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Coital frequency and condom use in age-disparate partnerships involving women aged 15 to 24: evidence from a cross-sectional study in KwaZulu-Natal, South Africa

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ABSTRACT

Objective This study examines the role of age-disparate partnerships on young women's HIV risk by investigating coital frequency and condom use within age-disparate partnerships involving women aged 15 to 24.

Design A community-based, cross-sectional study was conducted.

Setting Participants were randomly selected using a two-stage random sampling method in uMgungundlovu district, KwaZulu-Natal, South Africa, between June 2014 and June 2015.

Participants A total of 1306 15–24-year-old women in an ongoing heterosexual partnership were included in the analysis. Participants had to be a resident in the area for 12 months, and able to provide informed consent and speak one of the local languages (Zulu or English).

Primary and secondary outcome measures Sexual frequency was assessed by asking participants how many times they had sex with each partner in the past 12 months. The degree of condomless sex within partnerships was assessed in the survey by asking participants how often they used a condom with their partners.

Results Age-disparate partnerships were associated with a higher order category (once, 2–5, 6–10, 11–20, >20) of coital frequency (adjusted OR (aOR) 1.32, p<0.05, 95% CI 1.02 to 1.71) and with sex on more than 10 occasions (aOR 1.48, p<0.01, 95% CI 1.12 to 1.96) compared with age-similar partnerships. Age-disparate partnerships were also more likely to involve sex on more than 10 occasions with inconsistent condom use (aOR 1.43, p<0.05, 95% CI 1.04 to 1.96) in the previous 12 months.

Conclusion The finding that increased sexual activity is positively associated with age-disparate partnerships adds to the evidence that age-disparate partnerships pose greater HIV risk for young women. Our study results indicate that interventions to reduce risky sexual behaviour within age-disparate partnerships remain relevant to reducing the high HIV incidence rates among adolescent girls and young women.

Strengths and limitations of this study

- ► The study was able to access a vulnerable population of young women in one of the highest HIV prevalence districts in South Africa.
- ► The study collected data on sensitive sexual risk behaviours which are difficult to ascertain from young women.
- ► The study has a large sample and is community-based.
- ► The study further elucidates the risk to young women engaged in age-disparate partnerships.
- ► The self-reporting of sexual risk behaviours and coital frequency is susceptible to social desirability and recall bias.

INTRODUCTION

HIV prevention efforts in South Africa are particularly important among young women, given the high HIV incidence among this cohort.[1–3] In 2017, it was estimated that adolescent girls 15-19 years old accounted for 74% of new infections amongst adolescents 15-19 years old in sub-Saharan Africa, with more than 1000 HIV acquisitions among this group occurring daily.[4] Age-disparate partnerships (with an age difference of 5 years or more between partners) have been associated with increased risk of HIV infection among AGYW.[5–11] This risk to young women is driven by the higher HIV prevalence among older men, with HIV prevalence increasing steadily with age until peaking among men 35–40 years old.[1] Moreover, age-disparate male partners of young women are also more likely than age-similar male partners to have unsuppressed viral loads, resulting in an elevated risk of HIV infection to their partners.[12] HIV infection risk is further amplified by the increased prevalence of risky sexual behaviour within age-disparate partnerships, including inconsistent condom use,[13–15]

concurrent and multiple sexual partnering[16] and transactional sex.[17]

While some cohort and phylogenetic studies provide evidence that age-disparate partnership increase young women's risk of HIV acquisition,[18–21] other cohort studies have found no association between age-disparate partnerships and HIV acquisition.[22 23] One hypothesis following these null results is the possibility of reduced coital frequency, which has been posited as a potential characteristic of age-disparate partnerships that results from coital dilution: the reduction in frequency of sex acts per sexual partner as a result of concurrent partnering.[24] Given that age-disparate partnerships have been associated with concurrency,[16 25 26] sexual frequency could, by extension, be lower within age-disparate partnerships. The additional risk of HIV infection associated with age-disparate partnerships, due to riskier sexual behaviours, could thus be mitigated by the potential reduced sexual activity within these partnerships.

HIV infection risk for young women is, in part, based on whether their partners are HIV positive, but also on risky sexual behaviour (which heightens exposure to the virus) as well as sex frequency (degree of exposure). While evidence suggests that age-disparate male partners are riskier for young women due to their higher probability of HIV infection and the risky behaviours associated with these partnerships, there are limited data available on the variation in coital frequency by partnership type. This study adds to the body of evidence, exploring the extent to which young women engaged in age-disparate partnerships are susceptible to HIV infection by investigating the frequency of sexual intercourse and condom use in age-disparate and age-similar partnerships.

