High proportion of post-migration HIV acquisition in migrant men who have sex with men receiving HIV care in the Paris region, and associations with social disadvantage and sexual behaviours: results of the ANRS-MIE GANYMEDE study, France, 2021 to 2022

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TITLE PAGE

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High proportion of post-migration HIV acquisition in migrant men who have sex with men receiving HIV care in Paris region, in France, and associations with social disadvantage and sexual behaviours: results of the 2022 ANRS-MIE GANYMEDE study

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Key words

HIV; migrants; men who have sex with men; post-migration; foreign-born; born abroad

ABSTRACT

Background. Migrant men who have sex with men (MSM) are currently the population most affected by the HIV epidemic in France, in terms of both incidence and prevalence of undiagnosed infection. A large proportion of them may be HIV-negative on arrival in France and acquire HIV rapidly after migration.

Aims. The ANRS-MIE GANYMEDE investigated, in migrant MSM receiving HIV care in France, (i) the proportion of HIV acquisition after migration, (ii) the delay between arrival in France and HIV transmission, and (iii) factors associated with HIV acquisition after migration within the first year in France.

Methods. This is a multicentre, cross-sectional study of MSM over the age of 18 born outside France, receiving HIV care in 14 treatment centres in the Paris region. Data on migration history, socio-economic conditions, sexual activity, and health were collected through self-administered questionnaires and medical records. Post-migration HIV acquisition rate and delay between arrival in France and HIV transmission were estimated using biographical data and modelling based on declining CD4 T-cell counts over time. Predictors of HIV acquisition within the first year after migration were determined using logistic regression.

Results. Overall, 1159 participants were included. We estimated that 61.7% (95%CI 61.2-62.2) acquired HIV after migration. This proportion was lowest among participants from Latin America (40.5% 95%CI 39.6-41.6), and highest among those from North Africa (85.4%, 95%CI 83.9-86.0). We estimated that 13.1% (95%CI 11.6-14.6) of participants who acquired HIV after migration acquired it within the first year, reaching 25% (95%CI 21.5-28.3) in participants from Sub-Saharan Africa. Older age at arrival, region of origin (sub-Saharan Africa and Asia), degree of social disadvantage and number of sexual partners were independently associated with acquiring HIV during the first year in France.

Conclusion. Our findings should guide prevention policies, targeting the most vulnerable migrants arriving in European countries.

STATEMENTS

Ethical statement

According to the French law (Act 78–17 of Jan 6, 1978, on Computers, Files and Liberties) the GANYMEDE study has been conducted in compliance with the CNIL (French National Agency regulating Data Protection, registration number: 2085881), and with the reference methodology 004. ClinicalTrials.gov Identifier: NCT04684758.

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Data availability

Individual participant data that underlie the results reported in this article may be shared, after de-identification, for individual participant data meta-analysis. Proposals may be submitted up to 36 months following article publication, and should be directed to the corresponding author (RP).

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An abstract has been submitted to the 19th European AIDS Conference, Warsaw, Poland, October 18-21, 2023 (pending decision).

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Conflict of interest

None.

Authors' contributions

RP, JYLT and VS contributed to conceptualisation of the research. RP, MD, CLC, KL, JG, JPV, GP, MO and CD contributed to data collection. RP, AAR, MD, ORT, LB, LA and VS contributed to study and data management. RP, AAR, MD, LA and VS had access to the data and contributed to statistical analysis. RP and AAR contributed to writing the original draft. All authors contributed to discussing findings, and reviewing and editing the manuscript. RP, MD, LA and VS accessed the original data and vouch for its authenticity.

Collaborators

Contributors of the GANYMEDE study group are listed in a specific Supplementary File.

BODY TEXT

Introduction

In most Western European countries today, almost half of all people living with HIV (PLWH) are migrants, i.e., were not born in the country in which they reside [1]. Many countries consider migrants as a priority population in their national response to HIV. It has long been assumed that most HIV infections among migrants in Europe, particularly those from sub-Saharan Africa (SSA), are imported. Over the past decade, research has shown that a substantial proportion of these HIV infections are acquired after migration [2–6]. In 2017, a collaborative study, including nine European countries, which France did not participate in, showed that the rate of post-migration HIV acquisition differed across population subgroups (72% among men who have sex with other men [MSM] versus 51-58% among heterosexual individuals), host countries and geographic areas of origin (52% among individuals from sub-Saharan Africa versus 71% among those from Europe or Latin America) [7]. Knowing whether HIV acquisition occurs before or after migration is critical for designing appropriate HIV prevention and testing strategies.

