SELF-DECEPTION IN HIV/AIDS RISK ASSESSMENT? A TEST ON SEXUAL BEHAVIOR DATA FROM NORTHERN KENYA

ERIC ABELLA ROTH[1], ELIZABETH NGUGI[2], AND MASAKO FUJITA[3]

[1, 4])Department of Anthropology, University of Victoria, P.O. Box 3050, Victoria, British Columbia, Canada V8W 3P5 (ericroth@uvic.ca)

[2)] Department of Community Health, P. O. Box 19676
Nairobi, Kenya (stdhiv@arcc.or.ke)

[3)] Department of Anthropology, Box 353100, University of Washington, Seattle, Washington, USA 98195-3100 (masakof@u.washington.edu)

[4] Author for correspondence

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ABSTRACT

Throughout sub-Saharan Africa there is resistance to changing sexual behavior despite survey data indicating high levels of knowledge about HIV transmission patterns and high-risk behaviour. Previous explanations for this paradox emphasize indigenous cultural models linking sex with male health, and attributing death to multiple causation and/or supernatural forces. An alternative explanation, derived from evolutionary theory, is that due to strong natural selection for sexual gratification individuals evoke the evolved trait of self-deception to continue practicing high-risk sexual behavior. This alternative is tested using survey data from an Ariaal community in Marsabit District, northern Kenya. Results indicate that respondents make highly accurate self-assessments of HIV risk, negating the concept of self-deception in this study. These results are discussed within the larger context of the applicability of evolutionary theory to the AIDS pandemic.

KEYWORDS: HIV/AIDS, sexual behavior, risk, East Africa

INTRODUCTION

HIV/AIDS Education Program, Self-Awareness and Evolutionary Theory

In the absence of an effective vaccine, public education and self-awareness have long been cited as the best strategy against the transmission of HIV (Cohen, 1995; Singhal & Rogers, 2003). However, in two important works, "Underreaction to AIDS in sub-Saharan Africa" (Caldwell et al., 1992), and "Reasons for limited sexual behavioral change in the sub-Saharan African AIDS epidemic, and possible future intervention strategies", (Caldwell, 1999) the Australian demographer John Caldwell and colleagues called attention to the limited success of education programs in halting the AIDS pandemic in sub-Saharan Africa. As examples Caldwell pointed to Demographic and Health Survey data showing 98% of Tanzanian men knew about AIDS in 1991, and 99% of Kenyan men were familiar with the disease by 1998. Yet in both cases sexual behavior remained unchanged and prevalence rates stabilized at high levels, or even increased.

Outside sub-Saharan Africa programs successfully reducing HIV/AIDS rates are aligned with coercive measures, rather than voluntary change arising from education efforts and accurate risk assessment. A notable case in point is Thailand's "100% Condom Program" (Singhal & Rogers, 2003:98-99). Begun in the mid-1990s, this government sponsored program provided free condoms to commercial sex establishments. As a result condom use in these establishments went from less than 20% in 1989 to over 90% by 1992, the number of new Sexually Transmitted Infection (STI) cases for men treated at government clinics

dropped from 200,000 in 1989 to less than 20,000 in 1992, and HIV prevalence rates among Thai army conscripts declined from 4% in 1993 to less than 2% in 1996. The program's success has been attributed to "mass media campaigns, education and skills building in workplaces and schools, and peer education" (World Bank, 1999:159).

An equally viable alternative explanation is widespread government coercion. Health officials, government workers, and police were authorized to enforce condom use. Men turning up for treatment in STI clinics were reported to this bureaucratic array, who had the authority to trace sexual contacts back to possible sources of infection. Government officials posed as clients in commercial sex establishments to check on condom availability and use. Uncovering non-condom use in sexual acts made individual offenders liable for fines, and commercial sex houses faced loss of government licensing and/or immediate closure. Despite the threat of penalties, or perhaps as a result of them, Thailand now has 'invisible brothels", that is restaurant bars and karaoke pubs where sex workers serve as waitresses, and private massage parlors where "condom use is more difficult" (Im-Em, 1999:168) to enforce. Recognizing this coercive pressure to conform, the 100% Condom Program can also be understood as the evolution of group morals through punishment, as modeled by the evolutionary ecologists, Robert Boyd and Peter Richerson (1992) in their seminal article aptly entitled "Punishment allows the evolution of co-operation (or anything else) in sizeable groups."

As in the Thai case, can evolutionary theory offer a viable alternative explanation to the resistance to change sexual behavior in sub-Saharan Africa? In this region the failure of education programs is attributed to widespread culturally based beliefs and behavior. These include linking male heterosexual intercourse to overall health and well being (Orubuloye et al., 1997), the association of condoms with illegitimate sexual unions and prostitution (MacPhail & Campbell, 2001), the notion that one's time of death is preordained and therefore unaffected by behavioral change, and the belief that death occurs from multiple causes, invalidating the idea that a person could die from a simple virus (Caldwell, 1999). In addition, culturally condoned sexual behaviors include male preferences for sexual practices that elevate HIV transmission probabilities, exemplified by artificial vaginal tightening and drying (Brown et al., 1993; Sandala, 1995). In sub-Saharan Africa, where over 90% of HIV transmission results from heterosexual intercourse, these beliefs and behaviors constitute powerful forces for HIV transmission.

Yet from an evolutionary perspective this constellation of cultural traits may only constitute what biologists (Tindbergen 1963) term proximate variables, or what demographers (Bongaarts 1982) call intermediate variables, because they lie between higher order "distal" or "ultimate" variables representing the motivation for behavior, and final biological results, in this case HIV transmission via heterosexual intercourse. A possible alternative explanation, derived from evolutionary theory, is that the human biological drive for sexual gratification, the product of millions of years of natural selection, is the true ultimate or distal

variable responsible for what Caldwell and colleagues termed in the title of their 1999 text, "*Resistances to behavioural change to reduce HIV/AIDS infection in predominantly heterosexual epidemics in Third World Countries".*

Certainly there is evidence for strong selection for sexual gratification in humans, as shown in many of the psychological, morphological and behavioral characteristics that differentiate humans from other species. Examples include greater prominence of female secondary sex organs, lack of female estrus, concealed ovulation and greater prominence of organisms (Alexander & Noonan, 1979; Abramson & Pinkerton, 1995). Applying this biological evidence to sub-Saharan African cultural features including polygyny, the linkage of frequent heterosexual intercourse with male health, disdain for condoms, and "dry and tight" sex, suggests that this constellation of sexual behaviour constitutes only proximate variables reflecting regional variations of the biologically based human sex drive. This perspective goes a long way in explaining the continued resistance to heterosexual behavioral change throughout sub-Saharan Africa in spite of a generation of education programs and survey data revealing high levels of knowledge concerning HIV/AIDS. Evolutionary theory also provides an mechanism potentially capable of explaining the present misfit between high levels of understanding HIV transmission recorded for sub-Saharan African populations and continued high-risk sexual behavior; the evolved human trait of self-deception.

Self-Deception in Human Evolution

Evolutionary biology's current interest in the role of self-deception in human evolution stems from Robert Trivers' (1976) foreword to Dawkins' (1976) original edition of *The Selfish Gene,* in which Trivers argued that humans have been selected to both practice and detect deception. Trivers hypothesised that self-deception would be an efficient, if inherently dangerous, strategy to deceive others since the deceiver would not be consciously sending clues about their perfidy. In subsequent papers, including one co-authored with Huey P. Newton, the founder of the 1970s Black Panther movement, he (Trivers & Newton, 1982; Trivers, 1985, 2000) applied the concept of self-deception to human behaviour, specifically risk-taking and parent-offspring conflict. In addition he noted its applicability to models of group level selection, suggesting that self-deception is frequent in human warfare, exemplified by underestimating enemy commitment and motivation while overestimating one's own strengths. Documenting this behavior in the history of military disasters entitled, *The March of Folly: From Troy to Vietnam,* the noted Canadian historian Barbara Tuchman (1984) viewed self-deception as maladaptive, referring to it as "Woodenheadedness". However Trivers and other evolutionary biologists (Hartung, 1995; Wrangham, 1999) argue that such behavior is adaptive if it promotes in-group morality building leading to a ""Them versus Us" mentality necessary for prolonged warfare.