METHODS

Data

This study analyses data from the first cross-sectional survey conducted by the HIV Incidence Provincial Surveillance System (HIPSS) in two subdistricts (Vulindlela (rural) and Greater Edendale (peri-urban) in the uMgungundlovu District, KwaZulu-Natal (KZN) Province, South Africa. In 2013, this district had the third highest antenatal HIV prevalence of all districts in South Africa (42.5% antenatal HIV prevalence).[27] The cross-sectional household-based survey was conducted between June 2014 and June 2015. Households were randomly selected using two-stage random sampling. First, enumeration areas (EA), the primary sampling unit, were selected with households then drawn systematically from selected EAs using a serpentine pattern from a random starting location. One individual per household, within the age range of 15–49 years, was randomly selected from a roster of eligible household members. For our analyses, data were restricted to all ongoing heterosexual partnerships involving 15–24 year-old women. Full details on the design of HIPSS are available elsewhere.[8]

A face-to-face questionnaire was administered to collect data on, inter alia, demographics, socioeconomic status and health-related information. Data for this analysis were collected on participants' three most recent sexual partners. Specifically, for each partnership, participants reported the nature of the relationship, the partner's current age, the relationship start and end dates (with ongoing partnerships identified) and information on sexual frequency and condom use. Partnerships were classified as ongoing if participants reported that the relationship had not ended and that they had sex with the partner in the previous 12 months.

Venous blood samples were also collected from all participants and tested for HIV antibodies by means of the fourth-generation HIV enzyme immunoassays to test for HIV antibodies and antigens using enzyme Biomerieux Vironostika Uniform II Antigen/Antibody Microelisa system (BioMérieux, Marcy I'Etoile, France) and HIV 1/2 Combi Roche Elecys (Roche Diagnostics, Penzberg, Germany). Positive tests were confirmed with a Western blot (Biorad assay, Bio-Rad Laboratories, Redmond, Washington, USA). All sample results were verified using an internal and external quality assurance review.

Participant and public involvement

Participants were not involved in the design of the study. The local population was informed about the objectives and importance of the research through extensive community engagement with local stakeholders including traditional leaders, service providers for health, education and psychosocial support. All stakeholders were provided with information on the South African HIV epidemic, information on the availability and access to the government's HIV prevention and treatment programme and the rationale for undertaking this study. After the selection of the households, the objectives of the research were presented to participants. The results of the study were thoroughly disseminated within the population and discussed with public policy administrators from the district, provincial and national department of health.

Measures

Based on the Joint United Nations Programme on HIV/AIDS definition,[28] and consistent with the literature,[5 9 13] age-disparate partnerships were defined as those in which the male partner was five or more years older than the female partner. The key independent binary variable indicated whether partnerships were defined as age-disparate or not. The age of each partner was determined using the question 'What is (first name)'s current age?'

Outcome measures were created based on questions about sexual frequency and condom use within each partnership. Sexual frequency was assessed by asking participants how many times they had sex with each partner in the past 12 months (once, 2–5, 6–10, 11–20, >20). Sex was defined as vaginal or anal penetration. A binary variable was created to identify partnerships in which sex was

reported more than 10 times, which stratified approximately half the partnerships into lower and higher sexual frequency.

The degree of condomless sex within partnerships was assessed in the survey by asking participants how often they used a condom (always, sometimes or never). Using these data, we created two additional dependent variables that aimed to more precisely equate higher sexual frequency with potential risk of HIV infection by accounting for condom use. Specifically, we assumed that partnerships in which condoms were always used did not represent an HIV infection risk. An ordinal variable 'sex frequency and inconsistent condom use' was created with '0' representing consistent condom use (ie, condoms are always used), and the values 1 to 5 representing sexual frequency for partnerships with inconsistent condom use. A binary variable was also created to classify partnerships characterised by inconsistent condom use and more than 10 sex acts.

