kinshasa in two different periods.

A positive linear equation of the type $y = ax + b$ is equivalent to a positive upward evolution while a negative equation of the type $y = -ax + b$ is equivalent to a negative downward evolution. Subtype A which was at 30.8% in 2012 dropped to 15% in 2014 ($y = -15.8x + 46.6$; $R^2 = 1$) thus giving a downward linear trend line. The same with subtype G which went from 15.4% in 2012 to 15% in 2014 ($y = -0.4x + 15.8$; $R^2 = 1$). These support the hypotheses which advocate the reduction of wild strains in favor of recombinant strains [3] [7]. All the other strains showed upward trends from 2012 to 2014: subtype C from 7.7% in 2012 to 10% in 2014 ($y = 2.3x + 5$; $R^2 = 1$), subtype H from 0% in 2012 to 5% in 2014 ($y = 5x - 5$; $R^2 = 1$), subtype J from 0% in 2012 to 10% in 2014 ($y = 10x - 10$; $R^2 = 1$), subtype K from 0% in 2012 to 25% in 2014 ($y = 25x - 25$; $R^2 = 1$), and the CRF02_AG from 7.7% in 2012 to 10% in 2014 ($y = 2.3x + 5$; $R^2 = 1$). These trends paint a new picture of molecular epidemiology as seen as a whole. Through the data trends of this population, it emerges that subtype A which has always been dominant for years is declining and risks losing the place of the dominant subtype in the near future.

5. Conclusion

Through the data presented in this revue, it emerges that this key population is a group with complex and special epidemiology. The prevalence of wild subtypes such as A, C, D and G has been declining over the years while recombinant subtypes are on the rise. This calls for a reassessment of the care policy in relation to the complexity of the new strains.

Conflicts of Interest

The authors declare no conflicts of interest.

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List of Abbreviations

ART	AntiRetroViral Treatment;
ARV	AntiRetroViral
VL	Viral Load
DRC	Democratic Republic of the Congo
HIV	Human Immunodeficiency Virus
IBBS	Integrated Biological and Behavioral Surveillance Survey
PSW	Professional Sex Worker
RNA	Ribonucleic Acid.