

Differences in HIV clinical outcomes amongst heterosexuals in the United Kingdom by ethnicity

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Short title: Ethnic differences in HIV outcomes in the UK

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Abstract

Objective:

We investigated differences in clinical outcomes in heterosexual participants, by ethnicity in the UK Collaborative HIV Cohort Study from 2000-2017.

Design:

Cohort analysis.

Methods:

Logistic/Proportional hazard regression assessed ethnic group differences in CD4+ cell count at presentation, engagement-in-care, combination antiretroviral therapy (cART) initiation, viral suppression and rebound.

Results:

Of 12,302 participants (median age: 37 [interquartile range: 31, 44] years, 52.5% women, total follow-up: 85,846 person-years), 64.4% were Black African, 19.1% White, 6.3% Black Caribbean, 3.6% Black Other, 3.3% South Asian/Other Asian and 3.4% Other/Mixed. CD4+ cell count at presentation amongst participants from non-White groups were lower than the White group. Participants were engaged-in-care for 79.6% of follow-up time, however Black and Other/Mixed groups were less likely to be engaged-in-care than the White group (adjusted odds ratios vs. White: Black African: 0.70 [95% confidence interval 0.63, 0.79], Black Caribbean: 0.74 [0.63, 0.88], Other/Mixed: 0.78 [0.62, 0.98], Black Other: 0.81 [0.64, 1.02]). Of 8,867 who started cART, 79.1% achieved viral suppression, with no differences by ethnicity in cART initiation or viral suppression. Viral rebound (22.2%) was more common in the Black Other (1.95 [1.37, 2.77]), Black African (1.85 [1.52, 2.24]), Black Caribbean (1.73 [1.28, 2.33]), South Asian/Other Asian (1.35 [0.90, 2.03]) and Other/Mixed (1.09 [0.69, 1.71]) groups than in White participants.

Conclusions:

Heterosexual people from Black, Asian and minority ethnic groups presented with lower CD4+ cell counts, spent less time engaged-in-care and were more likely to experience viral rebound than White people. Work to understand and address these differences is needed.

Key words:

HIV, ethnic groups, health equity, Highly Active Antiretroviral Therapy, men, women

Background

Due to recent advances in HIV prevention, treatment and care, new HIV infections are decreasing and life expectancy has increased for people living with HIV in the UK[1,2]. UNAIDS targets of 90% of people living with HIV diagnosed, 90% of these on treatment and 90% of these virally suppressed [3] were exceeded in the UK at 93-97-97 in 2018[2], but if the goal of ending the AIDS epidemic by 2030 is to be met, all populational groups must benefit from these advances.

Black, Asian and minority ethnic (BAME) heterosexuals are disproportionately affected by HIV in the UK with 74% (of which 57% are Black African) from BAME backgrounds[1]. Of men who have sex with men (MSM), 14% are from BAME backgrounds[1] and a previous analysis of the UK Collaborative HIV Cohort (UK CHIC) study found differences in HIV outcomes amongst MSM by ethnicity[4]. Whilst there was no difference in viral suppression, BAME MSM were more likely to present at lower CD4+ cell counts, start combined anti-retroviral therapy (cART) later and be permanently lost to follow up than White MSM. Differences in clinical outcomes by ethnicity have also been shown in the United States (US), where studies have found that African Americans have lower rates of viral suppression than White communities[5,6]. However, there is a paucity of data comparing HIV outcomes by ethnic group amongst heterosexual men and women in the UK.

We aim to investigate whether there are differences in HIV clinical outcomes in the care continuum by ethnic group, amongst heterosexual women and men participating in the UK CHIC study.

Methods

The UK CHIC study, collates routine data on people with HIV, aged ≥ 16 years, who have attended one of 25 HIV clinical centres in the UK at any time from 1996 onwards. The study methods are described fully elsewhere[7]. Briefly, centres collect data on demographic information, cART history, laboratory results, and AIDS diagnoses, which are submitted annually to the co-ordinating centre. Ethnicity is based on how participants self-identify when they register with their HIV service. The project was approved by a Multicentre Research Ethics Committee (MREC/00/7/47) and by local ethics committees.