Analysis

We first present sample characteristics using individual-level data and partnership-level data. All subsequent analyses use the partnership as the unit of observation. Using partnership data enabled us to include all current partnerships (ie, both the primary and secondary partners) and present results which are representative of partnerships involving 15–24-year-old women within the study location. All analyses used sample weights. The weights accounted for the cluster-based sampling design and for respondent non-response, and were rescaled to the size of the population in the data collection area on the basis of the 2011 Census population.[29] We adjusted standard errors (SE) for clustering at the enumeration area level to account for all potential within-cluster error correlation. All analyses were conducted using Stata 15 (Stata Corporation LP, College Station, Texas, USA). The Brant test was used to determine whether the age-disparate relationship coefficients estimated in the ordered logistic models were similar across categories of sexual frequency and categories of sexual frequency and inconsistent condom use.[30]

Our main analysis used partnership data reported by 15–24-year-old women. We excluded all partnerships with missing data on frequency of sexual intercourse (n=44, 3%). For our bivariate analysis, χ^2 tests were used to test the difference in sexual behaviour measures according to relationship status. Ordered logistic regression models were used for ordinal outcome measures and logistic regression models for our categorical outcome variables to analyse the association between coital frequency and age-disparate partnerships. Multiple regression models were run to control for all potential confounding factors.

Several variables were considered as potential confounding factors. These included a measure of the women's age, in years from 15 to 24. Education (<secondary, some secondary, secondary completed, some tertiary) and household monthly income (in South African Rand) (≤500, 501–2500, 2501–6000, >6000) measures were included as socioeconomic status is associated with the formation of age-disparate partnerships as well as with sexual behaviour.[31–35] We posited that migration could disrupt regular contact with partners and accordingly included an indicator of whether participants reported being away for a period of greater than one consecutive month in the preceding year. As a proxy for HIV knowledge, we created a variable representing the sum of the number of sources in the previous 12 months from which participants 'received HIV information that has been useful to you', as knowledge about HIV may have influenced condom use.[36–39] Measures of both self-reported HIV-positive status and perceived HIV-positive status of partner were included since awareness of HIV status is associated with condom use[40] and, we posited, could also affect partnership formation through serosorting. Finally, we included measures of partnership duration (<12 months, 1–3 years, more than 3 years) and the nature of each relationship (casual partner, regular partner or spouse).

For secondary analysis, we repeated all regression models among women with an HIV-negative test result from the laboratory HIV testing conducted as part of the HIPSS fieldwork. As sexual behaviour typically changes after an HIV-positive diagnosis,[41] this analysis reduces potential bias from the misidentification of knowledge of HIV status. It is likely that some women who were aware of their HIV infection would not have disclosed their status to a fieldworker due to stigma-related fears.

In a sensitivity analysis, we excluded partnerships less than 12 months old because coital frequency was measured as the number of sex acts with a partner in the past 12 months. Accordingly, the number of sex acts reported may not represent the same coital frequency for partnerships of less than a year compared with those of more than a year duration. This analysis therefore standardised the reference period for the number of reported sexual acts (ie, the past 12 months for all partnerships). Approximately 19% of reported partnerships were excluded, with very similar proportions of age-disparate and age-similar partnerships being of less than a year in duration. Ideally, we would have divided the absolute number of sex acts by partnership duration to obtain an annualised measure of coital frequency for all partnerships, but this was not possible as coital frequency was captured in ranges and not as absolute numbers.

RESULTS

Female sample characteristics

Sample characteristics are presented in table 1. A total of 1306 young (15–24-year-old) women reported at least one ongoing heterosexual partnership. The majority (68%) were 20–24 years of age and had completed secondary school (55%). Women reported 1336 ongoing heterosexual partnerships, with 29 women reporting concurrent partnerships. A third (34%) of all partnerships were

Table 1 Individual and partnership sample characteristics for women 15–24 years old in KwaZulu-Natal, South Africa (2014–2015)

Individual-level data	n=1306
Race: Black African	100% (na)
Age (mean)	20.7 (20.5–20.8)
Age categories	
15–19	32% (29–35)
20–24	68% (65–71)
Grade 12 complete	55% (51–59)
Household monthly income*	
≤R500	17% (13–21)
R501–R2500	50% (46–54)
Away from home for >1 month last year	11% (8–13)
HIV status	30% (27–33)
Self-reported as HIV-positive	14% (11–16)
Sources of useful HIV information	
<2	25% (21–29)
2–4	59% (54–63)
>4	16% (13–20)
Partnership-level data	**n=1336**
Age-disparate partnerships	34% (30–37)
Age of male partner	
15–19	9% (7–11)
20–24	44% (40–47)
25–29	36% (32–39)
30–34	9% (7–12)
35–39	2% (1–3)
>40	0.4% (0.01–0.8)
Partner believed to be HIV-positive	3% (2–4)
Nature of relationship	
Casual	4% (2–5)
Spouse	3% (2–4)
Regular	93% (91–95)
Partnership duration	
<1 year	20% (17–22)
1–3 years	37% (34–41)
>3 years	43% (39–47)

Note: 95% CI in brackets.
*The sample size with complete data on income was n=1147.
na, not applicable for our analysis.