HIV acquisition, whether in the country of origin or in the host country, should be considered in the context of life course, in which the migration process is a major event. Contextual factors (such as economic level, health care system efficiency, HIV prevalence, or legal status and social tolerance of homosexuality in the country of origin) and individual factors (such as having multiple sexual partners, condomless sex, access to prevention, drug use, sex work, engagement with the gay scene, density of sexual network) may explain the increased risk of HIV exposure among migrant MSM [8,9]. Several studies carried out between 2010 and 2020 have shown that hardship during migration and in the first years after arrival in the host country influence emotional insecurity and HIV risk taking [10–13].

Since the mid-2010s, migrant MSM are known to be the population subgroup most affected by the HIV epidemic in France, as in many European countries, in terms of diagnosed and undiagnosed prevalence and incidence [14]. While new infections have been declining for several years in all population subgroups, they continue to increase among MSM born outside France [15]. In 2018, it has been estimated that nearly 50% of MSM migrants with undiagnosed HIV live in the Paris region, compared with only 19% of the French population [14].

The ANRS-MIE 14058 GANYMEDE study recruited migrant MSM followed up for HIV infection in the Paris region, in France. The objectives of the study were: (i) to estimate the proportion of post-migration HIV acquisition in this population, (ii) to estimate the time between arrival in France and HIV acquisition among participants who acquired the virus after migration, (iii) to describe the reasons for migration and living conditions upon arrival in France, and (iv) to investigate factors associated with HIV acquisition within the first year in France.

Methods

Study design, setting and participants

We designed a multicentre, cross-sectional study among a sample of migrant MSM living with HIV in the Paris region. Participants were cisgender men (≥18 years), born outside France, self-reporting having sex with other men (either current or historical), and followed for HIV treatment in one of the 14 centres participating in the study (Supplementary File, Figure S1). We aimed to include 1,200 participants, to compare individuals from different places of origin.

Data on migration history, socio-economic conditions, sexual activity, health before, after and at the time of migration to France, were collected through self-administered questionnaires and medical records. The questionnaire (148 items, including 62 depending on previous responses) was built after conducting an exploratory qualitative survey, based on 13 interviews among migrant MSM living with HIV, in order identify areas of focus and refine survey language [16].

Participants gave consent to participate and to complete a 40-minute-long digital questionnaire in one of the six available languages (French, English, Spanish, Portuguese, Arabic or Russian). An interpreter was available by telephone for participants who could not speak any of the six languages. Participants with the greatest difficulty in logging on or understanding the questionnaire were assisted by the research team. Only participants who immigrated after the age of 15 completed the questionnaire, on the assumption that those who had immigrated during childhood had not begun their sexual lives and tended to have living conditions more similar to those of people born in France. Participants who immigrated before or at the age of 15 were included but did not complete the questionnaire. Demographic and HIV-related clinical and biological data were collected for all participants. The study was offered to all patients who met the inclusion criteria. In case of refusal, age and country of birth were collected anonymously to adjust the analyses. Data were collected between May 2021 and June 2022.

Statistical analysis

The likely country of HIV acquisition was determined based on data from questionnaires and medical records. We assumed that all participants who arrived in France before the age of 15 acquired HIV in France, after verifying that there were no cases of mother-to-child transmission of HIV in this subgroup. For participants who arrived in France after the age of 15, we concluded that they acquired HIV before migration if they reported to be aware of their positive HIV status before migration, with a year of HIV diagnosis or antiretroviral therapy (ART) initiation prior to the year of arrival in France. Participants who did not meet the

aforementioned criteria were classified as having acquired HIV after migration if they met any of the following criteria: (i) first sexual intercourse in France (self-questionnaire), (ii) at least one negative HIV test in France (self-questionnaire), or (iii) diagnosis of primary infection at least one year after arrival in France (medical records).

If none of these criteria were met, we used a seroconversion model utilizing CD4 T-cell count data to estimate the time of HIV acquisition. We built our model using data from the French Hospital Database on HIV (ANRS CO4 FHDH), which is a large hospital-based cohort, established in 1989 [17], and providing information on HIV seroconversion and CD4 T-cell counts prior to ART initiation. We used a non-Markovian stochastic chains with memory of variable length model assuming a retrospective increase in CD4 T-cell count until reaching the date of the known HIV seroconversion [18]. Using this model, by integrating in it the first CD4 T-cell count available at entry into care in France, as well as the date of arrival in France for each participant, we were able to estimate whether HIV acquisition occurred before or after migrating, and time between migration and HIV acquisition in France for participants with post-migration HIV acquisition (Supplementary File).