The analyses presented here include most recently collected data (final dataset up to 31 December 2017). Individuals reporting having acquired HIV through heterosexual sex were eligible for the study if they had attended one of 25 HIV services between 2000-2017; participants were followed-up from their first visit until the earliest of death, permanent loss of follow-up from HIV care (defined as failure to return for a follow-up visit within 12 months) or 31st December 2017. There was no minimum follow-up requirement for this analysis. Exclusion criteria included participants who had started cART prior to UK CHIC entry, to ensure that only those starting cART prospectively after study entry were included, as well as women who had a recorded pregnancy, which would require an enhanced approach to HIV care. Participants were grouped by ethnicity (White, Black Caribbean, Black African, Black Other, South Asian/Other Asian, Other/Mixed).

Analyses considered CD4+ cell count at entry to UK CHIC and four outcomes: (i) cART initiation was defined as any regimen including at least one protease inhibitor (PI, boosted or non-boosted), nonnucleoside reverse transcriptase inhibitor (NNRTI) or integrase strand transfer inhibitor (INSTI) with two nucleoside reverse transcriptase inhibitors (NRTI) and no restriction on the total number of drugs in the combination. For this analysis, person-follow-up was split into a series of consecutive calendar periods, each of which started on the date of a new CD4+ cell count, and ended at the first of cART initiation, date of the next CD4+ cell count measurement, or 6 months after the measurement; (ii) Engagement in care (EIC) was defined using the REACH algorithm[8] in which a person's clinical status is used to estimate the likely time to the next scheduled follow-up appointment. Follow-up was split into consecutive monthly intervals and characteristics were determined at the start of each interval - based on this information, each person-month is classified as being 'in-care' or 'out-of-care' according to whether the person had a return visit within the expected time interval; (iii) Viral load (VL) suppression, defined as an initial VL ≤ 50 copies/mL in the subset of participants who initiated cART; and iv) VL rebound, defined on the date of the first of two consecutive VL > 50 copies/mL amongst participants who suppressed HIV VL.

Univariable and multivariable regression was used to assess the association between ethnic group and each outcome after adjustment for potential confounders. These included: sex, CD4+ cell count, VL, previous AIDS, calendar year, hepatitis B/C infection, additionally cART use was adjusted for when assessing EIC, VL suppression and time to viral rebound. To assess the association between CD4+ cell count and ethnicity, we used a linear regression model. Treatment initiation and ethnicity was assessed using a logistic regression model. Analyses of EIC used generalised estimating equations (GEE) to model the association between ethnicity and the binary outcome of whether each month of follow-up was deemed to be in or out of care, after adjusting for time-updated covariates. For the analyses of viral suppression, individuals who initiated cART were followed from cART initiation to the earliest of the censoring date (described above) or 12-months post cART initiation, and the time to VL suppression was compared across the ethnic groups using Cox proportional hazards regression. Among those with viral suppression, time to viral rebound was assessed from the date of viral suppression to the earliest of VL rebound, the censoring date or the first gap in treatment lasting for > 14 days, with comparisons between the ethnic groups undertaken using Cox proportional hazards regression models, after adjusting for time-updated covariates.