Table 2 Sexual frequency and condom use in partnerships reported by women aged 15 to 24 in KwaZulu-Natal, South Africa (2014–2015)

	Age-similar (n=852) %	Age-disparate (n=484) %	P value
Sex frequency (past 12 months)*			0.109
Once	4.4	2.1	
2–5	26.3	27.9	
6–10	27.1	21.0	
11–20	22.0	26.0	
>20	20.3	23.1	
Sex 10+ times (past 12 months)	42	49	0.057
Sex frequency and inconsistent condom use†			0.266
Condoms always used	26.3	22.8	
once	1.7	1.6	
2–5	18.3	20.9	
6–10	19.5	14.5	
11–20	18.3	21.7	
>20	15.8	18.5	
Sex 10+and inconsistent condom use	34	40	0.107

*Two of the response options in the survey instrument to capture frequency of sex included the response '10': 6–10 and 10–20. Immediately after the commencement of fieldwork, interviewers were instructed to capture a response of '10' in the '6–10' category, so the original response category '10–20' reflected a coital frequency range between 11 and 20.
†Sex frequency and inconsistent condom use: Sex frequency in the previous 12 months categories (once, 2–5, 6–10, 11–20, >20) multiplied by a binary indicator of inconsistent condom use (0=consistent, 1=inconsistent). Therefore, 0 represents no risk (no unprotected sex) and 5 represents high risk (most frequent condomless sex).

age-disparate, involving a man five or more years older. Relatively few partnerships (7%) involved a man 10 or more years older. The majority (80%) of the male partners among all the partnerships were 20 to 29 years old.

Sexual frequency and condom use reported by young women

Table 2 displays the difference in sexual frequency and condom use between the two types of sexual partnerships (age-similar partnerships vs age-disparate partnerships) for women aged 15 to 24. Women in age-disparate partnerships reported having had sex more times in the past 12 months compared with women in age-similar partnerships. Crude differences were small and only statistically significant below the 10% level for one indicator: having had sex more than 10 times in the previous 12 months (49% vs 42%, p=0.057).

After controlling for potential confounding factors (table 3) a positive relationship was found between age-disparate partnerships and coital frequency and condomless sex. Age-disparate partnerships were associated with a higher order category representing greater coital frequency (model 2, adjusted OR (aOR) 1.32, p<0.05, 95% CI 1.03 to 1.71). Women in age-disparate partnerships were more likely to have reported having sex more than 10 times in the previous 12 months (model

Table 3 Ordered logistic and logistic regression models of sexual behaviour among 15–24-year-old women (n=1336) in KwaZulu-Natal, South Africa (2014–2015)

	Sexual frequency†: categories 1–5		Sex 10+ times (0/1)		Sex frequency and inconsistent condom use‡ (0–5)		Sex 10+ times and inconsistent condom use (0/1)	
	Ordered logit		Logit		Ordered logit		Logit	
Model type	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Model no.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Age disparate	1.20 (0.92–1.56)	1.32** (1.03–1.71)	1.32* (0.99–1.75)	1.48*** (1.12–1.96)	1.18 (0.92–1.52)	1.28** (1.00–1.64)	1.30 (0.95–1.77)	1.43** (1.04–1.96)
Control variables	No	Yes	No	Yes	No	Yes	No	Yes
Partnership Observations	1336	1336	1336	1336	1336	1336	1336	1336

95% CI in parentheses.
*P<0.1, **p<0.05, ***p<0.01.
Control variables included in all analyses: women's age (15–24 years); education (<secondary, some secondary, secondary completed, some tertiary); household monthly income (≤R500, R501–2500, R2501–6000, >R6000); being away for a period of greater than one consecutive month in the preceding year; HIV knowledge (the sum of the number of sources in the previous 12 months from which participants 'received HIV information that has been useful to you'); self-reported HIV-positive status; perceived HIV status of sexual partner; partnership duration (<12 months, 1–3 years, more than 3 years); and the nature of each relationship (casual partner, regular partner or spouse).
See Supplemental Digital Content, online supplementary table S1 for the full models 2, 4, 6 and 8.
†Sex frequency in the previous 12 months categories: once, 2–5, 6–10, 11–20, >20.
‡Sex frequency and inconsistent condom use: sex frequency in the previous 12 months categories (once, 2–5, 6–10, 11–20, >20) multiplied by a binary indicator of inconsistent condom use (0=consistent, 1=inconsistent). Therefore, 0 represents no risk (no unprotected sex) and five represents high risk (most frequent condomless sex).

