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SOCIOECONOMIC STATUS AS A RISK FACTOR FOR HIV INFECTION IN WOMEN IN EAST, CENTRAL AND SOUTHERN AFRICA: A SYSTEMATIC REVIEW

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Summary. This is a critical, systematic review of the relationship between socioeconomic status (SES) and HIV infection in women in Southern, Central and Eastern Africa. In light of the interest in micro-credit programmes and other HIV prevention interventions structured to empower women through increasing women's access to funds and education, this review examines the epidemiological and public health literature, which ascertains the association between low SES using different measurements of SES and risk of HIV infection in women. Also, given the focus on structural violence and poverty as factors driving the HIV epidemic at a structural/ecological level, as advocated by Paul Farmer and others, this study examines the extent to which differences in SES between individuals in areas with generalized poverty affect risk for SES. Out of 71 studies retrieved, 36 studies met the inclusion criteria including 30 cross-sectional, one case-control and five prospective cohort or nested case-control studies. Thirty-five studies used at least one measurement of female's SES and fourteen also included a measurement of partner's SES. Studies used variables measuring educational level, household income and occupation or employment status at the individual and neighbourhood level to ascertain SES. Of the 36 studies, fifteen found no association between SES and HIV infection, twelve found an association between high SES and HIV infection, eight found an association between low SES and HIV infection and one was mixed. In interpreting these results, this review examines the role of potential confounders and effect modifiers such as history of STDs, number of partners, living in urban or rural areas and time and location of study in sub-Saharan Africa. It is argued that STDs and number of partners are on the causal pathway under investigation between HIV and SES and should not be adjusted as confounders in any analysis. In conclusion, it is argued that in low-income sub-Saharan Africans countries, where poverty is widespread, increasing access to resources for women may initially increase risk of HIV or have no effect on risk-taking behaviours. In some parts of Southern Africa where *per capita*

income is higher and within-country inequalities in wealth are greater, studies suggest that increasing SES may decrease risk. This review concludes that increased SES may have differential effects on married and unmarried women and further studies should use multiple measures of SES. Lastly, it is suggested that the partner's SES (measured by education or income/employment) may be a stronger predictor of female HIV serostatus than measures of female SES.

Introduction

HIV infection in sub-Saharan African undermines development, has resulted in falling life expectancy, increasing number of orphans and the destruction of family and community structures. In 1998, more than 2 million died of AIDS in sub-Saharan Africa (UNAIDS, 2000). UNAIDS anticipates the premature death of half of the adult population of sub-Saharan Africa, which in turn will have comprehensive effects on all aspects of social and economic life. It is argued that most HIV infection in sub-Saharan Africa is transmitted via unprotected heterosexual intercourse. In particular, women, especially younger girls, are more likely to become infected with HIV during unprotected vaginal intercourse. In addition to specifics of biology, including a more susceptible mucosal surface in the vagina and a larger exposed surface area (Abdool Karim, 1998; Rees, 1998) that allows for increased risk of heterosexual infection for women, sociocultural and economic factors that 'disempower' women have been linked with an increased risk of HIV infection (Rees, 1998, p. 47). In developing countries, in general, women have limited access to education, formal employment, training, credit and support for agricultural work. At the household level, it is argued that women are vulnerable to HIV infection as a result of the non-monogamous sexual activity of their male partner and their inability to negotiate condom use and influence behaviour change of male partners (Campbell *et al.*, 1998; Campbell & Kelly, 1995; Eaton *et al.*, 2003). In the developed, industrialized world, studies have argued that poor women are at a greater risk of being infected for similar reasons (Krueger *et al.*, 1990).