Results

Study participants

A total of 21,688 heterosexual individuals entered the UK CHIC study between 2000 and 2017. Of these, 9,386 were excluded due to insufficient follow-up ($n=94$), cART initiation prior to entry to the cohort ($n=6,721$) or because of a recorded pregnancy ($n=2,571$). Therefore, 12,302 UK CHIC participants were included and are described in Table 1 (52.5% women; median age: 37 [interquartile range (IQR): 31, 44]; median first CD4+ cell count: 276 [IQR: 126, 450] cells/mm³; median first HIV viral load (VL): 4.1 [IQR: 3.1, 4.9] log₁₀ copies/ml). Most participants were of Black African ethnicity (64.4%) followed by White

(19.1%), Black Caribbean (6.3%), Black Other (3.7%), South Asian/Other Asian (3.3%) and Mixed/Other (3.4%). More than half of Black African (57.6%), Black Other (51.9%) and Mixed/Other (52.8%) ethnic groups were women. Individuals of Black African, Black Other and Mixed/Other ethnicity entered UK CHIC at a younger median age. South Asian/Other Asian participants had the highest proportion of individuals entering UK CHIC with an AIDS event. The highest proportion of deaths was reported amongst the Black Caribbean population (7.4%).

CD4+ cell count at presentation

Upon entry to UK CHIC, individuals of all BAME groups had a lower CD4+ cell count when compared to the White group (Table 2), particularly amongst the South Asian/Other Asian and Black African participants. This effect was also seen in univariable linear regression analyses with a reduced impact on the mean CD4+ cell count across all BAME groups: Black Caribbean parameter estimate: -36.87 [95% confidence interval (95% CI): -54.45, -16.29]; Black African: -99.00 [95% CI: -110.6, -87.32]; Black other: -71.02 [95% CI: -96.54, -45.51]; South Asian/Other Asian: -83.27 [95% CI: -110.54, -56.00]; Mixed/Other: -56.20 [95% CI: -82.39, -30.01]. After adjusting for confounders, this effect was strengthened for all BAME groups with the exception of the South Asian/Other Asian category, though still significant (parameter estimate Black Caribbean: -42.64 [95% CI: -62.14, -23.15]; Black African: -108.52 [95% CI: -119.73, -97.30]; Black Other: -76.22 [95% CI: -100.30, -52.13]; South Asian/Other Asian: -72.97 [96% CI: -98.67, -47.27]; Mixed/Other: -65.13 [95% CI: -89.83, -40.43]).

Engagement in care

During follow up, individuals included in the study were classed as 'engaged in-care' (EIC) for 79.6% of their time in UK CHIC. Participants who initiated cART had a much greater median proportion of time EIC (median: 0.90 [IQR: 0.73, 0.98]) compared to those who did not (median: 0.42 [IQR: 0.73, 0.98]). Based on ethnicity (Table 3), those of a South Asian/Other Asian origin had the highest proportion of time spent EIC (83.6%), followed by White (80.9%) and Mixed/Other (80.6%) groups. Individuals of Black ethnicity had the lowest (Black African: 79.5%; Black Caribbean: 79.3%; Black Other: 74.8%) proportion of time EIC. This effect was also present in univariable logistic regression analyses, where there was a lower odds of EIC amongst the Black groups compared to the White group (Black Caribbean OR: 0.77 [95% CI: 0.69, 0.87]; Black African OR: 0.87 [95% CI: 0.81, 0.93]; Black Other OR: 0.91 [95% CI: 0.78, 1.05]; $p < 0.0001$). After adjustment, the associations with ethnicity were strengthened as shown in Figure 1 (Black Caribbean aOR: 0.74 [95% CI: 0.63, 0.88]; Black African aOR: 0.70 [95% CI: 0.63, 0.79]; Black Other aOR: 0.81 [95% CI: 0.64, 1.02]; $p < 0.0001$) and in addition the aOR for the Mixed/Other ethnic group fell below 1 (aOR: 0.78 [95% CI: 0.62, 0.98]).