4, aOR 1.48, p<0.01, 95% CI 1.12 to 1.96). Age-disparate partnerships were also associated with a higher order category (0–5) representing greater frequency of condomless sex (model 6, aOR 1.28, p<0.05, 95% CI 1.00 to 1.64). Women in age-disparate partnerships were more likely to report both having sex more than 10 times in the previous 12 months and inconsistent condom use (model 8, aOR 1.43, p<0.05, 95% CI 1.04 to 1.96). The difference between the unadjusted and adjusted coefficients of interest for each outcome was not driven by any specific control variable, with each having a very small independent effect on the coefficients. While their effects were small, the inclusion of the education and the household income control variables had the strongest influence on the models. Additional analyses (not presented) stratified by age group (15–19-year-old vs 20–24-year-old women) found that the associations presented in table 3 were not significantly different for younger compared with older women. See online supplementary table S1, in the Supplemental digital content, for the full regression models. The proportional odds asumption was upheld for the sex frequency (model 2, p=0.214) and the sexual frequency with inconsistent condom use ordered logit model (model 6, p=0.421).

Results from the sensitivity analysis (see online supplementary table S2, Supplemental digital content 1) with data restricted to partnerships of a year or longer in duration found similar results. The only noteworthy difference was that the association between age-disparate partnerships and the measure of sex frequency and inconsistent condom use (model 6) was not statistically significant (aOR 1.19, 95% CI 0.91 to 1.57).

Sexual frequency and condom use reported by young HIV-negative women

Substantively similar results were found among the sample of HIV-negative women (table 4). Among HIV-negative women, age-disparate partnerships were associated with a higher order category representing greater coital frequency (model 2, aOR 1.55, p<0.05, 95% CI 1.12 to 2.14), and with a higher order category (0–5) representing greater frequency of condomless sex (model 6, aOR 1.54, p<0.01, 95% CI 1.13 to 2.09). HIV-negative women in age-disparate partnerships were more likely to have had sex more than 10 times in the previous 12 months (model 4, aOR 1.62, p<0.05, 95% CI 1.10 to 2.40), and to have both had sex more than 10 times and used condoms inconsistently in the previous 12 months (model 8, aOR 1.60, p<0.05, 95% CI 1.09 to 2.36). See online supplementary table S3, in the Supplemental digital content, for the full regression models. For the HIV negative sample, the proportional odds assumption was upheld for the sex frequency (model 2,p=0.353) and the sexual frequency with inconsistent condom use ordered logit model (model 6, p=0.423).

The sensitivity analysis for HIV negative women (see online supplementary table S4, Supplemental Digital Content) found substantively similar results after data were restricted to partnerships of a year or longer in duration.

Table 4 Ordered logistic and logistic regression models of sexual behaviour among HIV-negative, 15–24-year-old women (n=894) in KwaZulu-Natal (2014–2015)

	Sexual frequency†: categories 1–5		Sex 10+ times (0/1)		Sex frequency and inconsistent condom use‡ (0–5)		Sex 10+ times and inconsistent condom use (0/1)	
	Ordered logit		Logit		Ordered logit		Logit	
Model type	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
Model no.	1	2	3	4	5	6	7	8
Age disparate	1.21 (0.87–1.69)	1.55*** (1.12–2.14)	1.35 (0.92–1.98)	1.62** (1.10–2.40)	1.34* (0.98–1.82)	1.54*** (1.13–2.09)	1.41* (0.95–2.08)	1.60** (1.09–2.36)
Control variables	No	Yes	No	Yes	No	Yes	No	Yes
Observations	894	894	894	894	894	894	894	894

95% CI in parentheses.
Control variables included in all analyses: women's age (15–24 years); education (<secondary, some secondary, secondary completed, some tertiary); household monthly income (≤R500, R501–2500, R2501–6000, >R6000); being away for a period of greater than one consecutive month in the preceding year; HIV knowledge (the sum of the number of sources in the previous 12 months from which participants 'received HIV information that has been useful to you'); perceived HIV status of sexual partner; partnership duration (<12 months, 1–3 years, more than 3 years); and the nature of each relationship (casual partner, regular partner or spouse). See Supplemental Digital Content, online supplementary table S3 for the full models 2, 4, 6 and 8.
*P<0.1, **p<0.05, ***p<0.01.
†Sex frequency in previous 12 months categories: once, 2–5, 6–10, 11–20, >20.
‡Sex frequency and inconsistent condom use: sex frequency categories in the previous 12 months (once, 2–5, 6–10, 11–20, >20) multiplied by a binary indicator of inconsistent condom use (0=consistent, 1=inconsistent). Therefore, 0 represents no risk (no unprotected sex) and five represents high-risk (most frequent condomless sex).