Most persuasively, looking at the developing world and poverty, physician–anthropologist Paul Farmer has discussed the relationship between what he terms structural violence and risk for HIV. He argues that poverty at the community and individual level directly affects risk for HIV for women as it constrains women's choices and agency (Farmer, 1999). Farmer defines structural violence and risk of HIV for women as follows:

> Structural violence means that some women are, from the outset, at high risk of HIV infection, while other women are shielded from risk. Adopting this point of view – that we can describe a political economy of risk that this exercise helps to explain where the AIDS pandemic is moving and how quickly – we begin to see why similar stories are legion in sub-Saharan Africa and India ... these women have been rendered vulnerable to AIDS through social processes – that is, through the economic, political and cultural forces that can be shown to shape the dynamics of HIV transmission. (Farmer, 1999, p. 79.)

According to Farmer, women who are born into poverty are denied access to the 'fruits of scientific and social progress'; their attempts to escape from poverty are long

shots and failure is infection with HIV/AIDS. Along similar lines, looking at the situation of women in Central Africa, Broeke Schoepf (1993) suggests that HIV is spreading as women need to take other partners to survive economically in an increasingly deteriorating economy. From a political perspective, the ongoing debate about the appropriate treatment for South Africans by Thabo Mbeki and the South African government is linked in part to associations made between HIV risk and poverty. At the 13th International AIDS Conference in Durban in 2000, Mbeki stated: 'What I heard as that story was told [by WHO] was that extreme poverty is the world's biggest killer and the greatest cause of ill health and suffering across the globe.'

Due to the often-assumed relationship between HIV risk and low socioeconomic status (SES), particularly in the realm of public health and intervention research, the author argues that a scientific, epidemiological examination of the relationship between SES and risk for HIV infection for African women at an individual and community level is necessary. Although the global burden of infectious diseases, including the number of HIV/AIDS cases, is clearly greatest in the developing world, the mechanism(s) through which differential poverty or access to resources *within* the developing world context affects risk for HIV/AIDS needs to be better elucidated in relation to the specifics of location and definitions of poverty or SES. As cited above, in the works by Farmer, Schoepf and others, it is often argued that poverty and structural violence result in risk of HIV infection in women. However, the contexts that Farmer describes are industrialized ones or countries in Latin America or the Caribbean that have high levels of income inequality or greater poor–rich differences than some of the countries of sub-Saharan Africa (particularly the low GNP countries of West, Central and Eastern Africa), as measured by the Gini coefficient (Jenkins & Thomas, 2000). The Gini coefficient is derived from the Lorenz curve, a cumulative frequency curve that compares the distribution of a specific variable with a uniform distribution that represents equality with 0 representing perfect equality and 1 total inequality (Castillo-Salgado *et al.*, 2001). Although this article does not dispute the relationship between structural violence and risk-taking, it is argued that the relationship between low SES, risk-taking and health outcomes needs to be better elucidated so as to develop a clearer understand of how different aspects of SES may influence health outcome in different regions of the developing world. In this article the following questions are addressed: what are the determining factors that affect risk for HIV among African women in areas with generalized poverty? Furthermore, which particular elements of low SES (educational status, income) might place women at increased risk in areas with disseminated poverty in contrast with industrialized countries?

Many prevention and intervention efforts are geared towards addressing poverty and disempowerment at the individual level among African women, focusing on those groups with limited access to financial resources and/or education. These programmes are structured on the premise that alleviating an individual's poverty or increasing female educational levels will result in decreased risk-taking and better health outcomes, even if the intervention does not have any health-related content (Gonzales *et al.*, 1999). Fewer intervention programmes focus on the neighbourhood or household level. Meanwhile, socioeconomic indicators at the neighbourhood level

may be better overall measurements of health outcomes as they provide a more stable measure of economic circumstance, in contrast with annual income or education (Smith *et al.*, 1999; Krieger *et al.*, 1997).