Treatment initiation

Over 70% of individuals entering UK CHIC initiated a cART regimen, with 52.2% initiating treatment within the first year of UK CHIC entry. Overall, 15.8% of CD4+ cell count measurements were followed by initiation of cART. By ethnicity (Table 3), this was highest

amongst participants of Black African (16.7%) and Mixed/Other backgrounds (16.8%), followed by the South Asian/Other Asian group (15.1%). Treatment initiation following a CD4+ cell measurement was lowest amongst the White (14.0%), Black Caribbean (14.4%) and Black Other (14.6%) groups. In a univariable logistic regression analysis, participants of Black African (odds ratio (OR): 1.23 [95% CI: 1.15, 1.31]) and Mixed/Other (OR: 1.24 [95% CI: 1.07, 1.44]) ethnicity were more likely to initiate cART after a CD4+ cell count measure when compared to the White group, suggesting an association between ethnicity and treatment initiation ($p < 0.0001$). These associations however, were attenuated in a multivariable logistic regression model (Black African adjusted OR (aOR): 0.88 [95% CI: 0.74, 1.05]; Mixed/Other aOR: 1.08 [95% CI: 0.90, 1.29]) and ethnicity was no longer associated with treatment initiation ($p = 0.45$) (Figure 1).

Time to viral suppression

Amongst those who initiated cART, 79.1% were virally suppressed within 12 months. The White group had the highest proportion of individuals becoming virally suppressed (81.8%), followed by South Asian/Other Asian (80.3%), Black Caribbean (79.8%), Mixed/Other (78.3%), Black African (78.2%) and Black other (77.5%) groups (Table 3). The median time to viral suppression was four months [IQR: 2-8 months]. This was similar across all ethnic groups (log-rank test: $p = 0.86$). There was no association between time to viral suppression and ethnicity in either univariable or multivariable Cox regression models (Figure 1).

Time to viral rebound

A total of 1,489 heterosexual individuals experienced viral rebound after viral suppression. By the end of the second year of follow-up, as shown in Table 3, 16.3% of White individuals had experienced viral rebound compared to 21.6% of Black Caribbean, 24.4% of Black African, 22.9% of Black other, 19.7% of South Asian/Other Asian and 19.6% of Mixed/Other participants (log rank test: $p < 0.0001$). In univariable Cox regression models, individuals from a BAME groups were more likely to experience viral rebound, in particular those from a Black group (Black Caribbean hazard ratio (HR): 1.41 [95% CI: 1.10, 1.81]; Black African HR: 1.56 [95% CI: 1.35, 1.81]; Black Other HR: 1.63 [95% CI: 1.22, 2.19]) compared to the White group. As shown in Figure 1, these associations were strengthened in the adjusted analyses for Black Caribbean (adjusted HR (aHR): 1.73 [95% CI: 1.28, 2.33]), Black African (aHR: 1.85 [95% CI: 1.52, 2.24]), Black Other (aHR: 1.95 [95% CI: 1.37, 2.77]) and South Asian/Other Asian (aHR: 1.35 [95% CI: 0.90, 2.03]) groups. In contrast there was an attenuation of this effect for the Mixed/Other group (aHR: 1.09 [95% CI: 0.68, 1.71]).

Discussion

Using data from heterosexual men and women participating in the largest cohort study of people living with HIV in the UK, we examined differences by ethnicity of HIV outcomes in the care continuum finding disparities in CD4+ cell count at presentation, viral rebound and engagement in care, but not cART initiation or viral suppression.

Individuals from all Black, Asian and minority ethnic (BAME) groups had lower CD4+ cell counts at presentation than the White group, similar to the UK CHIC analysis of HIV outcomes in MSM by ethnicity[4] and global studies looking at late diagnosis[9-14]. Like

previous London studies[15,16], there were no significant associations between ethnic group, cART initiation and time to viral suppression, suggesting that reassuringly, once linked into care there are no disparities in starting cART and becoming virally suppressed. However, all Black and Asian ethnic groups were more likely to experience viral rebound than the White and Mixed/Other ethnic groups consistent with previous analyses of UK CHIC investigating the durability of viral suppression with first-line anti-retroviral therapy[17,18].