We then investigated potential predictors of HIV acquisition within the first year after arrival in France among individuals who acquired HIV after migration. Firstly, we conducted univariate logistic regression models to select the variables of interest. We then used a Multiple Correspondence Analysis (MCA) to explore the relationship and the associations between different categories of potential explanatory variables. This revealed a set of variables, including participants' administrative status, health coverage, employment situation, and financial well-being, which were closely linked. To address any potential issues of multicollinearity, we constructed an indicator of social disadvantage, using the aforementioned variables. Each variable was transformed into an ordinal variable with three levels, where level 3 represented the most precarious conditions such as irregular administrative status, lack of medical coverage, unemployment or irregular employment, and insufficient economic resources; the social disadvantage indicator was derived by summing the contributions from each variable, resulting in a range of scores from 4 to 12. Individuals with an indicator score equal to or greater than 9 were classified as being disadvantaged (Supplementary File). In the multivariate logistic regression, the social disadvantage indicator was included as an explanatory variable along with other variables including age at arrival in France, place of birth, and variables related to sexual behaviour.

Ethical statement

In accordance with French law (Act 78–17 of Jan 6, 1978, on Computers, Files and Liberties) the GANYMEDE study has been conducted in compliance with the CNIL (French National Agency regulating Data Protection, registration number: 2085881), and with the reference methodology 004. ClinicalTrials.gov Identifier: NCT04684758.

Results

Study population

One thousand two hundred and eighty-two patients were approached to participate in the study, and 1159 consented and were included, leading to a study acceptance rate of 90.4%. Among the 994 participants who migrated to France after the age of 15, 831 completed the questionnaire, yielding a completion rate of 83.6%. Languages used to complete the questionnaire were: French (622, 74.8 %), Spanish (83, 10.0%), English (72, 8.7%), Portuguese (41, 4.9%), Arabic (12, 1.4%) and Russian (1, 0.1%). Four hundred and seventy-two (56.8%) participants completed the questionnaire on site, 359 (43.2%) completed it at home; 98 (11.8%) needed assistance from the local research team to log in and answer the questionnaire, but no interpreters were requested. Participants had been in France for a median of 15 years (IQR 6-32) at the time of questionnaire completion.

The three most represented geographical areas of origin were Latin America (336, 29.0%), Europe (244, 21.1%) and North Africa (187, 16.1%) (Table 1). Participants had arrived in France at a median age of 25 years (IQR 20-31); median age at arrival in France was lowest among participants from North Africa (20 years, IQR 10-28), and highest among those from South America (28 years, IQR 24-33). All were cisgender men who reported having had sex with other men during their lifetime. Their median age at time of the survey was 43 years (IQR 34-56). All were on ART, and 1003/1076 (93.2%) had a last HIV plasma viral load <50 copies/mL.

Table 1. Participants' demographic and HIV-related characteristics, Ile-de-France, France, May 2021-June 2022 (N=1159).

Age at study inclusion, years, median (IQR)	43 (34-56)
Place of birth, n (%)	
Latin America	336 (29.0%)
Europe	244 (21.1%)
North Africa	187 (16.1%)
Sub-Saharan Africa	180 (15.5%)
Asia, Oceania	174 (15.0%)
North America	38 (3.3%)
Age at arrival in France, years, median (IQR)	25 (20-31)
Age at arrival in France, n (%)	
<15 years	165 (14.2%)
15 – 20 years	143 (12.3%)
21 – 25 years	282 (24.3%)
26 – 30 years	259 (22.3%)
>30 years	310 (26.7%)
Time from first HIV medical visit in France, years, median (IQR)	5.9 (2.8-11.8)
Time from HIV diagnosis, years, median (IQR)	8.9 (5.1-18.1)
Hepatitis B co-infection (positive AgHBS), n (%)	63 (5.4%)
Hepatitis C co-infection (positive anti-HCV Ab), n (%)	84 (7.2%)
AIDS-event at care entry[1], n (%)	65 (5.4%)
First CD4 T-cell count available in France, cells/mm^3, median (IQR)	400 (246-604)
First plasma viral load available in France, n (%)	
≥50 cp/mL	861 (74.3%)
<50 cp/mL	168 (14.5%)
Missing	130 (11.2%)

1. Opportunistic disease diagnosed in the 6 months before or after the first HIV medical visit in France.

Proportion of post-migration HIV acquisition

We were able to determine whether HIV acquisition occurred before or after arriving in France for 561/944 persons (59.4%) who immigrated after the age of 15, considering data from questionnaires and medical records (Supplementary File, Figure S2). Among these participants, HIV acquisition before migration was definite for 250, including 221 who had started ART before migration. HIV acquisition after migration was definite for 311 participants, including 282 with negative HIV test in France, and/or 78 with a documented primary HIV infection in France, and/or 52 who had had their first sexual intercourse in France. We also considered that the 165 participants who immigrated before the age of 15 had contracted HIV in France. Among the 383/944 (40.6%) participants who immigrated after the age of 15 and whose time of HIV acquisition remained unknown, we estimated this time from the statistical model, based on their first CD4 T-cell count upon arrival in France.

