**BACKGROUND**

The HIV epidemic in sub-Saharan Africa (SSA) is known to be heterogeneous [1,2], and demographic growth means new young people continue to enter sexual activity and contribute to furthering epidemic spread. Heterogeneously in the epidemic highlights the importance of investing in preventative efforts that are focused on those at the most risk of transmitting or acquiring the virus.

Nationwide demographic and health surveys provide information on HIV prevalence which can inform interventions targeted at those most at risk of acquiring HIV. However, targeted interventions should also be informed by those most at risk of transmitting HIV.

**OBJECTIVES**

1. **Objective 1**: Quantify the proportion of new infections that arise from men and women of different age groups in a simulated epidemic of an intervention community in the HPTN 071 (PopART) trial.

2. **Objective 2**: Quantify the potential impact of suppressing transmissions from each of these groups in objective 1, in a simulated HIV epidemic of an intervention community in the HPTN 071 (PopART) trial.

**MODELING THE HIV EPIDEMIC**

The PopART individual-based model (IBM) is a computer simulation model of the HIV epidemic in the communities of the HPTN 071 (PopART) trial. It models every individual within a simulated population, approximately the same size as the PopART communities. The model has several components that model demographics, the introduction of HIV, heterosexual partnerships formation and dissolution, HIV progression, and both the PopART intervention and a background care cascade. Only heterosexual transmission is modeled, and age mixing is parameterized using data from the trial up to the last 3 last partners in the year.

For each community, the IBM is calibrated to four sets of data, each of which is stratified by age and gender: 1) HIV prevalence from historical health surveys; 2) HIV incidence from trial data; 3) the proportion of HIV-positive individuals that are aware of their HIV status from trial data; and 4) the proportion of individuals that are on ART among those that are aware of their HIV status from trial data.

We quantify transmissions from different age groups of men and women using two measures the direct population attributable fraction (PAF-direct) and the total population attributable fraction (PAF-total). Both measures have been previously used in modelling studies of HIV (2). PAF-direct quantifies the proportion of all transmissions that are attributable to men and women of different age groups from the simulated period from mid-2014 to mid-2015.

PAF-total includes both direct and indirect effects and quantifies the total number of HIV infections averted if a certain group were not able to transmit HIV over the period mid-2014 to mid-2015. For a particular age group, a, and gender, g, we calculate PAF-direct and PAF-total for a period, t, as follows:

\[ PAF_{direct} = \frac{\sum_{i \in [0.7, 0.8]} E_{(i,t)} \cdot R_{a,g} \cdot I_{a,g} \cdot P_{a,g}}{\sum_{i \in [0.7, 0.8]} E_{(i,t)} \cdot R_{a,g} \cdot I_{a,g} \cdot P_{a,g}} \]

\[ PAF_{total} = \frac{\sum_{i \in [0.7, 0.8]} E_{(i,t)} \cdot R_{a,g} \cdot I_{a,g} \cdot P_{a,g}}{\sum_{i \in [0.7, 0.8]} E_{(i,t)} \cdot R_{a,g} \cdot I_{a,g} \cdot P_{a,g}} \]

Where:

- \( E_{(i,t)} \) is the exposure to infection at age i and time t
- \( R_{a,g} \) is the reproductive value for age class a and gender g
- \( I_{a,g} \) is the proportion of individuals in age class a and gender g who are not infected
- \( P_{a,g} \) is the proportion of individuals in age class a and gender g who are not infected

In the first 20 years of the epidemic, the PAF-direct was highest in 25-29 year old men and in 20-24 year old women. Over the trial period these heterogeneities in contributions to the epidemic were increased (Figure 1). Beyond the trial, PAF-direct of 30-34 year old men was 15% in 2023-2028, twice that of 25-29 year old men.

**RESULTS**

### Objective 1

In all simulations, when considering individuals responsible for transmission, for individuals less than 25 years old, the PAF-direct of 40-44 year old men was higher than men whereas, for ages greater than 25 years old, this relationship was reversed.

**Figure 1**: The proportion of direct transmissions attributable to men and different age groups from 2014 to 2016.

### Objective 2

When considering indirect transmissions, PAF-total was similar in men and women across all age groups for those 25-34 year old risk groups.

**Figure 2**: The relative number of HIV infections averted to certain age groups not infected during the period 2015 to 2016.

**REFERENCES**


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