Internationally, US studies have found that Black ethnicity is associated with higher odds of having a detectable viral load[5,6] and suboptimal adherence[19]. Whilst the absolute differences in viral rebound rates between those in BAME and White groups were relatively small in our study (5-6%), these differences are clinically relevant in the context of optimal viral suppression. Black and Mixed/Other groups were less likely to be engaged in care than White and Asian/Other Asian groups, similar to several UK studies which showed higher rates of disengagement from care and more irregular clinic attendance for people from BAME groups and those born outside of the UK[20-23]. There are likely to be several reasons for our findings.

Firstly, social and economic disadvantage disproportionately affects Black and other racially minoritised groups in the UK[24] due to structural racism and is related to poor health outcomes and reduced life expectancy[25]. People living with HIV from racially minoritised backgrounds are more likely to experience social and economic hardship than people from White backgrounds[26-29] and this can impact on physical and mental health, viral rebound, access to care and quality of life[25,26,28-31].

Mental health and HIV-related stigma should also be considered. HIV-related stigma is associated with poor adherence[32] and may lead to avoidance of healthcare services[27]. A UK survey exploring HIV-related stigma found that people from BAME groups were half as likely to have discussed their diagnosis with anyone compared to White people[33] suggesting they may be more affected by HIV stigma. Mental health problems are common amongst people living with HIV[34] and can impact on clinical HIV outcomes[23]. Ethnic disparities in accessing mental health care in the UK are well-documented in the general population[35] and have been found amongst older women living with HIV[29].

Migration status may also impact on access to HIV testing, treatment and care due to recent changes in charging and data sharing between NHS Digital and the Home Office[36]. Although UK CHIC does not collect data on country of birth, national HIV surveillance data shows that 69% of people who acquired HIV through heterosexual contact were born outside of the UK[1], so it is likely many of the UK CHIC cohort were too. Studies looking at Black African migrants in the UK and Europe have found that barriers to testing, treatment and care included restrictive immigration policies, lack of political will and the absence of Black African representation in decision-making processes, HIV-related stigma and discrimination, competing priorities, the perception that accessing healthcare was not necessary if feeling well, and fear of involuntary disclosure[37,38].

Adherence and engagement in care may be affected by the relationship between the healthcare provider and service-user. Studies of Black Africans in the UK found a lack of confidence in cART, concerns about short and long-term side-effects and worries that they

were not being taken seriously by their healthcare provider to be important factors determining treatment adherence[39-42]. Medical mistrust should also be considered[19,39] as this has been associated with poor adherence[43]. A US study also found that barriers to engagement in care for African American and Hispanic people also included the perception that patients were excluded from the health decision-making process, an over-emphasis on cART compared to other non-HIV related priorities and the over institutionalisation of healthcare settings, which made them feel dehumanised[44].

There are several limitations to our study. As UK CHIC collects data from NHS HIV service providers, data is from people who attend these services, not those disengaged from care. Ethnic group categories are broad, so heterogeneity within groups is missed and as ethnicity is self-identified, there may be a lack of consistency in how individuals choose their ethnic identity. In addition, we excluded women with a recorded pregnancy from the analyses. Although a higher proportion of these women were Black African, than those included (77.6% vs. 64.4%), sensitivity analyses suggested that the exclusion of this group did not modify our findings greatly. Data are collected on CD4+ cell count at presentation to the HIV service, and may not necessarily reflect CD4+ cell count at diagnosis. Therefore those who test outside of the UK may have a delay before registering with an HIV service in the UK, so their CD4+ cell count at presentation may be lower than at diagnosis.

Our study also had considerable strengths. UK CHIC is the largest HIV cohort in the UK and the contributing HIV clinics are diverse in size and location making the cohort representative of the population of people living with HIV in the UK.

Our findings reinforce national recommendations to reduce late diagnosis by commissioning a range of approaches to promote and offer HIV testing[45] to ensure all population groups are targeted. Healthcare professionals working with people living with HIV from BAME communities should be aware that they may need additional support to stay engaged in care and on treatment, and their needs should be assessed and managed in a proactive and holistic way. We recommend adherence support from a specialist pharmacist, access to mental health services, peer support and referral pathways to organisations that can provide advice on benefits, employment, immigration and housing. Interpreters should be made available when required.