Overall, we estimated that 61.7% (95%CI 61.2-62.2) of participants had acquired HIV after, while 38.3% (95%CI 37.9-38.7) had acquired HIV before arriving in France (Figure 1a). There was significant variability in these proportions according to geographical area of origin; the rate of post-migration HIV acquisition peaked among participants from North Africa (85.4%, 95%CI 83.9-86.0), and was lowest among those from South America (40.5%, 95%CI 39.6-41.6). These proportions also decreased with age at arrival (Figure 1b).

Time between arrival in France and HIV acquisition

Among study participants who acquired HIV after migration to France, the median time from arrival to estimated date of HIV acquisition was 7.5 years (IQR 3.5-14.75). We estimated that 13.1% (95%CI 11.6-14.6) of participants acquired HIV during their first year in France, and this proportion was higher during the first year than during the second and third years combined, for participants from sub-Saharan Africa, Asia and Oceania, Latin America and North Africa (Figure 2). Excess risk of HIV acquisition in the first year was particularly marked among participants from sub-Saharan Africa (25.1%, 95%CI 21.5-28.3); it was not observed among participants from Europe.

A total of 222 participants who were already aware of their HIV-positive status prior to migrating to France were identified. These individuals had been diagnosed for a median of 4.2 years (IQR 2.1-8.0) before migrating to France. Among this group, 193 individuals (86.9%) had initiated ART before arriving in France, but 36/193 (18.7%) discontinued ART by the time they received medical care in France. In other words, of the 222 participants aware of their HIV-positive status before coming to France, 65 (29.3%) had either not started or had stopped ART upon arrival.

Among participants who acquired HIV in France, 83/449 (18.5%) had a CD4 T-cell count <200/mm^3 and 24 (5.4%) an AIDS defining event at entry into care. Median delay between estimated HIV acquisition time and first HIV medical visit was 2.0 years (IQR 0.3-2.8).

Reasons for migration and living condition at arrival in France

The three most frequently given reasons for migration were: studying (309, 37.2%), sexual orientation (290, 34.9%), and experiencing a new country (261, 31.4%); medical necessity was mentioned as a reason for migration by only 84 participants (10.1%) (Table 2). In case of medical problems, HIV infection was reported as the main issue by 54 (64.3%) participants.

About half of study participants were not able to understand or speak French at arrival. Two hundred and three participants (24.4%) were undocumented or were asylum seeker during the first 12 months on the French territory; 231 (27.8%) had no access to the French social insurance; 68 (8.2%) were homeless; 227 (27.3%) were unemployed; and 492 (59.2%) felt they had insufficient income to support themselves. While 82 participants (9.9%) reported no sexual partners in the first 12 months in France, 149 (17.9%) had had more than 10, with inconsistent condom use. Of the 831 participants who arrived in France after the age of 15, 532 (64.0%) regularly visited their country of origin, and 212/532 (39.8%) reported having sexual intercourse upon their return in their country of origin.

Table 2. Reasons for migration, social situation and sexual behaviour in the first 12 months after arrival in France, Ile-de-France, France, May 2021-June 2022 (N=831).

Reasons for migration[1], n(%)	
Studying	309 (37.2%)
Sexual orientation	290 (34.9%)
Discovering a new country	261 (31.4%)
Escaping from insecurity or war	169 (20.3%)
Economic considerations	177 (21.3%)
Joining the partner	119 (14.3%)
Escaping the family	107 (12.9%)
Working	108 (13.0%)
Medical issues	84 (10.1%)
Joining the family	50 (6.0%)
Having felt forced to leave the country of birth, n(%)	453 (54.5%)
Social environment (people to rely on) at arrival[2], n(%)	
Partner	132 (15.9%)
Family	252 (30.3%)
Friends	181 (21.8%)
Colleagues	29 (3.5%)
Non-governmental organizations	121 (14.6%)
Health care workers	60 (7.2%)
Nobody	257 (30.9%)
Practice of French language at arrival, n(%)	
Being able to speak	409 (49.2%)
Being able to read	440 (52.9%)
Being able to write	381 (45.8%)
Administrative situation at arrival, n(%)	
No paper or asylum seeker	203 (24.4%)
Temporary visa or residence permit	425 (51.1%)
French or European citizenship	188 (22.6%)
Missing	15 (1.8%)
Social insurance at arrival, n(%)	
None or State Medical Assistance[3]	231 (27.8%)
Universal Medical Coverage[4]	227 (27.3%)
Standard Health Coverage, including Student Health Coverage	327 (39.4%)
Missing	46 (5.5%)
Housing situation at arrival, n(%)	
Homeless	68 (8.2%)
Hosted by family or friends	296 (35.6%)
Owner or tenant of their own home	457 (55.0%)
Missing	10 (1.2%)
Working situation at arrival, n(%)	
No work	227 (27.3%)
Student[5]	241 (29.0%)

