



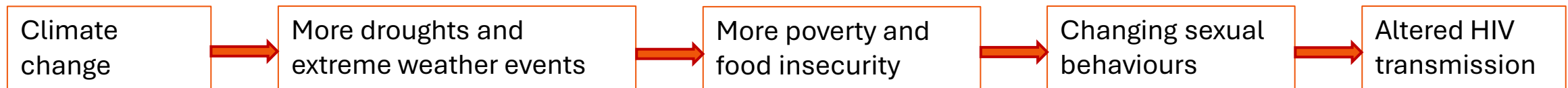
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Investigating the associations between drought, poverty, high-risk sexual behaviours, and HIV incidence in Sub-Saharan Africa

Links between climate change and HIV

- UNAIDS warned in 2008 that climate change could have a detrimental effect on HIV transmission in settings where HIV prevalence is high¹
- Impact could occur through intermediary mechanisms



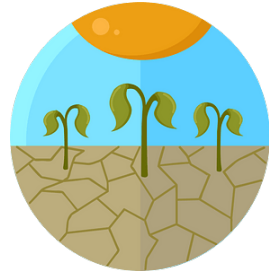
- Extreme weather events could exacerbate structural problems underlying HIV transmission, particularly among women in rural areas where subsistence farming is common
- Poverty and food insecurity can drive changes in sexual behaviours, such as increased **transactional sex**
- Also linked to **intergenerational sex** - particularly where young women partner with older men who have more resources and are more likely to have HIV
- Women in these circumstances may have less say in the use of contraception, increasing condomless sex with non-permanent partners (I will refer to this as “**high-risk sex**”)

Aims and methods

- We aimed to investigate a potential pathway by which drought may affect HIV transmission in sub-Saharan Africa
- We aimed use multivariable logistic regression modelling to examine associations between:
 - Drought and poverty
 - Poverty and sexual behaviours
 - Sexual behaviours and HIV incidence (recent HIV infections)
 - Drought and HIV incidence (recent HIV infections)
- We used data on adults (15-59 years old) from five **nationally representative** Population-Based HIV Impact Assessment (PHIA) cross-sectional surveys for **2016**:
 - Eswatini, Lesotho, Tanzania, Uganda, and Zambia
 - All analyses were stratified by sex and urban/rural location
- To classify **recent HIV infections**, staff used antigen avidity immunoassays
- Samples were considered a recent infection if there was a normalised optical density <1.5 and the individual did not have a suppressed viral load or detectable antiretroviral drugs



Data from population surveys



- Nationally-representative survey data included from household questionnaire, and, for each participant, the adult questionnaire and the results of the HIV testing
- **Wealth quintiles** were calculated based on household assets and included as a continuous variable in the analyses with sexual behaviours as the outcome
- Relative **poverty** was defined as being in the lowest two wealth quintiles for each country's survey
- **Transactional sex in the prior year** was defined as having bought/sold sex or entered into a relationship to either supply or receive food, money, or support
- **High-risk sex in the prior year** was defined as condomless sex with a partner who was HIV+ or had unknown HIV status, who they did not live with and were not married to
- **Intergenerational sex in the prior year** was defined for women as sex with a partner who was older by ≥ 10 years, and for men as sex with a partner that who was younger by ≥ 10 years

Data on changes in rainfall

- Precipitation data: Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS) at 0.05° resolution¹
- **The dataset summed the 2-year total rainfall from June 2014 to May 2016**
- **This was then ranked compared to all 2-year rainfall amounts over the period 1981–2016 to give an empirical percentile**
- Survey data and precipitation data were combined using latitude and longitude coordinates



Exposure to drought:

- **Drought** was defined for a location if the rainfall during the 2-year period (June 2014 to May 2016) vs historical values was less than the 15th percentile
- This binary variable approximates the level below which rainfall deficits are particularly harmful to gross domestic product (GDP) and maize yields¹
- This should be functionally equivalent to the commonly used Standardised Precipitation Index (SPI) definition of drought as $SPI < -1$