Self-deception is also viewed as central to the development and maintenance of altruism, defined in evolutionary terms as behavior increasing others' fitness while reducing one's own (Sober & Wilson, 1998:6). Altruism

confounded Darwin, who thought it an important exception to his principle of natural selection working at the individual level. Hamilton's (1964) concept of kin selection showed that altruism can increase individual organisms' inclusive fitness, while Trivers (1971) demonstrated the selective advantage of reciprocal altruism for humans. More recently evolutionary biologists considered the advantages of altruism in the context of building of a "good reputation", exemplified as image scoring in game theory based simulations (Wedekind and Milinski, 2000; Milinski et al., 2001). Applied to real life situations such as recycling materials and/or becoming a blood donor (cf. Low and Heinen, 1993), such behavior incorporates self-deception, with the actor believing he/she is behaving in an altruistic manner, while simultaneously reaping the prestige and status bestowed upon such "selfless" behavior.

With respect to the evolution of human sexuality, Burley (1979) considered concealed female ovulation an adaptive form of self-deception, arguing that if women knew when they were ovulating they would avoid sexual intercourse so they would later not have to endure the pain and health risks of childbearing (for alternate views of the evolution of concealed female ovulation in humans see Alexander & Noonan, 1979; Daniels, 1983; Laland & Brown, 2002). In a much more modern scenario, self-deception may underlie recent sexual survey data indicating that only a minority of North American adolescents consider oral sex to constitute "sex" (think Bill Clinton and Monica Lewinsky), even though recognising that it can result in sexually transmitted infections (Randall & Byers, 2002). Finally, until very recently contemporary gay communities represented

one of the few voluntary successes of HIV/AIDS education programs. With the goal of “sustaining safe sex”, gay groups around the world educated themselves about HIV, practiced low-risk sexual practices, and lowered HIV/AIDS infection rates (cf. Dowsatt, 1999). Their success led to an emphasis on the concept of “community” as a means of combating the spread of HIV/AIDS (Caldwell, 1999:249). Tragically, recent data from the United States (Kellog et al., 1999; Chen et al., 2002), Canada (Martindale et al., 2001), Europe (Dukers et al., 2000) and Australia (Van De Ven, 1998), all show increasing rates of STIs and HIV/AIDS among gay and bisexual men. One explanation offered for this reversal is the self-deceptive view that new anti-retroviral drugs will sustain a high-quality life-style for an indefinite time in HIV+ men.

These results are important for the hypothesis that, like adolescent North Americans and gay/bisexual men in Europe, North America and Oceania, heterosexual sub-Saharan men and women may also practice self-deception with respect to self-assessment of contracting a sexually transmitted infection, including HIV/AIDS. Self-assessment of the risk of contracting HIV is a valuable empirical and theoretical tool in the fight against the AIDS pandemic. In the first regard individual knowledge of HIV transmission dynamics and recognition of high-risk behavior such as multiple sexual partners and lack of condom use constitute both essential factors in the evaluation of HIV education programs effectiveness and key determinants of HIV incidence rates (UNAIDS, 2001). Theoretically self-assessment of AIDS risk is central to one of the earliest theories of AIDS prevention, the AIDS Risk Reduction Model (Catania, 1990),

which posits that accurate risk assessment can lead individuals to change their sexual behavior to lower the risk of contracting the disease.

Given the above this paper poses the question “Can the evolved human trait of self-deception impair self-assessment of personal risk of contracting HIV/AIDS, even when education programs clearly delineate high-risk behaviors?” We use data from a survey of sexual behavior conducted in September-October, 2003 among Ariaal agro-pastoralists in the sedentary community of Nasakakwe/Karare, Marsabit District, northern Kenya to construct tests capable of addressing this question.

The Research Setting

Today numbering about 10,000, Ariaal pastoralists subsist off the milk, blood and meat of their camels, cattle, goats and sheep in Marsabit District, Eastern Province, northern Kenya. As shown in Figure 1, they occupy the ecotone between the Nilotic-speaking Samburu (population approximately 75,000) who inhabit the Leroghi Plateau of central Kenya and the Cushitic-speaking Rendille (population approximately 30,000) of the lowlands Kaisut Desert. This permits them to keep both camels, which are adapted to desert conditions, and cattle, which do well in the wetter highlands environment. Culturally the Ariaal are also "between and betwixt" (Fratkin, 1998:49) the cattle-keeping Samburu, who are related linguistically to the Maasai of southern Kenya, and the camel-keeping Rendille, who are linguistically and physically linked to Somali populations. Speaking Maa and Rendille, Ariaal keep large herds of

camels and cattle, follow Samburu age-set rituals, yet incorporate Rendille camel ceremonies. Their unique "bridge culture" reflects their origin from impoverished Rendille and Samburu families ravaged by rinderpest and smallpox epidemics that respectively decimated animal and human populations throughout northern Kenya at the end of the nineteenth century (Waller and Sobania, 1994).

Figure 1 about here

Severe droughts beginning in the 1970s resulted in large-scale livestock loss (Roth, 1996) and increasing sedentism for formerly nomadic Ariaal (Fratkin et al., 1999; Fratkin and Roth, In Press). Destitute Ariaal resettled on agricultural schemes located on Marsabit Mountain. In the early 1970s the National Christian Council of Kenya founded an agricultural resettlement scheme for impoverished Ariaal families at a site called Nasikakwe, adjacent to the larger, predominantly pastoral community of Karare. Today Nasikakwe/Karare Ariaal families grow maize, raise cattle and sell milk in the major market of Marsabit Town (Smith, 1998).

Despite increasing articulation with local market economies, Ariaal culture retains much of its traditional elements, including a reliance on animal products for food, social adherence to a complex age-set system that determines when men are circumcised and later marry, and retention of a patrilineal, patrilocal, clan-based social system. Only unpaved, poorly maintained roads and charter air flights link Ariaal populations with down-country Kenya. Television and radio ownership is very rare in Marsabit District, and newspapers appear only irregularly in Marsabit Town. Because of its geographical and social isolation

community awareness of HIV/AIDS in Nasakakwe/Karare was low; as revealed by a 1997 survey of sexual knowledge, attitude and practices (Roth et al., 1999). In the survey's sample of 282 men and women of reproductive age only 75% recognized sexual fluids as a vector of HIV, less than 20% knew that the virus could be transmitted by blood, and only 1% recognized peri-natal transmission.

This survey also showed strong acceptance of the belief linking men's sexual activity with their overall health. We were told by both sexes that men should "practice" sex with as many people as possible, and that male health and general well-being is linked to frequency of intercourse. As a corollary of this indigenous model, both sexes overwhelmingly supported the notion that it is acceptable for a man to have more than one sexual partner at a time (Roth et al., 2001). As shown in Figure 2, in our survey sample women were even more accepting of this concept than men. These findings indicate that the sub-Saharan belief linking male health to frequent sexual intercourse and multiple partners is present in the community, and supported by both sexes. This belief provides a strong rationale for self-deception about HIV risk assessment.

Figure 2 about here

To raise community awareness about sexually transmitted infections, and particularly HIV/AIDS, Dr. Elizabeth Ngugi, an internationally recognized expert on community and peer education (Ngugi et al., 1988, 1996a, b) conducted sexual education seminars in Ariaal communities in 1999, including Nasakakwe/Karare. These were followed in 2001 by seminars and videos about HIV/AIDS, mounted with the support of the non-governmental organization Food

for the Hungry. Combined with recent Kenyan governmental efforts including condom distribution and expanded HIV education/awareness in the form of leaflets and posters, community awareness of HIV/AIDS and high-risk behavior has increased dramatically in the past three years.