Given the myriad number of definitions used for SES and many potentially confounding factors such as diversity of sociocultural practices in different African countries and the time when the study was conducted, the relationship between HIV and SES is difficult to elucidate. Through a critical examination of the material published on the relationship between SES and HIV infection in women in sub-Saharan Africa, this article reviews the evidence that low SES (defined in different ways) is a risk factor for HIV infection for women at the individual, household and ecological level. Although it is not debated that many poor women *do* engage in survival sex *and/or* take on extra partners for financial support as a result of their desperate economic situations (as the author has argued in other contexts: Wojcicki & Malala, 2001; Wojcicki, 2002a, b), this article reviews the inter-relationship between these practices, SES (using different indicators of SES) and HIV risk. In order to better understand how SES mediates sexual decision-making, this article evaluates studies that evaluate risk for HIV among low SES women compared with higher SES women residing in their same communities, in other communities with increased access to resources or in households with increased access to resources.

This review has public health implications as there are efforts to empower women, particularly through increasing women's independent access to funds, literacy and knowledge through micro-credit programmes and participation in women's groups as a means to address HIV risk. Such micro-credit programmes include: Ugafode (Opportunity International Affiliate in Uganda), the Foundation for International Community Assistance (FINCA) Uganda, Uganda Women's Efforts to Save Orphans (UWESO), the Association for Community Based Promotion (A.Com.B) in Togo, and URWEGO (World Relief Affiliate in Rwanda) (http://www.microcreditsummit.org/pdfs/AIDS.pdf). Implicit in such programmes is the notion that risk behaviour is linked to poverty and an absence of choices is related to economic disempowerment. The following quotation illustrates this premise:

> Because many women are economically dependent on men, the degree to which they are able to express their own will is often limited. This lack of choice - or lack of power - leads some women to engage in high-risk behaviours, which increases their chance of contracting the HIV virus. (*Opportunity International*, quoted in http://www.microcreditsummit.org/pdfs/AIDS.pdf.)

The above mentioned programmes primarily address women at the individual level and do not address elements of poverty that affect the community (e.g. access to safe water supplies, existence of local schools or other educational/training facilities, community health offices, etc.). Micro-credit programmes have been helpful in jump-starting small business development among poor people in the developing world (Pretes, 2002); it is not clear, however, whether the success of small business ventures could translate into specific, improved HIV outcomes for women.

As will be discussed below, the relationship between SES and HIV risk for women has not been systematically studied and is further complicated as SES is defined in non-uniform ways in different studies. Meanwhile, policymakers and public health

officials often structure interventions based on specific notions about the relationship between SES and HIV infection often based on the saliency of SES as a measure in the developed world in relation to health outcomes. By using SES as a proxy for empowerment among women and a predictor variable, this review explores the notion that disempowered women, defined as women who do not have access to independent capital, are at increased risk of HIV infection in and outside of marriage.

Methods

A MEDLINE search (1980–2002) and AIDSLINE search (1983–2002) were used to identify all studies addressing the link between socioeconomic status and HIV seroprevalence or seroconversion in sub-Saharan Africa. Searches were conducted of the English and other language material using the keywords 'HIV, socioeconomic and Africa', 'HIV, education and Africa' and 'women, risk factors, HIV and Africa.' French and English language papers were examined. Reference lists were subsequently examined in collected studies for relevant articles. Furthermore, the dissertation abstracts and the BIOSYSS databases were searched. Unpublished sentinel surveillance material from Zimbabwe and unpublished theses and dissertations from South Africa were also examined. Finally, the abstracts from the Durban 2000 Thirteenth International HIV/AIDS conference were reviewed and relevant authors were contacted so as to receive extended papers or full posters. Studies that focused on the relationship between men, SES and HIV risk were not included in the review but were used for reference purposes.