Any paid work, including permanent and temporary contracts	353 (42.5%)
Missing	10 (1.2%)
Subjective feeling on financial situation at arrival, n(%)	
Good	318 (38.3%)
Insufficient	446 (53.7%)
Very bad	46 (5.5%)
Missing	21 (2.5%)
Number of sexual partners in the first 12 months, n(%)	
0	82 (9.9%)
1	160 (19.3%)
2-5	206 (24.8%)
6-10	103 (12.4%)
>10	149 (17.9%)
Missing	131 (15.8%)
Condomless sex in the first 12 months[6], n(%)	
Yes, with all sexual partners	144 (23.3%)
Only with occasional partners	76 (12.3%)
Only with regular partners	65 (10.5%)
With no one	332 (53.7%)
Missing	1 (0.2%)
Means of meeting sexual partners in the first 12 months[1,7], n(%)	
Sexual meeting places (saunas, bars with darkroom)	150 (32.8%)
Outside hook-up locations	90 (19.7%)
Conviviality places (night clubs, bars)	202 (44.2%)
Internet and connected apps	247 (54.0%)

1. Participants could choose several reasons. 2. Participants could choose several reasons, excepting those who chose "Nobody". 3. For people with irregular administrative status. 4. For people with regular administrative status and low incomes. 5. Students who reported a paid work were classified in the category "Any paid work". 6. Among participants who reported having had at least one sexual partner in the last 12 months. 7. Among participants who reported having had at least two sexual partners in the last 12 months.

Factors associated with early HIV acquisition at arrival in France

We compared the demographic, socio-economic characteristics, and sexual behaviours of participants who acquired HIV during the first year in France with those who acquired it later. Participants who acquired HIV in the first year were older, more disadvantaged, and had more sexual partners than those who acquired HIV after the first year (Supplementary File, Table S1). In multivariable logistic regression analysis, participants who were older at arrival in France were more likely to acquire HIV within the first post-migration year (aOR 1.12 per year, 95%CI 1.06-1.18), as well as participants who came from Sub-Saharan Africa (aOR 9.90, 95%CI 3.07-35.90) or Asia (aOR 4.92, 95%CI 1.59-16.66), in comparison with those who came from Europe, those who had more than 10 sexual partners during the first 12 months (aOR 7.63 3.44-17.31), and those who were more disadvantaged, according to the social disadvantage indicator we built (aOR 2.44, 95%CI 1.17-5.05) (Table 3). This social disadvantage indicator included participants' legal status, health coverage, employment, and financial well-being (see Methods and Supplementary File).

Table 3. Factors associated with the acquisition of HIV in the first 12 months after arrival in France, May 2021-June 2022 (N=403 participants with post-migration HIV acquisition), using binary logistic regressions.

		Univariate		Multivariate	
		OR	[95%CI]	aOR	[95%CI]
Age at arrival in France	Per one year	1.10	[1.05-1.15]	1.12	[1.06-1.18]
Place of birth	Europe	Ref.		Ref.	
	Latin America	1.05	[0.34-3.18]	1.24	[0.36-4.38]
	North Africa	1.42	[0.49-5.62]	2.16	[0.63-7.70]
	Sub-Saharan Africa	4.49	[1.76-12.53]	9.90	[3.07-35.90]
	Asia, Oceania	2.79	[1.06-7.92]	4.92	[1.59-16.66]
	North America	0.90	[0.05-5.62]	0.83	[0.04-5.78]
Having felt forced to leave the country of birth	No	Ref.			
	Yes	1.80	[0.99-3.35]	-	-
Leaving the birth-country due to the sexual orientation	No	Ref.			
	Yes	2.47	[1.35-4.52]	-	-
Leaving the birth-country due to health reasons	No	Ref.			
	Yes	3.58	[0.16-30.06]	-	-
Social disadvantage indicator[1]	<9	Ref.		Ref.	
	≥9	3.38	[1.82-6.26]	2.44	[1.17-5.05]
To be alone at the arrival in France	No	Ref.			
	Yes	0.72	[0.38-1.44]	-	-
To speak French at the arrival in France	Yes	Ref			
	No	1.29	[0.71-2.34]	-	-
Number of sexual partners[2]	<=10	Ref.		Ref.	
	>10	4.80	[2.46-9.24]	7.63	[3.44-17.31]
Use of condoms based on sexual partner[2]	Yes, with all sexual partners	Ref			
	Only with occasional partners	0.39	[0.06 - 1.64]	-	-
	Only with regular partners	0.39	[0.02 – 2.30]	-	-