The meaningful involvement of people living with HIV is encouraged in at all stages of research, policy, service design and evaluation and we recommend that this includes people from BAME backgrounds, so a diversity of views are represented. Further research to investigate and address the disparities we have found should take a community participatory approach.

In conclusion, using data from one of the largest and most representative cohorts of people living with HIV in the UK, our results suggest that heterosexual people living with HIV from BAME groups in the UK face significant barriers to testing, maintaining viral suppression and remaining engaged in HIV care. As late diagnosis, suboptimal adherence to treatment and disengagement from care are associated with HIV-related morbidity and mortality and onwards transmission, this is of significant concern. Whilst excellent progress has been made in the UK towards reaching the UNAIDS targets of ending the AIDS epidemic by 2030 and

preventing new transmissions, not all groups are benefitting equally. It is therefore vital that these barriers are understood and addressed, so that people from Black, Asian and minority ethnic groups are not left behind.

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Author Contribution:

Author contribution – R.D. and C.A.S. conceived of and designed the analysis, H.O. and C.A.S. carried out the statistical analysis, R.D., H.O. and C.A.S. interpreted the results and wrote the manuscript. The UK CHIC steering group critically reviewed the results and the manuscript. T.H. carried out data collection and cleaning and revision of the manuscript.

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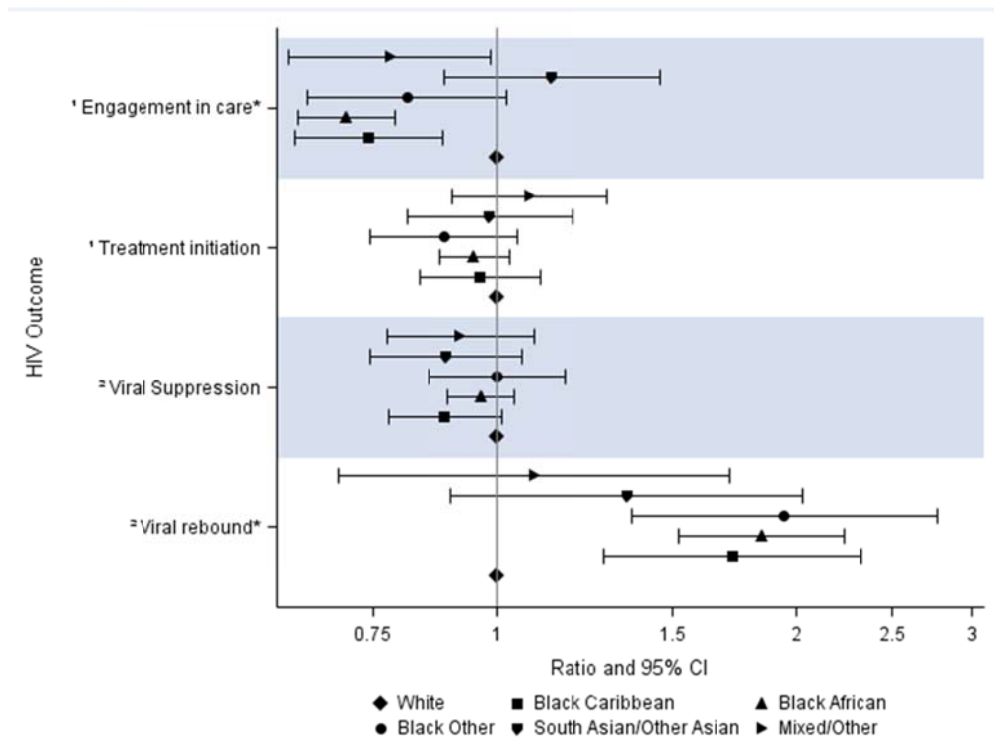
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Figure Legend

Figure 1: Adjusted ratios for HIV outcomes amongst heterosexual individuals in UK CHIC by ethnic group



¹ Adjusted odds ratio; ² adjusted hazard ratio; * time-updated co-variables. Adjusted for Sex, prior history of AIDS, Hepatitis B, Hepatitis C, age, CD4+ cell count and HIV viral load. Models for EIC, viral suppression and viral rebound were additionally adjusted for cART use.