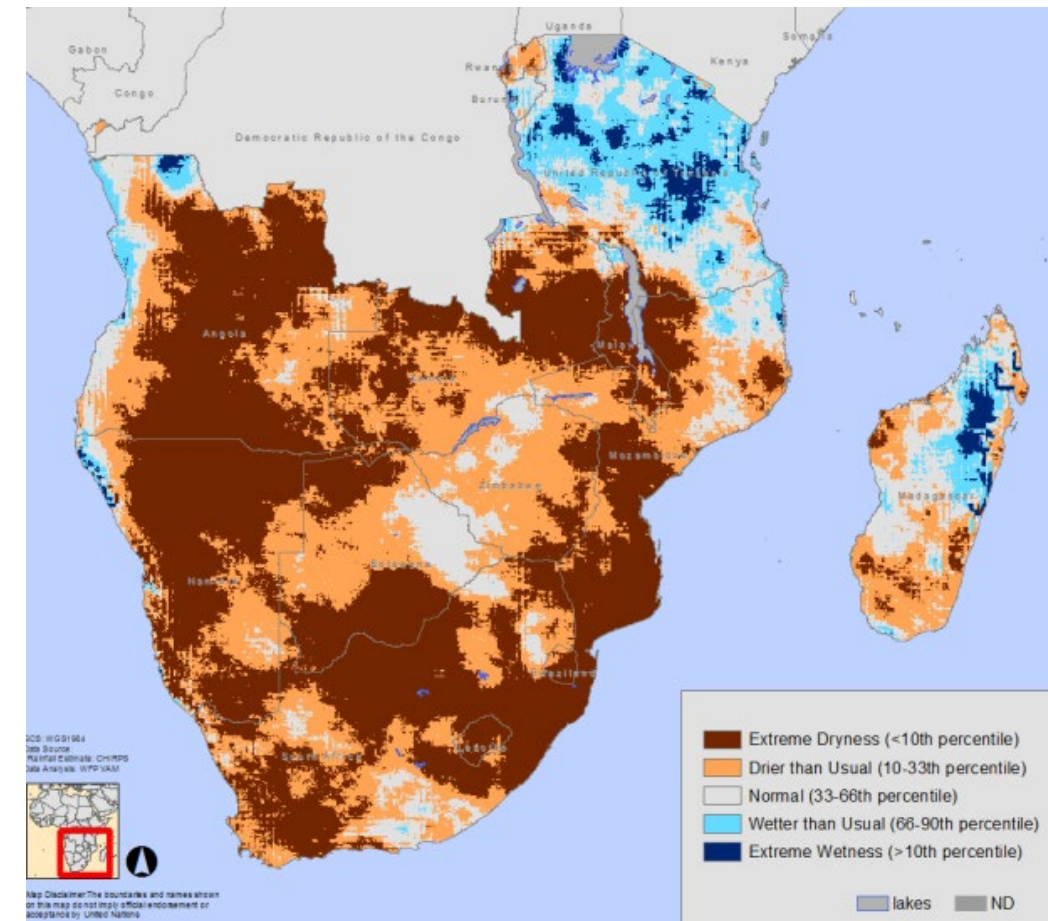
¹ Funk C, et al. The climate hazards infrared precipitation with stations-a new environmental record for monitoring extremes.

Population included

- 102,081 respondents aged 15-59 were included
- Mean age 30 years old
- 58,341 (57.2%) were female
- 34,388 (33.7%) lived in urban areas
- 32.1% had experienced a drought in the prior two years

Map of two-year (June 2014 – May 2016) rainfall extremes vs 1981-2016 in Southern Africa

Taken from: World Food Programme. Southern Africa growing season 2016–2017: Recovery after two years of drought? 2016.



Drought and poverty

- Weighted adjusted* odds ratios of poverty (95% confidence intervals)

| | Rural | Urban |
|--------------|------------------|------------------|
| Women | 1.28 (1.02-1.61) | 1.24 (0.68-2.26) |
| Men | 1.31 (1.04-1.66) | 1.03 (0.46-2.27) |

Numbers greater than 1 indicate greater odds of the outcome (poverty)

- Poverty was more common for both women and men living in rural areas who had experienced drought than those who had not experienced drought**
- No strong evidence of an association in urban areas – wide confidence intervals**

* Adjusted for age, secondary education, ever married, received pay check in last 12 months, food or other economic support, and country