Seventy-one studies were retrieved. Thirty-five studies were excluded from the review including the following: eleven studies that did not provide separate analyses for men and women (Melbye *et al.*, 1986; Mnyika *et al.*, 1994; Nunn *et al.*, 1994; Malamba *et al.*, 1994; Tswana *et al.*, 1995; Lagarde *et al.*, 1996; Kirunga & Ntozi, 1997; Nuwaha *et al.*, 1999; Wawer *et al.*, 1994; Dallimore, 2000; Glynn *et al.*, 2001), seven studies from West Africa (Dada *et al.*, 1993; Meda *et al.*, 1995; Sangare *et al.*, 1997; Wilkins *et al.*, 1991; Ghys *et al.*, 1995, 2001; Sauve *et al.*, 2002) and seventeen studies that did not conduct multivariate analysis or present age-adjusted measures of association (Temmerman *et al.*, 1992; Laga *et al.*, 1993; McGrath *et al.*, 1993; Ojwang *et al.*, 1993; Abbott *et al.*, 1994; Cossa *et al.*, 1994; Slutsker *et al.*, 1994; Ministry of Health of Zimbabwe (Masvingo), 1995, 1996; Laver *et al.*, 1997; Aseffa *et al.*, 1998; Colvin *et al.*, 2000; Ministry of Health of Zimbabwe, 2000; Quigley *et al.*, 2000; Mayala *et al.*, 2001; Machel, 2001; Agha, 2002). These studies that were excluded will be discussed from a reference perspective but were not used in the review. West African studies were excluded as many of those studies examined risk factors for HIV-2 in addition to HIV-1. As discussed above, education is correlated with age group in some sub-Saharan African countries and age group is also a risk for HIV infection; along these lines, studies that at minimum did not control statistically for age group were excluded from analysis.

The 36 studies selected for review were evaluated based on the following criteria: (1) type of study design, (2) representative-ness of study sample of country or regional population, (3) completeness of follow-up for cohort studies, (4) measurement(s) of SES used and (5) measurement of outcome (HIV infection or other indicators of

sexual risk-taking) and (6) attention to potential confounders and interaction/effect modification. Furthermore, for those studies that did not find an effect, statistical power was taken into consideration (particularly case-control and cohort studies) and in positive studies, studies were evaluated for whether they controlled for potential confounders. It is argued that number of sexual partners, use of contraceptives and current or history of STDs should not be adjusted for in the analysis as a confounder as these variables are on the causal pathway under investigation between SES and HIV risk. The hypothesis being tested is that low SES results in increased risk for HIV infection (measured by HIV prevalent infection, HIV incident infection, increased number of partners, infrequent use of contraceptives or infection with an STD). Below, some of the complexities associated with socioeconomic status, and why timing of the study (when the study was conducted) is important to consider in this analysis, have been elucidated.

Definition of socioeconomic status

Defining SES is challenging because a single, consistent unit of measurement is not used in the studies reviewed. Furthermore, debate exists within public health on the appropriate components of socioeconomic status, the correct terminologies to use, and methods of measurement. Krieger *et al.* (1997) have argued that it is important to emphasize two different components of socioeconomic position (actual resources and prestige or rank-related characteristics) and prefer the use of the term socioeconomic position (instead of socioeconomic status). Similarly, they argue that it is important to collect data at the individual, household and neighbourhood level. Additional points emphasized include the fact that data on individuals supported from 'annual family income' should be collected, measurements should incorporate the recognition that socioeconomic position can change over a lifetime, and measures of socioeconomic position may perform differentially based on racial/ethnic group and gender background. Most of the articles reviewed do not attend to these complexities but rather use one to three measures of SES, most often simplistic measures of female and male income and education. The articles reviewed are analysed with the understanding that the complexities present in SES highlighted by Krieger *et al.* (1997) should ideally be incorporated in future studies designed to tease out the relationship between HIV and SES or other health outcomes and SES in African populations. Meanwhile, the term SES will be used in this article rather than socioeconomic position, simply because this is how these measures are discussed by the authors in the papers reviewed. Furthermore, it is acknowledged that prestige or rank-based elements of SES are often not commonly incorporated into measurements reviewed in this paper.

