Sexual behaviour and HIV prevalence trends among residents and non-residents in a general population in rural South Africa: Implications for studies of migration and HIV risk

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Introduction

When highly active HIV treatment became available in developed countries, several studies reported increases in sexual risk behaviour amongst high-risk populations and suggested that these changes could potentially offset the preventive benefits of treatment [1, 2]. As HIV treatment was made available through public health services in developing countries, the same concerns were again raised - that riskier sexual behaviour may increase in the general population if individuals believe their risk of infection has decreased or that HIV has become a treatable disease [3, 4]. In South Africa, a country with very high levels of HIV prevalence, studies about changes in sexual behaviour in the era of HIV treatment have predominantly focused on cohorts of HIV-infected adults starting on treatment [5-8]. In a recent analysis using repeated cross-sectional sexual behaviour data in a rural South African community 2005-2011, McGrath et al found no evidence of increased sexual risk behaviours following ART availability [9]. However, as the authors note, the trends in sexual behaviour observed in the overall study population may mask sexual behaviour change in specific subgroups. They explored trends in sub-groups defined by HIV status, knowledge of HIV status, and by age and marital status. Generally, trends within these sub-groups were consistent with the overall trends. One group of particular interest that was not examined are adult migrants from rural households.

Rural communities in South Africa have high levels of adult in- and out-migration, with a long history of adult labour migration [10-12]. The association between migration and increased HIV transmission and acquisition has long been postulated and documented [13-16]. In this paper, we use data from the Africa Centre Demographic Information System to examine sexual behaviour and HIV prevalence trends in a population cohort by residential status. We also explore the extent to which current residential status may not be a good indicator of migration history.

Methods

Study Population

The Africa Centre demographic information system (ACDIS) has been described in detail elsewhere [17, 18] In brief, since January 2000 ACDIS has collected longitudinal demographic and health data on approximately 90,000 resident and non-resident members of 12,000 households in a predominately rural 438 km² demographic surveillance area (DSA) within the Hlabisa sub-district in northern KwaZulu-Natal, South Africa. The ACDIS includes all households resident at a bounded structure (homestead) in the DSA, and all household members are recorded. Household membership is defined by respondents and primarily relates to perceptions of social connectedness and belonging. An individual is considered a resident household member if they usually sleep in the household and keep their belongings there. An individual is considered a non-resident household member if they do not fulfil the conditions for residency but remain socially connected to the household. Routine demographic data are reported by household respondents during routine household data collection visits two or three times a year. This includes the types, dates and character of any change in the place of residence (migration events) and the frequency return visits by non-residents and the pattern of nights spent. The migration data have been described in detail elsewhere [10, 11].
Individual annual HIV surveillance was initiated as part of ACDIS in 2003 [18]. Recognising the importance of investigating the relationship between migration and health, all resident household members aged 15 years and older are eligible to participate in the annual individual surveillance, together with a stratified sample of non-resident household members (women aged 15-49 years and men aged 15-54 years) in which the strata relate to the distribution of return patterns by migrants (e.g. monthly or annual return visits). Consenting sampled non-residents are interviewed at their home in the surveillance area during a return visit, or are interviewed by a special tracking fieldwork team in their place of residence if outside the surveillance area. Tracking teams went as far as Gauteng province but not outside the country.

The study population has experienced a severe HIV epidemic. In the first HIV surveillance round (2003/4), HIV prevalence differed significantly in men and women by residency status. HIV prevalence in resident women aged 25-29 years was 50.9%, 95%CI (47.2 -54.6) in females and 43.5% (38.0- 49.0) in men aged 30-34 years. The equivalent HIV prevalence by age and sex in non-resident household members was 63% (95% CI 50-76%) and 56% (95% CI 34-78%) respectively [19]. In women and men, significant differences in the number of lifetime partners and the number of partners in the last year were found between groups classified on the basis of recent migration, residence with household and migration frequency [10]. The local HIV treatment and care programme was initiated in 2004 [20]. HIV prevalence among adults aged 15-49 years was 29% in 2011 [21], and crude HIV incidence has remained high, estimated to be 2.63 per 100 person-years, 95% CI (2.50, 2.77) during the period 2004-2011 [22]. HIV surveillance of residents and non-residents has continued annually providing a unique opportunity to compare and contrast trends in sexual behaviour and HIV prevalence within a highly mobile general population in the era of HIV treatment.