MATERIALS AND METHODS

In September/October 2003 a team of ten Ariaal enumerators administered a questionnaire based on the UNAIDS (1998) document "*Looking deeper into the HIV epidemic: A questionnaire for tracing sexual networks*" to 400 respondents in Nasakakwe/Karare. Aimed at reproductive-aged Ariaal men and women, 100 respondents were represented in each of four sub-groups; unmarried men, unmarried women, married men and married women. Unlike earlier surveys, all respondents had heard of HIV/AIDS, and focus groups conducted following the survey revealed widespread knowledge of HIV transmission and the identification of specific, high-risk behaviors.

The survey contained questions on number of lifetime sexual partners, number of partners in the past year, degree of mixing among the four major sub-groups, duration of relationships, and patterns of condom use. In addition, the survey asked each respondent to evaluate their own personal risk of acquiring HIV, dichotomized as "low" or "high". These data were used in two manners to delineate self-assessment of HIV risk. First, we used the methodology developed by Prata et al. (2003) for self-assessment of HIV risk in Mozambican adolescents. In this approach respondents are assigned one point for each

behavior associated with a high risk of contracting HIV. For our data these behaviors included having multiple partners, both in the past year and over one's lifetime, sexual mixing between age and economically differentiated sub-populations, concurrency (defined as partnerships that overlap in time (Morris, 2001)), and unsafe sex (represented by non-use of condoms). Specific risks for each are described below.

First, having multiple sequential sexual partners elevates HIV transmission efficiency (Anderson and May 1988; Aral 1992). Similarly simulation analyses (Morris & Kretzschmar, 1977, 2000) and empirical studies (Colvin et al., 1998) show that concurrency facilitates HIV transmission by linking previously isolated sexual dyads. The third factor, sexual mixing among sub-groups, exerts a major effect on HIV transmission when sub-groups are differentiated on the basis of sexual activity (Anderson et al., 1990; Anderson, 1996). The fourth factor, sexual mixing in the form of age and economically asymmetrical unions, is currently emphasized as a major determinant of the AIDS pandemic in sub-Saharan Africa (Gregson et al., 2002; Luke, 2003; Longfield et al., 2004), since such mixing leads both to differential condom use and exposure time to HIV/AIDS. Finally, simulation studies highlighted the importance of proper and regular condom use at different stages of the HIV/AIDS epidemic (cf. Van Vliet et al., 1998; Bracher et al., 2003).

All these risk factors were explained to community participants during the 1999 and 2001 education seminars in Nasakakwe/Karare. Even though not all residents attended these seminars, information imparted in them diffused quickly

throughout the community. At the time of our 2003 survey all respondents knew about these seminars and could recognize the concept of high-risk behavior.

In our second analysis we used these behaviors as independent variables for logistic regression analysis using the SAS® (1999) PROC LOGISTIC routine to delineate how respondents weighed specific risk factors. Independent variables derived from the survey instrument were coded as:

> **PARTNERS** = 0 for one or less partner per year and 1 for more than one.
>
> **MIXING** = 0 for assortative partners (e.g. married women with married men, unmarried women with unmarried men) and 1 for dissasortative partners (e.g. unmarried men with married women).
>
> **CONCURRENCY =** 0 for the absence of concurrent sexual partners in the past year and 1 for the presence of such partners.
>
> **CONDOMS**= 0 for either total or partial non-use and 1 for reported cases of complete use with all partners in past year.
>
> **LIFETIME PARTNERS** = 0 for unmarried and married women if lifetime partners $\leq$2 and 1 if lifetime partners >2, and 0 for unmarried and married men if lifetime partners $\leq$5 and 1 if lifetime partners >5.

For the Ariaal, these risks vary at different culturally defined points in men and women's sexual and reproductive careers. Ariaal culture is maintained and regulated by the elaborate fourteen year age-set system described in detail by Spencer (1973) and Fratkin (1998). Age-sets open with male circumcision ceremonies, marking the transition from boy to warrior for males. Warriors (known by the Maa term, *moran)* provide both labor and defense of livestock for an eleven -year period before they marry *en masse.* Once married they become

elders (known by the Kiswahili term *wazee)*, and make decisions about the movement and care of livestock. While moran are discouraged from producing children during their warriorhood, they are encouraged to "practice" sex, partly in order to alleviate inter-generational tensions between moran and wazee, for the latter control the livestock resources moran need to marry and establish an independent household, as well as practice polygyny, taking sequentially younger wives from the pool of unmarried women.

Recognizing these inequalities Ariaal culture maintains a pre-marital tradition known as *nykeri.* In this tradition warriors give an unmarried girl's parents successive strands of beads that her mother sequentially places around her daughter's neck. Once all beads are accepted warriors and beaded girls, known as nkeryi, initiate long-term pre-marital sexual relationships. A warrior can bead as many nykeri as he wants, the limiting factor only being the cost of beads. Furthermore, since male age-mates are required to share all assets, moran often sexually share nykeri with other moran. Warriors and nkeryi usually do not marry; instead their spouses come from parentally arranged marriages. Over the past decade the moran tradition has been maintained, while female education and the high cost of beads have led to a decrease in the nykeri tradition. Nevertheless pre-marital sex remains culturally acceptable for both sexes, with multiple short-term sexual unions outside the formal moran-nykeri relationships permitted before marriage.

Once married, men (*wazee*) and women (married women are called by the generic term, *mamas)* should end any other sexual relationship. However,

wazee frequently maintain sexual dalliances with their former nykeri and other girlfriends. Age and economic asymmetrical unions also arise between married women (mamas*)* and unmarried men (moran) when the former are junior wives to much older, polygynous men, or when wealthy married men (wazee) take nykeri mistresses.

These cultural patterns result in differing specific risks throughout the life cycle. As a result, accurate self-assessment of HIV risk should reflect past and present specific risk factors, while self-deception would not. For example, concurrency should be a concern of married women, many of whom are in polygynous relationships featuring co-wives. Similarly, married men should be more concerned about the number of lifetime partners than younger unmarried warriors.

Both methodological approaches generate specific hypotheses to test for self-deception in HIV risk self-assessment. For analysis of risk scores the null hypothesis is:

> H_0: Risk scores will not differ directionally with self-assessment status, e.g. those who rate their risk of contracting HIV as “Low” will not have significantly lower average risk scores than those with “High” self-assessments.

For logistic regression analysis the null hypothesis is:

> H_0: Logistic regression analysis will not delineate sub-group specific high-risk behaviors, e.g. married women and concurrency.

ANALYSIS AND RESULTS

As predicted, data showed that Ariaal cultural patterns result in varying exposure to risk behaviors throughout an individual's life cycle, and between the sexes. Figure 3 depicts percentages of each high-risk behavior arranged by sub-group (moran, nykeri, wazee and mamas), clearly showing the different patterning of risks associated with each. For example, because of polygyny mamas are at much lower risk from having multiple annual partners relative to wazee (27% mamas, 48% wazee). Also notable is the very low level of condom use for both married men and women (respectively 3% and 1%) relative to those for unmarried men (16%) and women (14%). This mirrors past studies indicating low rates of condom use within marriage throughout sub-Saharan Africa (Caldwell, 1999; Muhwava, 2003) due to condoms' association with illegitimate sexual unions and prostitution.

Figure 3 about here

Figure 4 presents the composite risk scores (mean values and standard deviations) for each sub-group, plus the total sample. First and foremost, this figure shows a very high average degree of overall risk behaviors in the total sample. The mean value of 2.55 strongly indicates that Ariaal sexual culture is fraught with high-risk behaviors. Figure 4 also shows that average risk varies by sex and age. For example both unmarried and married men have higher composite scores (respectively 3.38 and 2.84) than do unmarried and married women (respectively 1.74 and 2.15). The third and final noteworthy point from

Figure 4 is that all measures have large standard deviations, signifying a great deal of variation within each sub-group.