Poverty and recent sexual behaviours

- Weighted adjusted odds ratios of sexual behaviours for an increase in wealth quintile (the exposure)

| Outcome | Population | Fully adjusted* Odds Ratio (95% confidence interval) |
|-----------------------|-------------|--|
| Transactional sex | Rural women | 0.92 (0.88-0.97) |
| | Urban women | 0.88 (0.81-0.94) |
| | Rural men | 0.92 (0.85-1.00) |
| | Urban men | 0.84 (0.74-0.95) |
| High-risk sex | Rural women | 1.04 (0.98-1.10) |
| | Urban men | 0.98 (0.90-1.06) |
| | Rural men | 1.08 (1.02-1.13) |
| | Urban men | 0.90 (0.83-0.98) |
| Intergenerational sex | Rural women | 1.04 (1.01-1.08) |
| | Urban women | 1.01 (0.95-1.07) |
| | Rural men | 0.99 (0.94-1.04) |
| | Urban men | 1.03 (0.94-1.12) |

- Transactional sex was more common for people in lower wealth quintiles
- Associations between wealth quintile and high-risk sex and intergenerational sex were less clear

Numbers less than 1 indicate that as wealth increases, the chance of the outcome increases

* Adjusted for receipt of food or economic support, secondary education, having received a pay check in the previous

12 months, ever married, age, and country

Recent sexual behaviours and recent HIV

| | % with recent HIV | aOR (95%CI)* | % with recent HIV | aOR (95%CI)* |
|--------------------------|---|------------------|---|-------------------|
| Exposure | Rural women (88/31647 with recent HIV) | | Rural men (43/25812 with recent HIV) | |
| No transactional sex | 0.2% | 1 | 0.1% | 1 |
| Transactional sex | 0.4% | 1.73 (0.71-4.18) | 0.1% | 0.97 (0.20-4.66) |
| No high-risk sex | 0.2% | 1 | 0.1% | 1 |
| High-risk sex | 0.8% | 3.40 (1.34-8.59) | 0.2% | 1.39 (0.39-4.98) |
| No intergenerational sex | 0.2% | 1 | 0.1% | 1 |
| Intergenerational sex | 0.3% | 1.66 (0.81-3.41) | 0.3% | 1.84 (0.68-4.99) |
| Exposure | Urban women (63/15698 with recent HIV) | | Urban men (20/11424 with recent HIV) | |
| No transactional sex | 0.2% | 1 | 0.1% | 1 |
| Transactional sex | 0.5% | 1.61 (0.63-4.10) | 0.0% | 0.35 (0.04-3.09) |
| No high-risk sex | 0.2% | 1 | 0.1% | 1 |
| High-risk sex | 1.2% | 2.86 (1.30-6.32) | 0.4% | 3.81 (0.85-17.12) |
| No intergenerational sex | 0.2% | 1 | 0.1% | 1 |
| Intergenerational sex | 0.6% | 2.60 (1.22-5.58) | 0.2% | 1.92 (0.47-7.83) |

Numbers greater than 1 indicate greater odds of the outcome (having recently acquired HIV)

aOR: Adjusted Odds Ratio*

95%CI: 95% confidence interval

- For women, the percentage who had recently acquired HIV was higher for those reporting each individual sexual behaviour than those than who did not
- Less clear among men
- Wide confidence intervals due to few recent HIV events

*Adjusted for sexual risk behaviour variables, age, and an interaction between survey country and regional viraemia. Regional viraemia is defined as the percentage of individuals in the enumeration area with unsuppressed HIV viral loads

Drought and recent HIV

- In both unadjusted analyses and when adjusted for survey country, regional HIV viraemia levels and various demographic and sexual behaviours*, **women in rural areas who had been exposed to drought had double the odds of having recently acquired HIV than women who had not been exposed to drought:**
- Adjusted odds ratio: 2.10 [95% confidence interval: 1.17-3.77]
- **For women in urban areas, and men in both rural and urban areas, there was no evidence of an association between having been exposed to drought and having recently acquired HIV**

* Additionally adjusted for secondary education, receiving a paycheck in the last 12 months, ever married, food or other economic support, severe food insecurity (defined as having no food more than 3 times in the last 4 weeks), wealth quintile, and transactional, high-risk, and intergenerational sex

Conclusions

- **We found that women in rural areas of five countries* in sub-Saharan Africa who had recently experienced drought had increased odds of having recently acquired HIV**
- **No evidence of associations for women in urban areas or men**
- Also, associations linking drought with poverty, wealth with recent sexual behaviours, and recent sexual behaviours with recent HIV
- The association between drought and recent HIV did not attenuate upon adjustment for mediating factors as expected, potentially as some of these are imperfectly collected (e.g., self-report)
- **Longitudinal data analyses are needed to better understand the potential causal mechanisms**

*Eswatini, Lesotho, Tanzania, Uganda, and Zambia

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