**Statistical Analyses**

Sexual behaviour data including details about each participant’s three most recent sexual partners in the past year have been collected since 2005 [9]. The outcomes considered in these analyses by residency status are: a) the proportion ever had sex; b) the proportion who were sexually active in the past year; c) the average number of sexual partners in the last year among people with at least one sexual partner in the same period; d) the proportion reporting multiple partnerships in the last year, e) the proportion reporting a casual partnership; f) the point-prevalence of concurrent sexual partnerships [23, 24]; g) the proportion reporting condom use at last sex with the most recent regular partner; h) the proportion reporting condom use at last sex with the most recent casual partner; and, i) the average age difference in years between the respondent and his or her most recent regular partner.

The demographic information available in ACDIS provides information about those who do and do not complete surveys allowing us to adjust estimates for missing data due to survey non-participation. In order to represent the sexual behaviour of the population of non-resident members of households in the DSA, combined probability weights were calculated to account for respondents’ probability of selection and response in each survey round and applied throughout the analyses. For residents, response weights were calculated according to strata defined by sex, age group, residence location (rural, peri-urban, urban), and education level.

We have previously published work examining the impact of multiple imputation (MI) methods on estimates of different sexual behaviour trends using ACDIS data. We demonstrated that MI adjustment made little difference to overall trend estimates [9]. In the analyses presented in this paper adjusted trends representing pooled estimates of 100 imputed datasets are used in all analyses. For each sexual behaviour outcome, regression models were also used to investigate trends over time after adjusting for any differences in age composition between residents and non-residents. HIV prevalence trends (2005-2011) were also examined by residency status after adjustment for any age compositional differences.
In order to explore the heterogeneity in migration history within groups defined by current residency status, we examined the proportion of residents and non-residents who had migrated in the past 2 years (considered recent migration), and mobility in the past 6 months represented by reports of the proportion of nights slept in the DSA household in the last 6 months.

Analyses were conducted using R [25]. Multiple imputation was implemented by creating customised imputation models for the imputation framework in the R package ‘mi’ [26].

**Results**

Table 1 describes the data available each year by sex and residential status. Contact rates differed between residents and non-residents, with significantly more of the resident eligible population successfully contacted compared to the non-residents. Participation rates, defined as individuals responding to sexual behaviour questions among those that were eligible (residents) or eligible and sampled (non-residents), was higher among non-residents than residents. Table 1 also shows the non-resident eligible population by return visit patterns, and the numbers sampled from each strata. Survey participation among residents was highest in 2005, at 44% for men and 57% for women. Participation amongst residents declined sharply after this year, reaching 27% of resident men and 39% of resident women by 2010. In contrast, 26% of sampled non-resident men and 32% of sampled non-resident women participated in 2005 and there was no obvious trend in participation over time.

Figure 1 shows adjusted trends in reported sexual behaviour indicators by residential status for men and women separately. For both men and women, higher levels of sexual risk behaviour tended to be reported by non-residents compared to residents, including more partners in the last year, a higher percentage with multiple partnerships, a higher point prevalence of concurrency, and more casual partnerships. Non-resident women were more likely than resident women to report condom use at last sex with their regular partner. In contrast, non-resident men were less likely to report condom use at last sex with their regular partner than resident men.