Tables

Table 1: Demographic and clinical characteristics at time of entry to UK CHIC of the heterosexual participants included in the study, stratified by ethnicity

		Total (n=12302)	White (n=2345)	Black Caribbean (n=773)	Black African (n=7919)	Black other (n=449)	SA/Other Asian (n=401)	Other/Mixed (n=415)
Age at UK CHIC entry (median, IQR)	years	37 (31, 44)	39 (30, 49)	38 (30, 48)	36 (31, 43)	36 (30, 43)	38 (31, 45)	36 (29, 43)
HIV viral load at entry (median, IQR)	Log copies/mL	4.1 (3.1, 4.9)	4.1 (3.2, 4.9)	4.2 (3.2, 4.9)	4.2 (3.1, 4.9)	4.2 (3.1, 4.9)	4.1 (3.0, 5.1)	4.3 (3.1, 4.9)
Sex (n, %)	Male	5845 (47.5)	1439 (61.4)	407 (52.7)	3359 (42.42)	216 (48.1)	228 (56.9)	196 (47.2)
	Female	6457 (52.5)	906 (38.6)	366 (47.3)	4560 (57.6)	233 (51.9)	173 (43.1)	219 (52.8)
Year entry into UK CHIC (n,%)	2000-2006	5105 (41.5)	756 (32.2)	343 (44.4)	3600 (45.5)	135 (30.1)	129 (32.2)	142 (34.2)
	2007-2011	4776 (38.8)	927 (39.5)	269 (34.8)	3037 (38.4)	219 (48.8)	163 (40.7)	161 (38.8)
	2012-2017	2421 (19.7)	662 (28.2)	161 (20.8)	1282 (16.2)	95 (21.2)	109 (27.1)	112 (27.0)
Hepatitis B at entry (n,%)	Yes	72 (0.6)	7 (0.3)	3 (0.4)	58 (0.7)	3 (0.7)	0 (0.0)	1 (0.2)
Hepatitis C at entry (n, %)	Yes	29 (0.2)	13 (0.6)	4 (0.1)	11 (0.1)	0 (0.0)	2 (0.5)	2 (0.5)
AIDS at entry (n, %)	Yes	1265 (10.3)	224 (9.5)	55 (7.1)	833 (10.5)	45 (10.0)	65 (16.2)	43 (10.4)
Lost to follow up (n, %)	Yes	108 (0.9)	27 (1.1)	7 (0.9)	64 (0.8)	3 (0.7)	4 (1.0)	3 (0.7)
Died (n,%)	Yes	631 (5.1)	150 (6.4)	57 (7.4)	372 (4.7)	22 (4.9)	12 (3.0)	18 (4.3)
Initiated cART (n,%)	Yes	8867 (72.1)	1714 (73.1)	547 (70.8)	5666 (71.5)	328 (73.0)	295 (73.6)	317 (76.4)

SA: South Asian; IQR: interquartile range; cART: combination antiretroviral therapy.