Figure 4 about here

Does this within-group variation translate into different self-assessments of HIV risk? Figure 5 presents means and standard deviations for the composite risk scores by sub-group and self-assessed risk status, i.e. “Low” versus “High”. Results show that for all sub-groups the empirical average risk score for those who rated their risk of contracting HIV as “High” was indeed higher than those who assessed their risk as “Low”. In all but the married men (wazee) sample the average score differences by response were significantly different ($t_{moran} = -2.13$, $p=0.038$, $t_{nykeri} = -3.08$, $p=0.003$, $t_{wazee} = -0.087$, $p=0.387$, $t_{mamas} = -2.60$, $p= 0.010$). These results suggest that Ariaal sub-groups are making accurate overall self-assessments of HIV risk based on their sexual behavior. This invalidates our first null hypothesis that predicted no difference in risk scores for “Low” versus “High” risk self-assessments.

Figure 5 about here

To isolate specific high risk behaviors by sub-group we next employed logistic analysis, using the risk factors as independent variables and the dichotomous categorical self-assessments of risk, i.e. “Low” versus ”high” as the dependent variable. This allowed us to decompose the aggregate risk scores used in the previous analysis in order to look for individual factors that we now know are represented in varying degrees in each of the four sub-samples. Returning to Figure 3, which depicted levels of individual risk factors by sub-

group, we see that for all sub-groups the greatest risk comes from lack of condom use. Following that, for both moran and wazee, the greatest number at risk comes from a high number of lifetime partners. For nykeri and mamas the greatest risk is from concurrent relationships. Logistic regression analysis for each of the four groups has the potential to reveal if Ariaal men and women accurately recognize these group-specific risks.

Tables 1-4 present the results of these analyses respectively for moran, nykeri, wazee and mamas. Each table presents two different runs. The first represents a main effects model, i.e. with no interaction between the independent variables. The second utilizes the SAS® (1999) backward selection option, which eliminates independent variables that do not significantly improve the fit between data and the main effects model, yielding the most parsimonious fit between data and model.

Table 1a first shows the main effects results for the moran sub-group, using the independent variables mixing (**MIXING**), concurrency (**CONCURR**), condom use (**CONDOMS),** number of lifetime partners (**LIFEPART**) and number of annual partners (**ANNUAL**). With one exception maximum likelihood coefficients estimates for each independent variable feature the correct algebraic sign in relation to the high risk category, i.e. they are positively signed. The exception is for annual partners, which has a negative value. This is somewhat surprising, since the number of recent sexual partners would appear to be an easier understood risk than mixing, or concurrency. Nonetheless, decomposing the multiple risk factors again shows a strong, positive association between

actual and perceived risk. In Table 1b the backward elimination procedure reveals the number of lifetime partners to be the single significant variable. The associated Odds Ratio value of 4.133 indicates that moran who reported more than five lifetime sexual partners were over four times more likely to assess their risk of HIV/AIDS as “High” relative to their counterparts reporting less than five lifetime partners. This last result conforms to the empirical data in Figure 4 showing that the greatest percentage of Ariaal men is at risk due to having a high number of lifetime partners.

Table 1 about here

The logistic model was constructed differently for the nykeri sample. Because both the numbers of lifetime and annual partners is greatly reduced relative to moran and wazee, these variables were omitted, and the model consisted of measures of concurrency, condom use and mixing. The main effects model shown in Table 2a reveals that the single significant variable is concurrency (**CONCURR,** Odds Ratio=7.339, p= 0.0025). The backward elimination model in Table 2b repeats these findings, with concurrency again the only significant variable. Unmarried women in concurrent relationships are 5.166 times more likely to rate their risk of HIV infection as high. Again, these quantitative results conform to the graphic results of Figure 4, which showed that after lack of condom use concurrency was the most significant risk to nykeri.

Table 2 about here

For married men (wazee) and women (mamas) the same statistically significant independent variables for unmarried men (moran) and women (nykeri)

are repeated. As shown in Tables 3a and 3b, the only significant independent variable for married men is lifetime partners, as it was in the analysis of unmarried men. However the variable is now signed differently, so that men featuring more than five lifetime partners are *less* than one-half (Odds Ratio, backward elimination model = 0. 476, p=0.0063) as likely to rate their risk of HIV infection as high. For married women the picture is more logically consistent, with the backward elimination model in Table 4b again showing women in concurrent relationships far more likely (Odds Ratio = 2.176, p=0.0079) to rate their risk of HIV infection as high than those not in temporally overlapping sexual unions.

Table 3 about here

Table 4 about here

Taken together, these results do not support our second null hypothesis that predicted logistic regression analysis would not reflect accurate sub-group specific high-risk behaviors. Instead it appears that for three of the four cases members of specific sub-groups were fully capable of accurately assessing their risk factors for contracting HIV. Considering high-risk patterning by sub-group with condom use removed, as shown in Figure 6, highlights this accuracy. Seen in this manner, it is clear that for both moran and wazee the single most important variable is lifetime partners, while for nykeri and mamas it is concurrency. In three of the four cases, moran, nykeri and mamas, these are indeed the variable identified by the backward elimination model as the most important determinant of self-assessment status. For the wazee sub-group the correct determinant, lifetime partners, is delineated, but this has the incorrect

algebraic sign, so that men with a low number (<5) of lifetime partners were more likely to have a “High” self-assessment status.

However, across all sub-groups condom use, which Figure 3 revealed to be the most prevalent risk factor for all groups, was never a factor in the logistic regression analysis. One reason for this lies in the make-up of logistic regression models, which work best if the categorical independent variables approach a 50% range, e.g. 50% use condoms regularly (and correctly) and 50% do not. For all sub-groups the percentage using condoms regularly was low overall and extremely low within marriage (wazee = 3%, mamas = 1%). As a result condom use was never a factor in any of the models.

Figure 6 about here

SUMMARY AND DISCUSSION

As originally pointed out by Caldwell and colleagues (Caldwell, 1999; Caldwell et al., 1992), throughout sub-Saharan Africa, there is a pronounced misfit between knowledge of the HIV sexual transmission and resistance to sexual behavioral change. In the current paper we raised the question of whether the paradox of populations possessing high knowledge levels of the disease transmission dynamics and consequences yet attempting little or no individual change in sexual behavior represents an example of the evolution of human self-deception. One vital piece of supporting evidence for such a scenario would be inaccurate self-assessments of HIV/AIDS risk. Using micro-demographic data from a 2003 survey of Ariaal agro-pastoralists in the sedentary

community of Nasakakwe/Karare we constructed two tests of self-assessment that generated hypotheses assuming inaccurate self-assessment stemmed from self-deception.

Neither of our two methodological approaches, one based on comparing composite risk scores calculated from reported sexual behavior with self-assessments of HIV/AIDS risk, nor the other using logistic regression analysis to delineate sub-group specific high-risk behavior, supported our hypotheses. In the first case risk scores based on empirical data were always higher for those who evaluated their risk of contracting HIV/AIDS as “High” than those whose self-assessment was “Low”, and three of the four times the differences were statistically significant. In the second approach logistic regression correctly identified the single most prevalent high-risk behavior associated with self-assessed “High” risk status in three of the four sub-groups.

From an applied perspective we interpret these results as indicating that information disseminated from our previous workshops on sexually transmitted disease is well received and clearly understood in the community. At present we can not tell if they support the AIDS Risk Reduction Model because they do not establish a link between what people know and any change in their sexual behavior. Rather they constitute strong baseline data from which we can monitor possible future behavior change.

Equally important are the exceptions to the findings of accurate self-assessment. In this case there is one group-specific exception, the inaccurately signed lifetime partner variable for the wazee sub-group. This makes us consider

if our hypotheses are as clear-cut as we originally thought. Can we attribute a misfit to self-deception alone, or does this reflect simple confusion among this sub-group? How can we separate and measure the effects of these two possible explanations? One approach is to consider self-assessment as a two-stage process. In the first the goal is to assess the fit between empirically recorded behavior and self-assessment. If the fit is good, as in most of the cases here, then the explanation that people are assimilating information clearly enough to make accurate self-assessments suffices, and self-deception is not a factor. If, however, there is a misfit between empirical data and self-assessment, then a second stage, devoted to determining the underlying cause of the misfit, must be undertaken.