Generally, trends for each sexual behaviour indicator were in the same direction for residents and non-residents. Figure 2 shows the estimate and 95% CI for the slope of the linear trend over the period 2005-2011 for each sexual behaviour outcome for residents and non-residents by sex. Among residents, there was a significant trend for men and women in (i) the proportion ever having had sex, 0.8% per year, 95% CI (0.3%, 0.9%) and 0.8% per year, (0.6%, 0.9%) respectively, (ii) condom use at last sex with a regular partner, 4% per year, (3.4%, 4.6%) and 3.9% per year, (2.5%, 5.4%) respectively, and (iii) average age difference with a regular partner, 0.08 per year, (0.03, 0.12) and -0.05 per year, (-0.09, -0.01) respectively. In addition, among resident women the percentage reporting casual partnerships significantly increased over the period, 0.3% per year, (0.2%, 0.34%). For resident men, significant trends were observed in the percentage reporting multiple partnerships, -0.9% per year, (-1.2%, -0.7%), concurrency, -0.5% per year, (-0.7%, -0.3%), and condom use at last sex with a casual partner, 2.5% per year, (0.5%, 4.5%). Trend estimates for non-residents generally had much wider confidence intervals as a result of smaller sample sizes and for some respondents much larger sample weights and response weights compared to residents. The only significant trends for non-resident men and women were a decline in multiple partnerships, -1.5% per year, (-2.9%, 0%) and -0.9% per year, (-1.5%, -0.4%) respectively, and an increase in condom use at last sex with a regular partner for non-resident women, 4.6% per year, (2.6%, 6.6%).

Given the significant differences between residents and non-residents in the proportion who had ever had sex we adjusted the regression models for each sexual behaviour and HIV indicator to control for age composition (estimates not shown). We find that for men, the pattern of significant difference between residents and non-residents remains the same for all sexual behaviour indicators. For resident and non-resident women, the impact of adjusting for age on the pattern of significant difference is more mixed. The pattern of significance remained the same for reporting of multiple partnership, concurrency, condom use at last sex with regular and casual partner remained
the same. However, for women, the indicators ever had sex, sexually active in the last year and mean number of sexual partners were no longer significantly different between residents and non-residence after adjusting for age composition.

Figure 3 shows the estimated HIV prevalence trends by residency status. There is no significant difference in HIV prevalence by residency status for men or women. In regression models of HIV prevalence adjusting for age (not shown) the pattern of significant difference between residents and non-residents in HIV prevalence and knowledge of HIV did not change.

**Discussion & conclusion**

The differences in sexual behaviour between non-residents and residents after controlling for differences in age highlights is consistent with previous findings [10]; and demonstrates migration and mobility continue to be an important set of complex demographic and social processes for HIV epidemiology in the era of HIV treatment. Early research exploring the role of migrants as what has been termed ‘drivers of the epidemic’ focused on differentials in HIV risk behaviours, particularly in male migrants. These data, several decades into the epidemic show that men from rural households that are living elsewhere, continue to place themselves and their regular partners at higher risk of HIV through lower condom use than do men living in the surveillance area. This differential is not observed in women and suggests that the interplay between migration and risk taking may be quite different for men than women.

These data suggest that it is increasingly difficult to tease out the role of historical migration in populations with high prevalence, generalised HIV epidemics. However, there are compelling reasons to continue to document and consider the impact and consequences of migration in the era of HIV treatment and continued risk of HIV acquisition for people in these communities, particularly given that most adults and their partners in this population will migrate at some time during their lives, and many will change residence several times.

In the paper, we consider the limitations of the available data and make recommendations for enhancing research and operational data collection efforts.

**References**


Table 1. Contact and participation rates in annual sexual behaviour surveys by residential status, ACDIS 2005-2011

<table>
<thead>
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<th>Men</th>
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<tr>
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Footnote Table 1:

The eligibility list for the non-residents HIV surveillance in each year represents a 10% stratified random sample of non-resident adult members of households in the surveillance area in December of the previous year. Strata are defined by sex and pattern of return visits to their household in the DSA. In addition, any non-resident individuals who had a negative HIV test result in the HIV surveillance in the 2 years preceding the survey but were not selected in the current random sample are ‘forced’ to be part of the non-resident sample.

With respect to calculating weights to account for respondents’ probability of selection and response in each survey round. Individuals who were part of the forced sample have a selection weight of 1 in the analyses.
Figure 1. Adjusted trends in reported sexual behaviour indicators by residential status and sex, ACDIS 2005-2011
Figure 2. Slope estimates and 95% CIs of the linear trend for each sexual behaviour outcome by residential status and sex, ACDIS 2005-2011.
Figure 3. Estimated HIV prevalence trends by residency status and sex, ACDIS 2005-2011