DISCUSSION

Questions of sexual risk-taking remain highly relevant in sub-Saharan Africa, especially with regard to young women, who are disproportionally affected by the epidemic. HIV incidence rates are persistently high among this cohort across the region.[1–3 42] Age-disparate partnerships have often been cited as posing a high HIV risk for young women.[5–11] However, the risk posed by age-disparate partnerships for young women have been questioned following longitudinal study results indicating that partner age disparity did not predict HIV acquisition.[22 23]

Reanalysis of partnership age pairing data and risk of HIV acquisition has subsequently shown that while linear models may not show an association between partner age and HIV risk, age of sexual partner remains a major risk factor for HIV acquisition for both men and women.[18] A further study using phylogenetic analysis has further affirmed these results.[20] While these epidemiological studies have reaffirmed the potential HIV risk posed by age-disparate partnering, this paper sought to examine the proposition that while age-disparate partnerships were characterised by concurrency,[16 17] and concurrency characterised by coital dilution,[24] the null result presented by some longitudinal studies[22 23] could potentially be explained through reduced coital frequency within age-disparate, compared with age-similar, partnerships. This study found no evidence suggesting that sexual frequency is lower in age-disparate partnerships. Data from this study suggest that reduced sexual activity within age-disparate partnerships does not explain the lack of association between age-disparate sex and HIV incidence found in longitudinal studies.[22 23] On the contrary, our findings indicate that coital frequency may be somewhat greater in age-disparate partnerships. These findings are shared by emerging evidence which indicates that partner age discordance is associated with greater odds of reporting more frequent sex, despite the presence of concurrent partnering.[19 43] One explanation posited for the increased coital frequency within age-disparate partnerships is that these relationships are longer in duration,[19] with more stable relationships resulting in more regular sex and inconsistent condom use.[44] However, our data do not support this hypothesis. The increased sexual frequency that characterises age-disparate relationships is not fully understood and remains an area for future research. It would be valuable, for example, to examine whether the differences in coital frequency by partnership type can be attributed to the age discrepancy itself or to attributes of older male partners.

Notwithstanding, more frequent sex could potentially present an additional factor compounding the increased risk posed by age-disparate partnerships to young women. Studies have already established that these include a greater likelihood of having an HIV-positive partner, and are characterised by a range of risky sexual behaviours.[13–17]

The results of this study should be interpreted in light of its limitations. It is possible that social desirability bias and recall bias might have resulted in the misreporting of partnership data, including the partner's

age, frequency of sex and condom use; and some women may not have provided data on their second or third most recent partners.[45] This may have led to measurement error in identifying age-disparate partnerships. In a study conducted in rural KwaZulu-Natal, the results showed that women underestimated their partner's age by 0.85 years.[46] The results showed that there was a tendency to over-report age disparities in partnerships where both partners had very similar ages and to under-report extreme differences in a partner's age. It is unclear how this bias would affect our results.[46] Furthermore, the study area was limited to peri-urban and rural areas and therefore cannot speak directly to the nature of sexual partnerships among young urban women.

Our results add to the emerging evidence that sexual frequency may be higher in age-disparate partnerships.[47 48] However, arguments based on the assumption that increased sexual frequency directly translates into increased risk of HIV transmission could not be made as there are additional factors impacting risk, such as concurrency, the duration of relationship overlaps, number of partners, HIV status and viral loads of respective partners.[48]

This study contributes to a greater understanding of how age-disparate partnerships influence young women's susceptibility to HIV infection. The finding that coital frequency is positively associated with age-disparate partnerships adds to the evidence that age-disparate partnerships potentially increase the exposure to HIV for young women.