One important point highlighted by Krieger *et al.* (1997) is the interaction between measures of SES, gender, sociocultural or ethnic background and different health outcomes. Furthermore, different measures of SES cannot be expected to perform identically within the same populations; in other words, education may perform differently from income in examination of risk for HIV (Braveman *et al.*, 2001). In the sub-Saharan African context, differences in SES may not translate to the

important health differences associated with measures of SES at the individual, household or neighbourhood level found in the United States. In other words, categories associated with SES in all parts of the developing world may not have the same saliency as terms associated with these same measures in different areas of the industrialized world. Strong associations have been found between measures of poverty (annual family income) and health in the United States (US Department of Health and Human Services, 1990, 1991). It is argued that if poverty were listed as a cause of death in the United States it would be listed as third among African-American men and fourth among African-American women (Hahn *et al.*, 1996, cited in Krieger *et al.*, 1997). With reference to HIV, minorities and those with low SES are at higher risk for infection. In the United States, in the past 10 years, increasingly communities of colour, women and those with limited access to resources are at risk for HIV infection (Karon *et al.*, 2001). For example, in the first half of 2000, 70% of all AIDS cases diagnosed in the US were in racial/ethnic minorities. Over 50% of these AIDS cases were among African-Americans and Hispanics and over 75% of women and children with AIDS were African-American or Hispanic (CDC, 2002a). However, African-Americans represent only 13% of the US population (CDC, 2002b). Furthermore, 13·3% of Americans lived below the poverty line in 1997, but 26·5% of African-Americans and 27·1% of Hispanic-Americans were below the poverty line (Center on Budget and Policy Priorities, 1998).

However, how does elevated risk for African-Americans and some US minorities translate to sub-Saharan Africa? It is argued that countries that have greater income disparities are often at increased risk of poor health status, explaining the risk for HIV in impoverished groups in the United States and the high HIV incidence in countries like Brazil (Wilkinson, 1992, 1994, 1996). However, as poverty in certain parts of sub-Saharan Africa is widespread, the same SES measurements that elucidate risk for HIV in industrialized countries or medium income countries may be not applicable or have the same validity in illustrating differential risk in countries with very low GDP. In those parts of sub-Saharan Africa with growing and historical within-country differences in SES, such as Southern Africa, with sectors of the population benefiting from globalization and higher GDP, SES indicators may perform similarly to the industrialized context (Braveman & Tarimo, 2002). The generalized poverty present in many parts of sub-Saharan Africa is captured by the United Nation's Development Programme's (UNDP) poverty index. The UNDP human poverty index ranks countries based on poverty indicators (UNDP, 2001); out of the 35 poorest countries, 26 are in sub-Saharan Africa. Moreover, among the countries that have a high human development ranking, none is in sub-Saharan Africa and within the medium human development range only fourteen African countries are within this range (the majority ranked in the lowest quintile) (UNDP, 2001). The World Bank acknowledges that there is a problem in comparing poverty across countries and within countries. The World Bank and other institutions that compare poverty levels between countries often use purchasing power parity measures (PPP) adjusted for *per capita* income, which were designed to be able to adjust for the income required to purchase basic goods across societies. Another measurement commonly used is the human development index (HDI), which is based on equal weighting of three factors: PPP, literacy and life expectancy. These measures,

however, do not take into consideration any differences in income mobility between countries and within different regions of individual countries (Aaberge *et al.*, 2002). It is also argued that these measures are based on aggregate statistics and do not tell us much about the situation at the family or household level (Lindenberg, 2002). Furthermore, in understanding differences within countries, the cost of living is typically higher in urban than rural areas.

With these limitations in mind and the complexities of SES highlighted, studies are compared that measure SES, taking into consideration the different measurements used. A fundamental goal of this review was to examine the measures used for SES in sub-Saharan African studies and explore the association between these measures and risk for HIV, meanwhile having a background understanding that the saliency of the indicator may not translate to explaining health outcomes as found in US studies. Additionally, different measures of SES (income, education) may spell out different health outcomes (Krieger *et al.*, 1997). Subsequently, it is argued that it is necessary to compare African results with studies using these measures in the United States and other industrialized countries (Krieger *et al.*, 1997; Moss, 2002).