	With no one	1.89	[0.85 – 4.65]	-	-
	Not concerned[3]	0.69	[0.26 – 1.90]	-	-
Meeting sexual partners in saunas, sex-clubs or outside hook-up locations[2]	No	Ref.			
	Yes	0.56	[0.26-1.17]	-	-
	Not concerned[4]	0.30	[0.14-0.60]	-	-
Meeting sexual partners through internet and dating apps[2]	No	Ref.			
	Yes	0.50	[0.24-1.07]	-	-
	Not concerned[4]	0.24	[0.11-0.53]	-	-

1. The social disadvantage indicator included the administrative status, the working situation, the social insurance, and the subjective feeling on financial situation in the 12 months after arrival in France (see the Methods section of the article and the Supplementary File). 2. During the first year after arrival in France. 3. No sexual partners during the first year after arrival in France. 4. Less than two sexual partners during the first year after arrival in France.

Discussion

We found that 62% of migrant MSM acquired HIV after migrating to France. This high proportion is consistent with previous results obtained in the past decade in other European countries, ranging from 39% to 72% [5,7,19,20], and is higher than in heterosexual migrant populations. The places of origin of our study population, representative of MSM living with HIV currently in HIV care in the Paris region, highlight the heterogeneity of the MSM population, clearly differentiated from heterosexuals living with HIV in France, who are overwhelmingly from sub-Saharan Africa [15]. A significant proportion of MSM came from Latin America and Europe, with the remainder evenly distributed between North Africa, sub-Saharan Africa and Asia. We showed significant variations in the proportion of person who acquired HIV after migration, depending on participants' origins (ranging from 41% for Latin America to 85% for North Africa). In addition, we showed that the lower the age at migration to France, the higher the probability of acquiring HIV after migration, as suggested elsewhere In Europe between 2007 and 2016 [19]. A large proportion of North African participants migrated to France at a very young age, due to the historical links between the Maghreb and France, which may partly explain the high rate of post-migration HIV acquisition in this sub-population. However, we hypothesize that contextual factors (e.g., legal status of homosexuality and economic status in the country of origin) and individual factors (e.g., reason for migration and sexual behaviour) primarily determine the risk of HIV acquisition before, during and after the migration process. Finally, it is important to note that acquiring HIV after migration does not necessarily mean acquiring HIV in France; indeed, we know that two-thirds of the participants returned regularly to their country of birth, and that around 40% of them also engaged in sexual intercourse there.

Among participants who acquired HIV after migration, we estimated that 13% acquired HIV within the first year; this proportion reached 25% in participants who came from Sub-Saharan Africa. To our knowledge, our study is the first to suggest an increased risk of contracting HIV early after migration among MSM. This finding should shape public health and prevention policies, and highlights the need to investigate the causes of this excess risk.

We collected information on the social and economic situation during the first year in France, and found a high degree of social disadvantage in the study population. Indeed, over half of the participants did not speak French on arrival; 24% were undocumented; 28% had no access to French social insurance; 8% were homeless; 27% were unemployed; and more than half felt they had insufficient income to support themselves. In the past decade, in Europe, several studies have identified irregular status [21], economic disadvantage [22], administrative complexity [23], or understanding and communication problems [24,25] as obstacles to HIV risk management (including HIV testing) among migrants [26,27], particularly in the first years after migration. It should be noted that most studies have focused on heterosexual populations

and very few concern migrant MSM [28]. We believe that the high degree of social disadvantage of the participants in the GANYMEDE study made them vulnerable to HIV, notably due to a lack of access to the healthcare system and prevention services. Although HIV pre-exposure prophylaxis (PrEP) was not yet approved at the time of migration for the vast majority of participants, it is likely that MSM experiencing precarity and who have recently migrated miss out on opportunities to benefit from PrEP. Today, a number of community initiatives are informing newcomer migrants about PrEP and facilitating access to it. We believe that simplified circuits should be created between these field actions and specialised care settings. However, as previously described, our study population was very heterogeneous and included a significant proportion of participants with a high social and economic status (55% with their own home, and 43% with a legal employment contract), who likely did not experience these specific barriers.