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REFERENCES

1. Shisana O, Rehle T, Simbayi LC, *et al*. *South African national HIV prevalence, incidence and behaviour survey, 2012*, 2014.
2. Dellar RC, Dlamini S, Karim QA. Adolescent girls and young women: key populations for HIV epidemic control. *J Int AIDS Soc* 2015;18:19408.
3. Joint United Nations Programme on HIV/AIDS. UNAIDS Data 2017. 2018.
4. Joint United Nations Programme on HIV/AIDS. 2018. Fact Sheet.
5. Gregson S, Nyamukapa CA, Garnett GP, *et al*. Sexual mixing patterns and sex-differentials in teenage exposure to HIV infection in rural Zimbabwe. *Lancet* 2002;359:1896–903.
6. Katz I, Low-Beer D. Why has HIV stabilized in South Africa, yet not declined further? Age and sexual behavior patterns among youth. *Sex Transm Dis* 2008;35:837–42.
7. Kelly RJ, Gray RH, Sewankambo NK, *et al*. Age differences in sexual partners and risk of HIV-1 infection in rural Uganda. *J Acquir Immune Defic Syndr* 2003;32:446–51.
8. Kharsany AB, Karim QA. HIV Infection and aids in sub-saharan africa: current status, challenges and opportunities. *Open AIDS J* 2016;10:34–48.
9. Pettifor AE, Rees HV, Kleinschmidt I, *et al*. Young people's sexual health in South Africa: HIV prevalence and sexual behaviors from a nationally representative household survey. *AIDS* 2005;19:1525–34.
10. Chapman R, White RG, Shafer LA, *et al*. Do behavioural differences help to explain variations in HIV prevalence in adolescents in sub-Saharan Africa? *Trop Med Int Health* 2010;15:554–66.
11. Schaefer R, Gregson S, Eaton JW, *et al*. Age-disparate relationships and HIV incidence in adolescent girls and young women: evidence from Zimbabwe. *AIDS* 2017;31:1461–70.
12. Maughan-Brown B, George G, Beckett S, *et al*. HIV risk among adolescent girls and young women in age-disparate partnerships: evidence From KwaZulu-Natal, South Africa. *J Acquir Immune Defic Syndr* 2018;78:155–62.
13. Beauclair R, Kassanjee R, Temmerman M, *et al*. Age-disparate relationships and implications for STI transmission among young adults in Cape Town, South Africa. *Eur J Contracept Reprod Health Care* 2012;17:30–9.
14. Volpe EM, Hardie TL, Cerulli C, *et al*. What's age got to do with it? Partner age difference, power, intimate partner violence, and sexual risk in urban adolescents. *J Interpers Violence* 2013;28:2068–87.