The measurements used in the studies reviewed include the following: monthly household income, husband/partner's level of education, woman's level of education, woman's occupation and woman's employment status or possessions owned by the household (such as type of home, bicycle, automobile, etc.). Potentially, a woman's employment status may be a better measurement of a woman's access to liquid funds (and hence a proxy for measurement of power in the household); on some level, a woman's educational level can be linked to employment status and access to funds but the link is more tenuous than directly using a woman's employment status. Nonetheless, it should be noted that these are imprecise measurements. In spite of the goal of being able to measure a woman's power and decision-making capabilities in the household with power defined as 'having a positive self-image and self confidence, developing the ability to think critically, groups cohesion and decision-making and action' (Tallis, 2000, p. 64), women may not have complete control over funds from employment in marriage or other relationships (Moss, 2002). Education will be evaluated separately in this article in addition to jointly with the other measures of SES, as studies from the United States have found that education and income may produce varied results in examining different health outcomes in the same population (Braveman *et al.*, 2001). Micro-credit programmes also often have literacy- and knowledge-based components, in addition to providing funds for income-generating projects (Hadi, 2001).

Studies that only use men's income and educational level as a proxy for women's SES status are further from measuring the amount of power and hence control that women have in relationships and households. Furthermore, there are specific problems associated with the general measurement of household income (particularly if this was the only measurement used). In assessing household income, investigators do not clearly differentiate between the income available to women in a particular household out of total household income. Additionally, micro-credit intervention programmes often work to provide access to funds for women independent of household funds or funds of their husbands.

Marital status

It is likely that employment status and/or education may have different impacts on married versus single women. Because many married women face unequal control of resources within the household, access to increased resources or educational/training opportunities may differentially affect married women in comparison with women living in female-headed households (Moss, 2002). In other words, it is argued that there is a possible interaction between marital status/number of partners, SES and risk for HIV infection that should be investigated. Studies of HIV risk in women have had inconclusive results in examining the relationship between HIV and marital status. In some studies, single/divorced and widowed African women have been shown to be at higher risk for HIV than married women, with marriage being protective against HIV infection (Mann *et al.*, 1986; Ryder *et al.*, 1990; Allen *et al.*, 1991; Nunn *et al.* 1994; Chao *et al.* 1994). However, other studies suggest that in some contexts marriage is the only risk factor for women (Mbizvo *et al.*, 2001). Additionally, other studies have indicated that married women have the highest levels of perceived risk (Kengeya-Kayondo *et al.*, 1999).

History of relationship between SES, HIV/AIDS and sub-Saharan Africa

Early HIV studies from sub-Saharan Africa showed a relationship between high socioeconomic status, particularly a history of travel, and risk of HIV infection in men and women (Van de Perre *et al.*, 1987; Hira *et al.*, 1990; Wilkins *et al.*, 1991). It was argued that high SES in African men and women was a proxy for travel and as such men and women who had travelled to Central Africa, Europe or North America were at increased risk of being HIV-infected. Africans with occupations that involved travel such as truck drivers and drivers' assistants were deemed to be at greater risk and continue to be at higher risk for HIV than the general population (Carswell *et al.*, 1989; Rakwar *et al.*, 1999). Other occupations such as waitresses, barmaids, those in the army, migrant workers and prostitutes/commercial sex workers have also been shown to be at increased risk due to the travel associated with some of these occupations or the likelihood of coming in contact with those who travel (Kirunga & Ntozi, 1997; Hope, 2000). Studies also suggest that men with access to resources, including those who are employed, may be more likely to have a greater number of female sexual partners, disposable income and be at increased risk for HIV (Wilkins *et al.*, 1991; Gregson *et al.*, 2001). Furthermore, rural sub-Saharan African studies indicate that those who frequently travelled to urban areas were at increased risk of HIV infection (Van de Perre *et al.*, 1987; Barongo, 1992). From a socio-cultural perspective, within African communities, HIV has been associated with European influences, wealth and urban life. AIDS has been described using slang terminology such as Acquired *Income* Deficiency Syndrome, *Juliana* (a brand of illegally imported clothing in Tanzania that was a status symbol among young men: Setel, 1999) and other terms associated HIV with wealth and Western influences.