In this case we provided direction for a possible second stage by following the question on risk self-assessment with an open-ended question asking respondents to explain their answer. For the wazee sample of 66 men who rated their risk of HIV/AIDS as “High” the great majority explained their self-assessment as stemming from concern with their present situation, specifically their wives’ faithfulness and their own extra-marital relationships, rather than lifetime number of sexual partners. Rather than self-deception, wazee appear to accurately assess their risk of HIV/AIDS, but recognize and are concerned with high-risk behavior in their current sexual situation, rather than past circumstances.

From an applied perspective, the other important exception in the analyses was condom use. This never appeared as a significant independent

variable in the logistic regression analysis, even though it was invariably the most prevalent high-risk factor. In the risk score analysis, we weighed condom use the same (one point) as all other risk factors. However, if condoms are regularly and correctly use they largely negate all other risk factors. The paradox is that while condom use is one of the cheapest and most effective HIV/AIDS interventions, building an effective condom program means overcoming enormous logistic, cultural and biological barriers. In the first regard Hunter (2003:32) details the difficulties in initiating and maintaining a regular supply of condoms in isolated rural settings with poor transportation and road systems, situations which describe the Marsabit setting, and indeed much of Sub-Saharan Africa. Even if a steady supply could be guaranteed for these areas, cultural stigma against condoms, which are associated with prostitution and promiscuity, is particularly strong within marriage (Chimbiri, 2003). Lastly, the association of condoms with decreased sexual gratification is evident in African statements that “one does not take a shower in a coat” or, “one does not eat a sweet with the wrapper on” (McPhail & Campbell, 2001).

Turning to theoretical considerations, because our results do not support our hypotheses, we address the usefulness of applying evolutionary principles to HIV/AIDS research. Freed from the dogmatic stances taken by their proponents and opponents (Roth, 2004) evolutionary principles and the hypotheses they can generate can be valuable tools for the study of HIV/AIDS. This is true even when reporting negative results, as in Borgerhoff Mulder’s (1988) search for evidence of the Trivers-Willard Model among Kipsigi agro-pastoralists of Kenya, or in the

present study. Positive results are exemplified in Bailey and Aunger's (1995) study of farming and foraging groups in the Ituri region of Central Africa. Lying within the great African infertility belt, their interview data clearly show that all groups understand the relationships between early sexual debut, increased risk of STDs and reduced fertility, yet maintain risky sexual cultural practices, e.g. early age of sexual initiation, multiple partners, and extramarital partners. Bailey and Aunger (1995:217) ask: "Why do people in the Ituri persist in their promiscuous attitudes and behaviour even in the face of such great loss in fertility, and by extension, in their own sense of social and psychological well-being?" Their answer is that humans are designed by evolution to actively seek sexual contact and gratification and that:

> An outcome of our remarkable capacity for sexual pleasure and desire for sexual contact is an apparent inability or unwillingness to detect and avoid the pathogens transmitted by the frequent sexual contacts we seek. While we have the cognitive processes that enable us to be conscious of the risks associated with sexual contacts, the evolved psychological mechanisms driving out desires may be overcome only under extreme conditions.
> (Bailey and Aunger, 1995: 218)

Such "extreme conditions" are exemplified by the Thai governmental coercion present in the aforementioned "100% Condom Program". Lacking coercion we noted that the perceived threat of HIV/AIDS is lessened and/or ignored via self-deception of risk in gay communities throughout the First World, and by adolescent heterosexuals in North America. In this paper we raised the question of whether self-deception of personal risk of HIV/AIDS was also associated with resistance to change in sexual behavior throughout sub-

Saharan Africa, even though education programs have raised levels of general knowledge about HIV/AIDS. Our micro-data do not support this contention, since Ariaal accurately evaluated their general risk of contracting the disease (e.g. Low versus High) based on group-specific risk factors, e.g. concurrency, lifetime sexual partners, etc. We do not know yet how people will act upon this behavior. Will they, as every HIV/AIDS education program hopes, dramatically reduce the incidence of high-risk behavior, or will they continue these actions? We feel that this question will provide the real test of both the effectiveness of our education programs among the Ariaal and the role of self-deception in risk assessment.

ACKNOWLEDGEMENTS

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Table 1A. Results of logistic regression analysis, moran sample, main effects model.

Parameter	Degrees of Freedom	Estimate	Standard Error	Chi-Square	Prob.	Odds Ratio
MIXED	1	0.1335	0.5945	0.0504	0.8223	1.143
LIFEPART	1	0.8111	0.5663	2.0512	0.1521	2.250
CONCURR	1	0.5404	0.8486	0.4053	0.5244	1.716
CONDOMS	1	0.5092	0.4901	1.0794	0.2988	1.664
ANNUAL	1	-0.3424	0.8337	0.1687	0.6813	0.710

Table 1B. Results of logistic regression analysis, moran selection option, backward selection option.

Summary of Backward Elimination

Step	Effect Removed	Degrees of Freedom	Number In	Wald Chi-Square	Pr> Chi-Square
1	MIXED	1	4	0.0250	0.8223
2	ANNUAL	1	3	0.1713	0.6789
3	CONCURRS	1	2	0.3330	0.5639
3	CONDOMS	1	1	1.9614	0.1614

Analysis of Maximum Likelihood Estimates

Parameter	Degrees of Freedom	Estimate	Standard Error	Chi-Squared	Prob.	Odds Ratio
LIFEPART	1	1.4190	0.2877	24.3218	<0.0001	4.133

Table 2A. Results of logistic regression analysis, nykeri sample, main effects model.

Parameter	Degrees of Freedom	Estimate	Standard Error	Chi-Square	Prob.	Odds Ratio
MIXED	1	-1.3819	0.8139	2.8828	0.0895	0.251
CONCURR	1	1.9933	0.6605	9.1074	0.0025	7.339
CONDOMS	1	0.2430	0.2776	0.7664	0.3813	1.275

Table 2B. Results of logistic regression analysis, nykeri sample, backward selection option.

Summary of Backward Elimination

Step	Effect Removed	Degrees of Freedom	Number In	Wald Chi-Square	Pr> Chi-Square
1	CONDOMS	1	2	0.7664	0.3813
2	MIXED	1	1	2.8876	0.0893

Analysis of Maximum Likelihood Estimates

Parameter	Degrees of Freedom	Estimate	Standard Error	Chi-Squared	Prob.	Odds Ratio
CONCURR	1	1.6420	0.4460	13.5560	<0.0002	5.166

Table 3A. Results of logistic regression analysis, wazee sample, main effects model.

Parameter	Degrees of Freedom	Estimate	Standard Error	Chi-Square	Prob.	Odds Ratio
MIXED	1	0.6126	0.6521	0.8825	0.3475	1.845
LIFEPART	1	-0.7905	0.3689	4.5917	0.0321	0.454
CONCURR	1	0.5314	1.3283	0.1601	0.6891	1.701
ANNUAL	1	-0.8209	1.3921	0.3477	0.5554	0.440

Table 3B. Results of logistic regression analysis, wazee sample, backward selection option.

Summary of Backward Elimination

Step	Effect Removed	Degrees of Freedom	Number In	Wald Chi-Square	Pr> Chi-Square
1	CONCURR	1	3	0.1601	0.6891
2	ANNUAL	1	2	0.2817	0.5956
3	MIXED	1	1	0.7052	0.4011

Analysis of Maximum Likelihood Estimates

Parameter	Degrees of Freedom	Estimate	Standard Error	Chi-Squared	Prob.	Odds Ratio
LIFEPART	1	-0.7418	0.2717	7.4549	0.0063	0.476

Table 4A. Results of logistic regression analysis, mamas sample, main effects model.

Parameter	Degrees of Freedom	Estimate	Standard Error	Chi-Square	Prob.	Odds Ratio
LIFEPART	1	0.0077	0.4283	0.0003	0.9858	1.008
MIXED	1	0.1945	1.3046	0.0222	0.8815	1.215
ANNUAL	1	-0.0022	1.2972	0.0000	0.9986	0.998
CONCURR	1	0.6878	0.5073	1.8379	0.1752	1.989

Table 4B. Results of logistic regression analysis, mamas sample, backward selection option.