15. Malema BW. Determinants of Condom use in Botswana: An empirical Investigation of the Role of Gender. *Botswana Journal of Economics* 2012;10:59–78.
16. Maughan-Brown B, Kenyon C, Lurie MN. Partner age differences and concurrency in South Africa: Implications for HIV-infection risk among young women. *AIDS Behav* 2014;18:2469–76.
17. Maughan-Brown B, Evans M, George G. Sexual behaviour of men and women within age-disparate partnerships in south africa: Implications for young women's HIV Risk. *PLoS One* 2016;11:e0159162.
18. Akullian A, Bershteyn A, Klein D, *et al*. Sexual partnership age pairings and risk of HIV acquisition in rural South Africa. *AIDS* 2017;31:1755–64.
19. Beauclair R, Dushoff J, Delva W. Partner age differences and associated sexual risk behaviours among adolescent girls and young women in a cash transfer programme for schooling in Malawi. *BMC Public Health* 2018;18:403.
20. de Oliveira T, Kharsany AB, Gräf T, *et al*. Transmission networks and risk of HIV infection in KwaZulu-Natal, South Africa: a community-wide phylogenetic study. *Lancet HIV* 2017;4:e41–e50.
21. Stoner MCD, Nguyen N, Kilburn K, *et al*. Age-disparate partnerships and incident HIV infection in adolescent girls and young women in rural South Africa: An HPTN 068 analysis. *AIDS* 9000.
22. Balkus JE, Nair G, Montgomery ET, *et al*. Age-disparate partnerships and risk of hiv-1 acquisition among south african women participating in the VOICE trial. *J Acquir Immune Defic Syndr* 2015;70:212–7.
23. Harling G, Newell ML, Tanser F, *et al*. Do age-disparate relationships drive HIV incidence in young women? Evidence from a population cohort in rural KwaZulu-Natal, South Africa. *J Acquir Immune Defic Syndr* 2014;66:443–51.
24. Sawers L, Isaac AG, Stillwaggon E. HIV and concurrent sexual partnerships: modelling the role of coital dilution. *J Int AIDS Soc* 2011;14:44.
25. Kenyon C, Colebunders R. Correlates of concurrency among young people in Carletonville, South Africa. *Sahara J* 2015;12:51–8.
26. Kenyon CR, Tsoumanis A, Schwartz IS, *et al*. Partner concurrency and HIV infection risk in South Africa. *Int J Infect Dis* 2016;45:81–7.
27. *South African National Department of Health. The 2013 National Antenatal Sentinel HIV Prevalence Survey South Africa*: National Department of Health Pretoria, 2015. (22 May 2018).
28. Joint United Nations Programme on HIV/AIDS. *UNAIDS Terminology Guidelines*, 2015. (22 May 2018).
29. Statistics South Africa. *Census 2011: Statistical release P0301.4*, 2012.
30. Brant R. Assessing proportionality in the proportional odds model for ordinal logistic regression. *Biometrics* 1990;46:1171–8.
31. Luke N. Confronting the 'sugar daddy' stereotype: age and economic asymmetries and risky sexual behavior in urban Kenya. *Int Fam Plan Perspect* 2005;31:6–14.
32. Leclerc-Madlala S. Age-disparate and intergenerational sex in southern Africa: the dynamics of hypervulnerability. *AIDS* 2008;22 Suppl 4:S17–S25.
33. Nzyuko S, Lurie P, McFarland W, *et al*. Adolescent sexual behavior along the Trans-Africa Highway in Kenya. *AIDS* 1997;11 Suppl 1:S21–6.
34. Wamoyi J, Wight D, Plummer M, *et al*. Transactional sex amongst young people in rural northern Tanzania: an ethnography of young women's motivations and negotiation. *Reprod Health* 2010;7:2.
35. Ott MQ, Bärnighausen T, Tanser F, *et al*. Age-gaps in sexual partnerships: seeing beyond 'sugar daddies'. *AIDS* 2011;25:861–3.
36. Conserve DF, Middelkoop K, King G, *et al*. Factors associated with hiv discussion and condom use with sexual partners in an underserved community in South Africa. *J Health Care Poor Underserved* 2016;27:131–44.
37. Hendriksen ES, Pettifor A, Lee SJ, *et al*. Predictors of condom use among young adults in south africa: The reproductive health and hiv research unit national Youth Survey. *Am J Public Health* 2007;97:1241–8.
38. Kirby DB. The impact of abstinence and comprehensive sex and STD/HIV education programs on adolescent sexual behavior. *Sexuality Research and Social Policy* 2008;5:18–27.
39. Peltzer K, Promtussananon S. Perceived vulnerability to AIDS among rural Black South African children: a pilot study. *J Child Adolesc Ment Health* 2003;15:65–72.
40. Dokubo EK, Shiraishi RW, Young PW, *et al*. Awareness of HIV status, prevention knowledge and condom use among people living with HIV in Mozambique. *PLoS One* 2014;9:e106760.
41. Bunnell R, Ekwaru JP, Solberg P, *et al*. Changes in sexual behavior and risk of HIV transmission after antiretroviral therapy and prevention interventions in rural Uganda. *AIDS* 2006;20:85–92.
42. Kharsany ABM, Cawood C, Khanyile D, *et al*. Community-based HIV prevalence in KwaZulu-Natal, South Africa: results of a cross-sectional household survey. *Lancet HIV* 2018;5:e427–e437.
43. Ritchwood TD, Hughes JP, Jennings L, *et al*. Characteristics of age-discordant partnerships associated with hiv risk among young south african women (HPTN 068). *J Acquir Immune Defic Syndr* 2016;72:423–9.
44. Marston C, King E. Factors that shape young people's sexual behaviour: a systematic review. *Lancet* 2006;368:1581–6.
45. Maughan-Brown B, Venkataramani AS. Measuring concurrent partnerships: potential for underestimation in UNAIDS recommended method. *AIDS* 2011;25:1549–51.
46. Harling G, Tanser F, Mutevedzi T, *et al*. Assessing the validity of respondents' reports of their partners' ages in a rural South African population-based cohort. *BMJ Open* 2015;5:e005638.
47. Delva W, Meng F, Beauclair R, *et al*. Coital frequency and condom use in monogamous and concurrent sexual relationships in Cape Town, South Africa. *J Int AIDS Soc* 2013;16:18034.
48. Warren JT, Harvey SM, Washburn IJ, *et al*. Concurrent sexual partnerships among young heterosexual adults at increased HIV risk: types and characteristics. *Sex Transm Dis* 2015;42:180–4.