HIV transmission risk cannot be understood without studying the sexual behaviour of migrant MSM. In our study 65% of migrant MSM had had more than one sexual partner, including 18% with more than ten partners. Further, 77% used condoms inconsistently or not at all within the first 12 months in France. Previous studies have shown a high prevalence of condomless sex, including during periods without access to PrEP, associated with a high prevalence of drug and alcohol use among migrant MSM in Europe and North America, as reported in a review published in 2017 [29]. There is also evidence of sexual mixing between established and migrant populations based on virus phylogenic analyses and survey results [5]. We hypothesize that sexual encounters both within migrant communities and in new sexual networks may lead to HIV acquisition, especially in the context of insufficient access to prevention. In addition, an American qualitative study conducted in 2015 has demonstrated the complexity and risks of entering a new sexual scene in a new country, particularly in large cities [11]. In our study, sexual orientation was highlighted as a reason for migration by a third of participants. We believe that radical changes in the sexual behaviours of participants from countries where homosexuality is repressed may have led to increased exposure to HIV. This hypothesis is supported by a study conducted in 2019 among Latin American migrant MSM living in New-York City, where escaping violence or persecution associated with homosexuality was strongly associated with post-migration HIV acquisition [30]. In parallel, only 6% of participants indicated that they had left their country of birth due to HIV-related medical problems; this refutes the common belief of 'medical tourism' associated with migrant PLWH (i.e., going to another country for treatment).

By cross-referencing the estimated time of HIV acquisition after migrating to France with demographic, social and sexual determinants, we were able to determine predictors of early HIV acquisition in France. A older age at arrival, certain places of origin (sub-Saharan Africa and Asia), a higher level of social disadvantage and a greater number of sexual partners were independently associated with acquiring HIV after migration during the first year in France. These predictors are of great importance when it comes to designing preventive actions, both

for associations working locally with newcomer MSM migrants and for health authorities defining national prevention strategies.

Our study has some limitations. We only included participants who disclosed having had sex with other men, as they were identified first with the self-reported route of HIV transmission; we cannot exclude that participants who were uncomfortable with their homosexuality would have come from specific places and would have had different sexual behaviour and levels of social disadvantage. All participants included in the study were engaged in HIV care, and by definition, this excludes MSM migrants living with HIV without knowing it, or refusing care. Another factor is potential memory bias, since half the participants arrived in France more than 15 years ago, which may have affected the accuracy of some responses. Finally, the quantitative nature of the study prevented us from capturing the diversity of individual life stories. A qualitative approach would complement our results, for example to explore the complex ways in which socio-economic and sexual vulnerabilities are intertwined on arrival in France.

In conclusion, we show that a high proportion of migrant MSM living in the Paris region acquire HIV after migrating to France, and that a significant proportion of them acquire it in the first few years after arrival. We believe that this increased risk can be explained by the accumulation of vulnerability factors and changes in sexual behaviour, particularly as a result of a more permissive environment to have gay sex.

This research is of great interest in guiding prevention policies in France, facilitating engagement with the most vulnerable migrants arriving in the country while responding to the factors that contribute to their vulnerability. Finally, it is critical that the rate of post-migration HIV acquisition is continuously monitored to assess and adapt prevention policies accordingly; the two-pronged method based on simple biographical data (age of first sexual intercourse, last negative HIV test) and biological data (first available CD4 T lymphocyte count, evidence of primary infection) that we used in the GANYMEDE study should be implemented routinely.

Figure 1. Proportions of participants who acquired HIV after migration, according to place of birth (a) and age at arrival in France (b), Ile-de-France, France, May 2021-June 2022.

Figure 2. Time of HIV acquisition after migration, according to place of birth, Ile-de-France, France, May 2021-June 2022.