Summary of Backward Elimination

Step	Effect Removed	Degrees of Freedom	Number In	Wald Chi-Square	Pr> Chi-Square
1	ANNUAL	1	3	0.0000	0.9986
2	LIFEPART	1	2	0.0003	0.9858
3	MIXED	1	1	0.1072	0.7434

Analysis of Maximum Likelihood Estimates

Parameter	Degrees of Freedom	Estimate	Standard Error	Chi-Squared	Prob.	Odds Ratio
CONCURR	1	0.7777	0.2930	7.0451	0.0079	2.176

FIGURE TITLES

Figure 1. Map of study area (After Bates and Fratkin 1998:205).

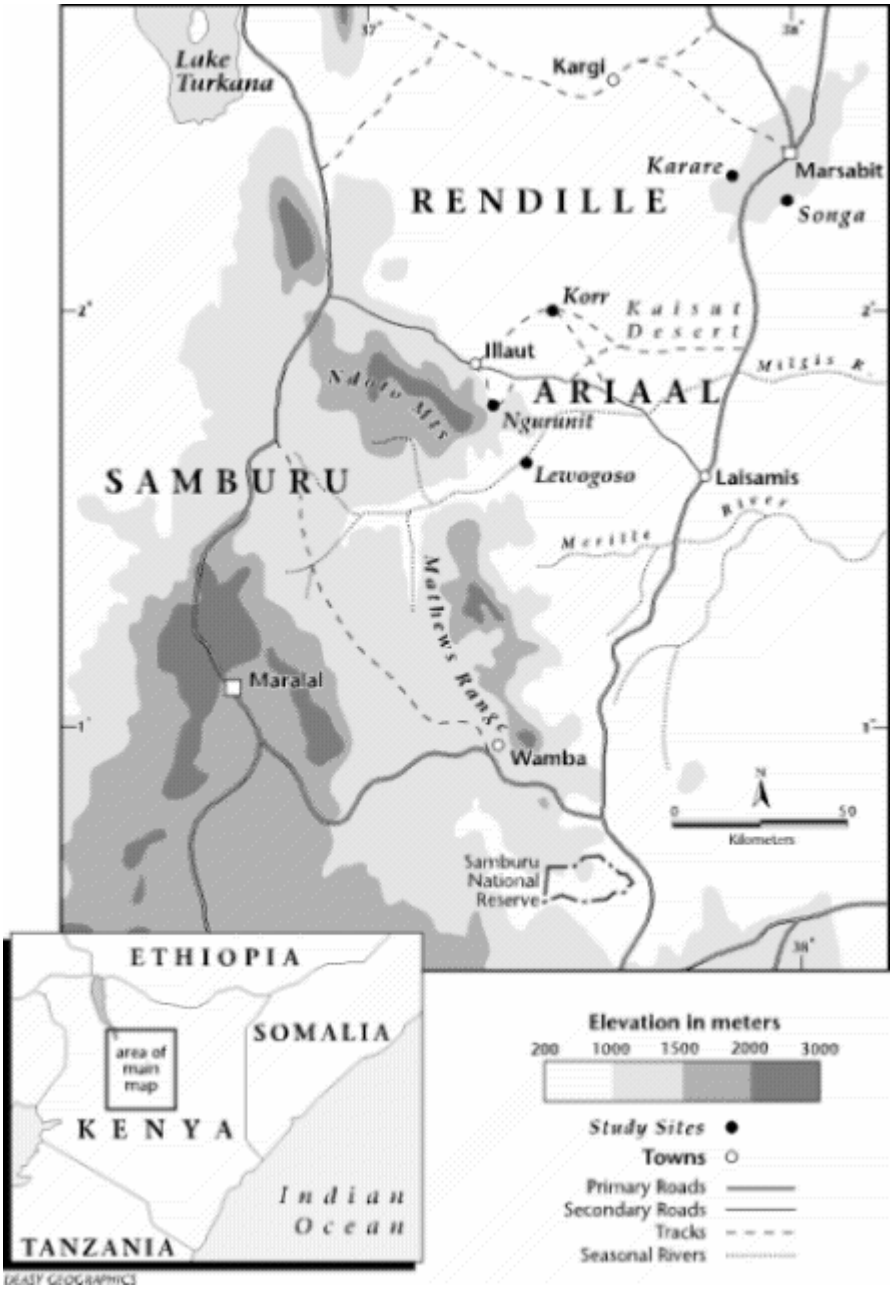
Figure 2. Responses to 1999 survey question “Should a man have more than one sexual partner at a time?”.

Figure 3. Percentage at risk by factor and sub-group.

Figure 4. Risk scores (means and standard deviations) for sub-groups and total sample.

Figure 5. Low and high risk scores (means and standard deviations) by sub-group and factor.