Table 2: Demographic and clinical characteristics at treatment initiation of the heterosexual participants in the study, stratified by ethnicity

		Total (n=8867)	White (n=1714)	Black Caribbean (n=547)	Black African (n=5666)	Black other (n=328)	SA/Other Asian (n=295)	Other/Mixed (n=317)
Age at cART (median, IQR)	years	39 (33, 46)	42 (34, 51)	41 (34, 50)	38 (33, 44)	39 (33, 45)	39 (33, 47)	39 (32, 44)
Year cART initiated (n,%)	2000-2006	2533 (28.6)	338 (19.7)	149 (27.2)	1837 (32.42)	63 (19.2)	79 (26.8)	67 (21.1)
	2007-2011	3864 (43.6)	730 (42.6)	209 (38.2)	2512 (44.3)	164 (50.0)	119 (40.3)	130 (41.0)
	2012-2017	2470 (27.9)	646 (37.7)	189 (34.6)	1317 (23.2)	101 (30.8)	97 (32.9)	120 (37.9)
CD4+ count at cART (median, IQR)	cells/mm ³	192 (80, 309)	232 (102, 349)	211 (90, 333)	180 (79, 285)	191 (65, 303)	160 (54, 294)	226 (95, 320)
HIV VL at cART	Log	4.8 (4.2, 4.9)	4.8 (4.2, 4.9)	4.8 (4.1, 5.3)	4.8 (4.2, 4.9)	4.9 (4.3, 4.9)	4.9 (4.2, 4.9)	4.8 (4.3, 5.3)

(median, IQR)	copies/mL	5.3)	5.3)	5.3)	5.4)	5.4)		
Hepatitis B at cART (n,%)	Yes	225 (2.5)	16 (0.9)	7 (1.3)	184 (3.2)	8 (2.4)	3 (1.0)	7 (2.2)
Hepatitis C at cART (n,%)	Yes	120 (1.3)	66 (3.8)	4 (0.7)	38 (0.7)	2 (0.6)	4 (1.4)	6 (1.9)
AIDS at cART (n,%)	Yes	1657 (18.7)	267 (15.6)	87 (15.9)	1120 (19.8)	56 (17.1)	68 (23.0)	59 (18.6)
Base regimen (n,%)	NNRTI	5596 (63.1)	247 (19.9)	333 (60.9)	3805 (67.1)	189 (57.6)	186 (63.1)	175 (55.2)
	PI	2130 (24.0)	486 (39.2)	132 (24.1)	1244 (22.0)	91 (27.7)	58 (19.7)	92 (29.0)
	INI	561 (6.3)	346 (27.9)	48 (8.8)	254 (4.5)	26 (7.9)	20 (6.8)	29 (9.2)
	Other	580 (6.5)	162 (13.0)	34 (6.2)	363 (6.4)	22 (6.7)	31 (10.5)	21 (6.6)

SA: South Asian; IQR: interquartile range; cART: combination antiretroviral therapy; NNRTI: nonnucleoside reverse transcriptase inhibitor; PI: protease inhibitor; INI: integrase inhibitor.

Table 3: Median and interquartile range or crude number and percentage of HIV outcomes among heterosexual individuals in UK CHIC, stratified by ethnic group.

Ethnicity	CD4+ cell (n=12302)	cART initiation [^] (n=43336)	Time in-care* (n=966658)	Viral suppression (n=8472)	Viral rebound (n=6698)
All	276 (126, 450)	6851 (15.8)	769523 (79.6)	6698 (79.1)	1489 (22.2)
White	363 (180, 547)	1349 (14)	146701 (80.9)	1324 (81.8)	216 (16.3)
Black Caribbean	315 (160, 510)	427 (14.4)	47697 (74.8)	403 (79.8)	87 (21.6)
Black African	250 (118, 410)	4346 (16.7)	497126 (79.5)	4263 (78.2)	1039 (24.4)
Black other	288 (117, 410)	269 (14.6)	27085 (79.3)	245 (77.5)	56 (22.9)
South Asian/Other Asian	240 (98, 430)	213 (15.1)	26089 (83.6)	228 (80.3)	45 (19.7)
Mixed/Other	311 (155, 483)	247 (16.8)	24825 (80.6)	235 (78.3)	46 (19.6)

[^]cART initiation recorded based on treatment start after a CD4+ cell count measurement.

*Time in care percentages recorded as percentage of person-months based on EIC from the REACH algorithm. cART: combination antiretroviral therapy.