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a

Proportion of post-migration HIV acquisition

100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%

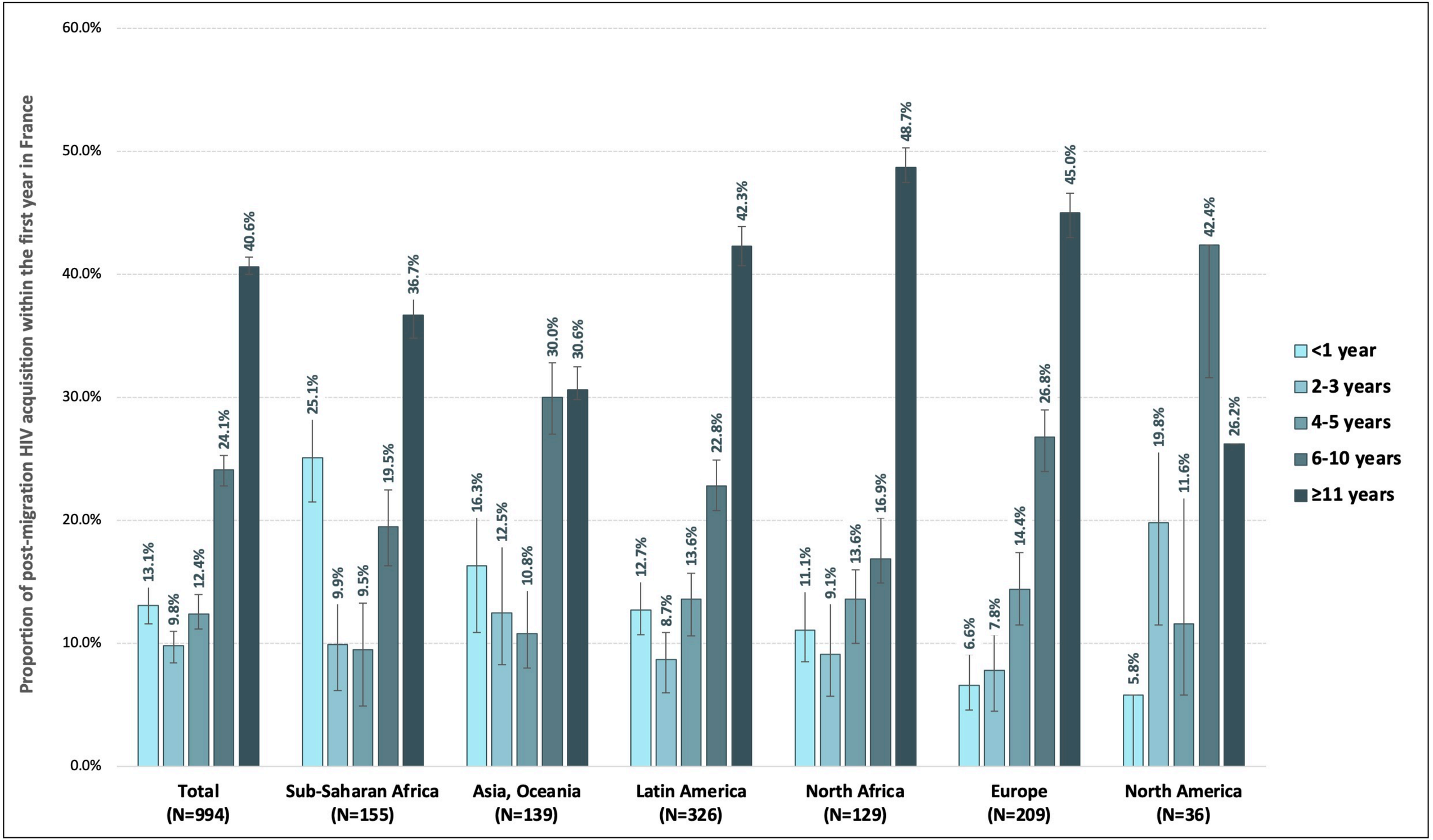
Total (N=1159)	North Africa (N=187)	Asia, Oceania (N=174)	Europe (N=244)	North America (N=38)	Sub-Saharan Africa (N=187)	Latin America (N=336)
61.7%	85.4%	72.9%	66.1%	65.6%	58.6%	40.5%

b

Proportion of post-migration HIV acquisition

100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%

Total (N=1159)	<15 years (N=165)	15-20 years (N=143)	21-25 years (N=282)	26-30 years (N=259)	>30 years (N=310)
61.7%	100.0%	89.7%	68.3%	49.7%	32.6%


Proportion of post-migration HIV acquisition within the first year in France
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
13.1%
9.8%
12.4%
24.1%
40.6%
25.1%
9.9%
9.5%
19.5%
36.7%
16.3%
12.5%
10.8%
30.0%
30.6%
12.7%
8.7%
13.6%
22.8%
42.3%
11.1%
9.1%
13.6%
16.9%
48.7%
6.6%
7.8%
14.4%
26.8%
45.0%
5.8%
19.8%
11.6%
42.4%
26.2%
Total (N=994)
Sub-Saharan Africa (N=155)
Asia, Oceania (N=139)
Latin America (N=326)
North Africa (N=129)
Europe (N=209)
North America (N=36)
<1 year
2-3 years
4-5 years
6-10 years
≥11 years