Figure 6. Percentages at risk, by sub-group and factor, condom use removed.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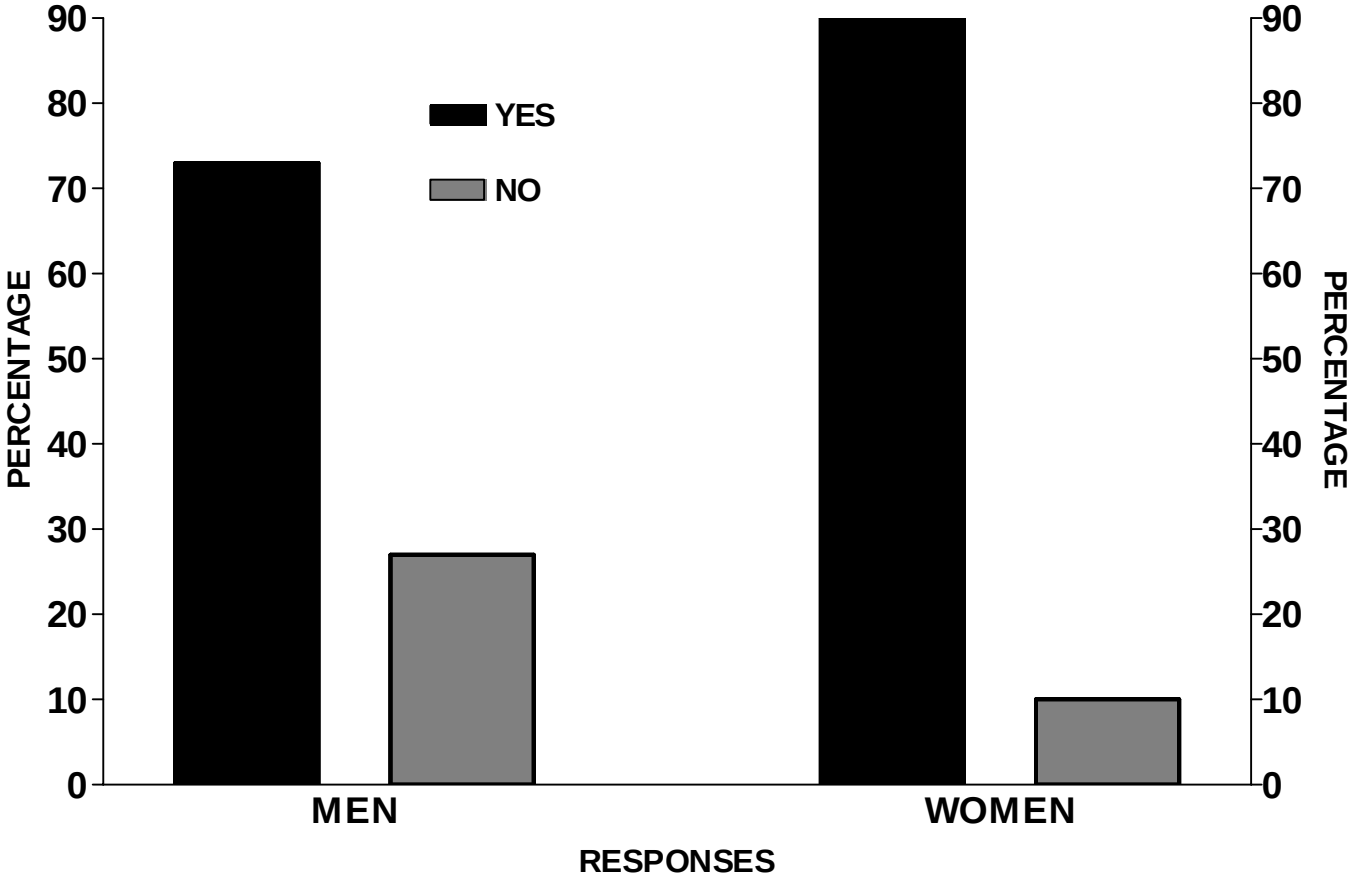
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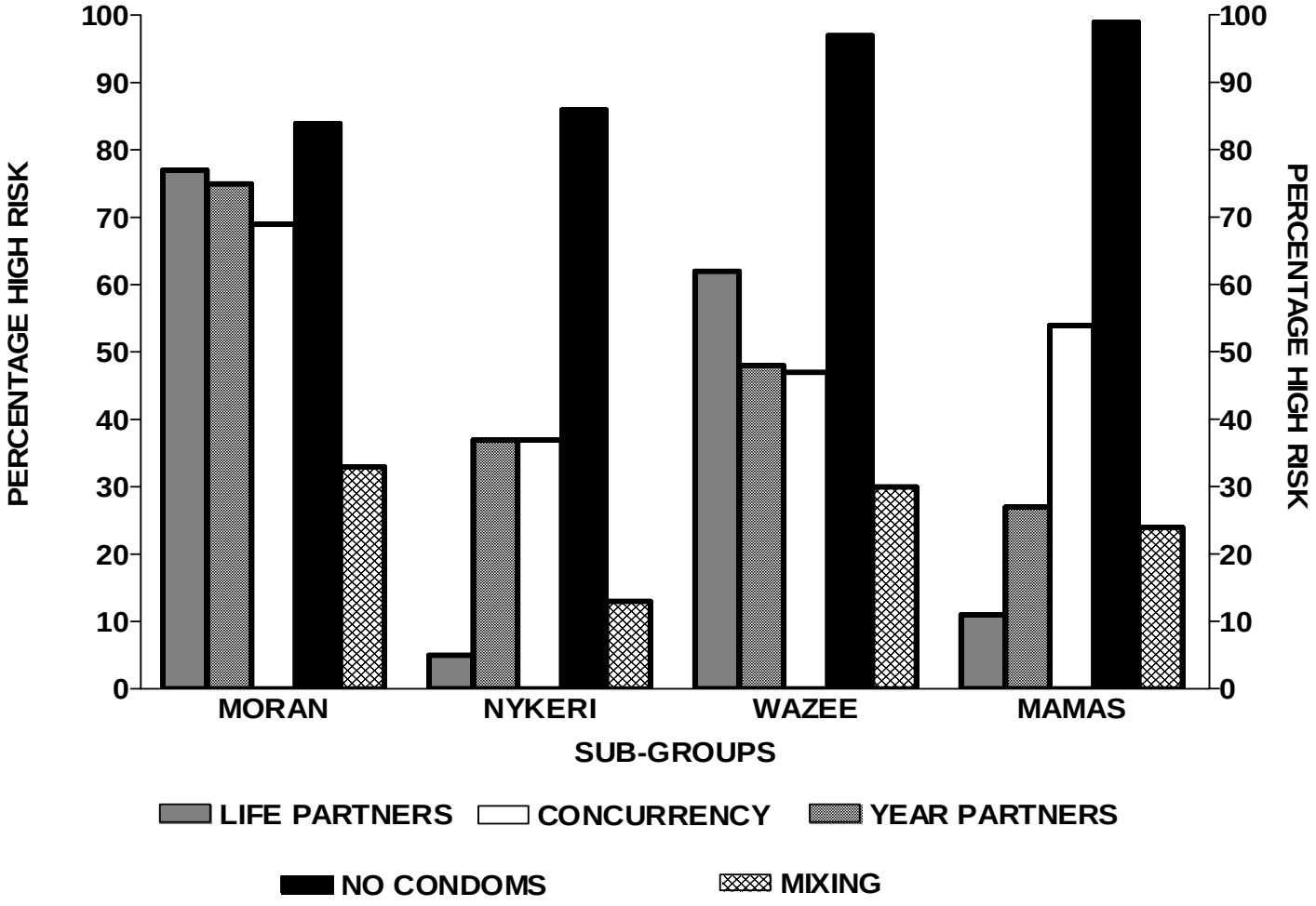
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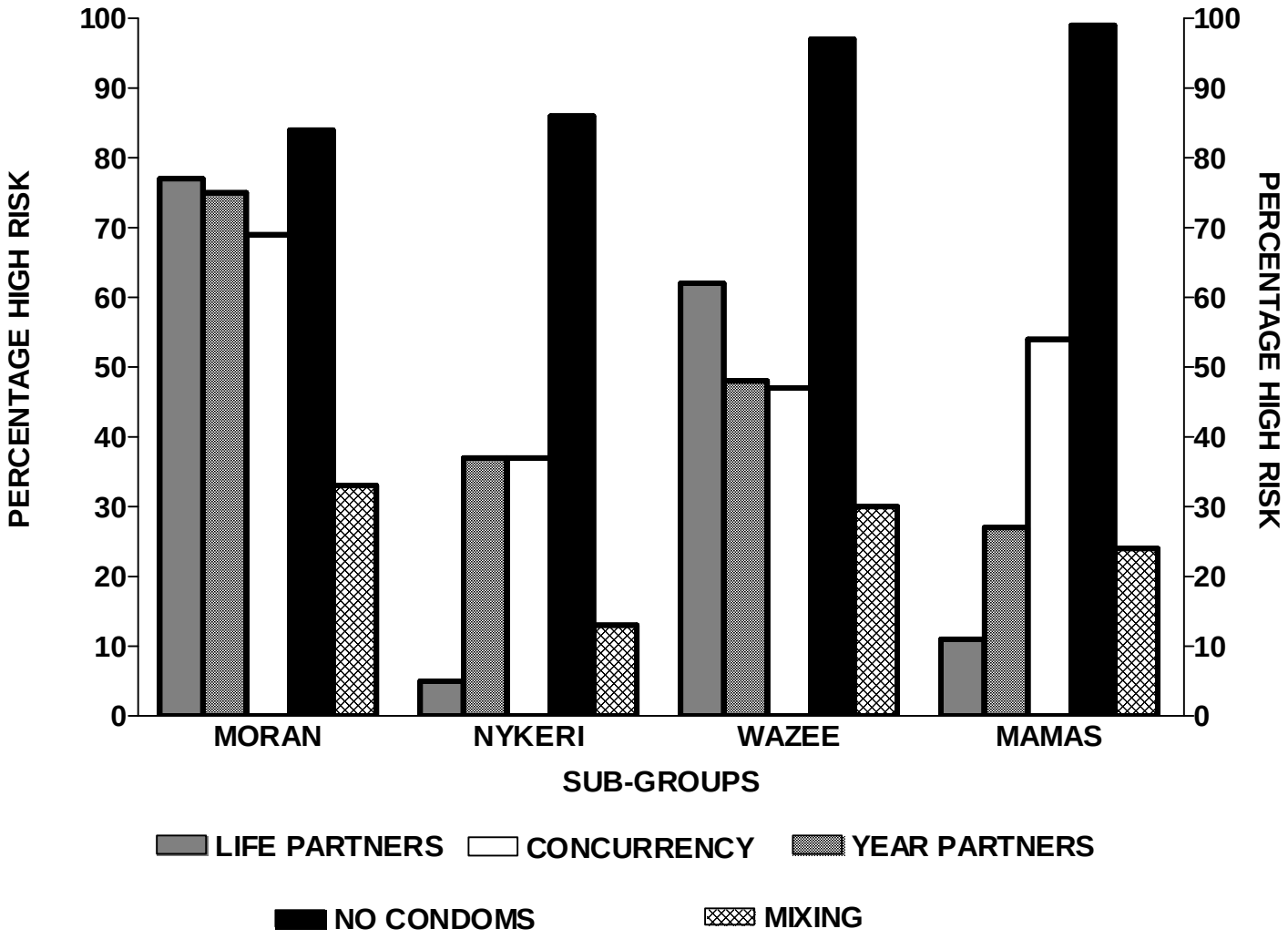
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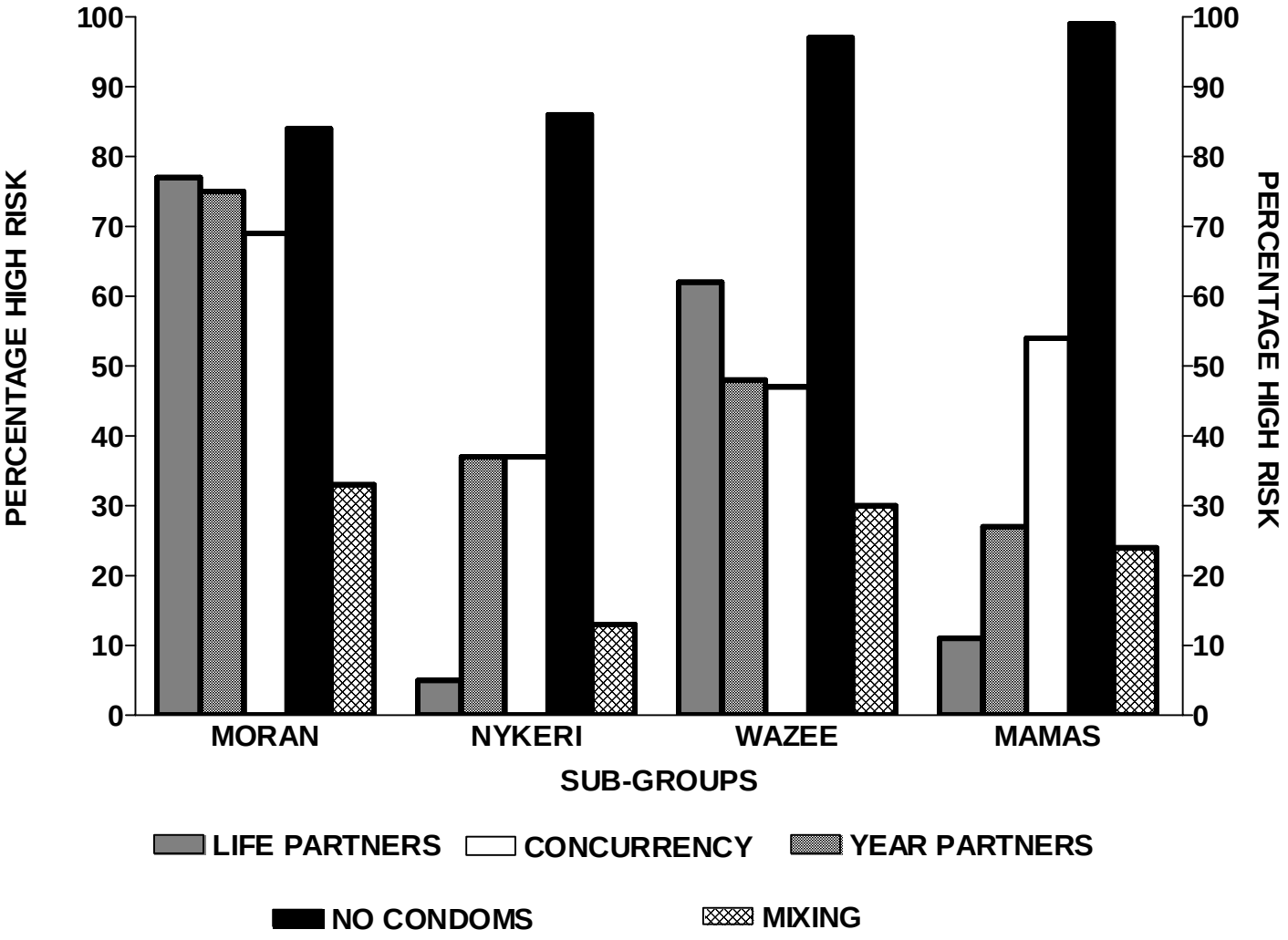
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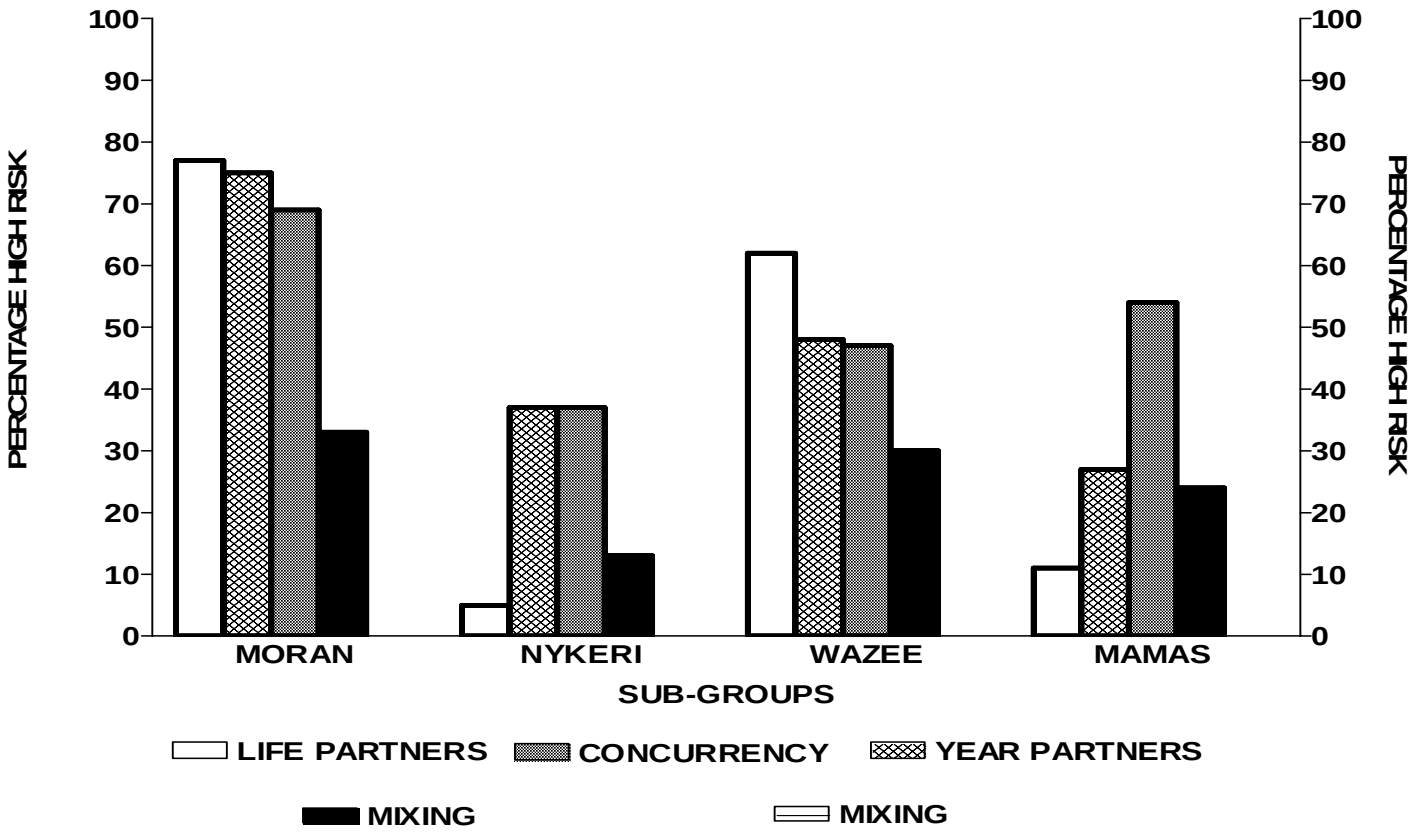
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