In the past 5–10 years, however, researchers have argued that HIV has moved from urban, wealthy areas into more impoverished, rural ones and from highly, educated and wealthy Africans to the larger population, becoming a widely, disseminated epidemic (Decosas & Padian, 2002). This paper examines these ideas by

taking into consideration the following potentially confounding factors in the studies reviewed: (1) date that research was conducted, (2) location of study and finally (3) urban or rural focus. Lastly, in many countries, there is a strong correlation between age and educational status as universal educational access only became available within the last 10–20 years and so a significantly greater proportion of younger men and women are educated compared with older men and women (e.g. Zimbabwe, Laver *et al.* 1997); along these lines, studies that did not control for age as a potential confounder were excluded from the analysis, as will be discussed below.

Results

Out of the 36 studies that met the inclusion criteria, fifteen found no association between a woman's SES status and HIV infection, twelve found a positive association, eight found a negative association and one was mixed. Of these 36 studies, 30 were cross-sectional (including two ecological studies (Armstrong, 2000; Auvert *et al.*, 2001a), and the outcome measure was the prevalence of HIV infection in 26 of these studies. Two studies used low condom use as a proxy for HIV infection and risky sexual practices (Kirigia & Muthuri, 1999; Lagarde *et al.*, 2001), another two used risky sexual behaviour (defined as multiple regular partners or many casual partners or two or more partners in the past two months as a proxy for HIV infection: Moses *et al.*, 1994; Kapiga & Lugalla, 2002). The only case-control study reviewed similarly used HIV prevalence as an outcome measure (Quigley *et al.*, 2000). An additional five studies were prospective cohort or nested case-control studies, and these studies used HIV seroconversion as an outcome measure (Bulterys *et al.*, 1994; Kapiga *et al.*, 1998; Mbizvo *et al.*, 2001; Quigley *et al.*, 1997; Senkoro *et al.*, 2000). Sample sizes in these 36 studies ranged from a high of 11,517 women in a cross-sectional study of childbearing women in 27 areas of Zambia by Fylkesnes *et al.* (1997) to 130 men and 133 women in a case-control study by Quigley *et al.* (1997). Specifically, looking at the different studies based on study design, the following results were found.

Cross-sectional studies

Of the 30 cross-sectional studies, ten found an association between high household SES (measured by monthly/yearly household income, male partner's level of education, male partner's occupation, wife's level of education or wife's occupation) and HIV infection (Allen *et al.*, 1991; Barongo *et al.*, 1992; Dallabetta *et al.*, 1993; Chao *et al.*, 1994; Kapiga *et al.*, 1994, 2000; Fylkesnes *et al.*, 1997; Wannan *et al.*, 1997; Smith *et al.*, 1999; Armstrong, 2000); seven studies found a protective effect of high SES defined similarly (Lagarde *et al.*, 2001; Seeley *et al.*, 1994; Mbizvo *et al.*, 1996; Auvert *et al.*, 2001a; Fylkesnes *et al.*, 2001; Gregson *et al.*, 2002; Kapiga & Lugalla, 2002); one study was mixed with a protective effect of high SES for HIV infection in unmarried, single women but a positive association in married women (Kirigia & Muthuri, 1999); and twelve studies found no significant association between SES status and HIV infection in women (Ryder *et al.*, 1990; Serwadda *et al.*, 1992; Lallemant *et al.*, 1992; Hunter *et al.*, 1994; Moses *et al.*, 1994; Gregson *et al.*,

1995, 1996; Mati *et al.*, 1995; Ayisi *et al.*, 2000; Auvert *et al.*, 2001b; Kapiga *et al.*, 2002; Msuya *et al.*, 2002). Five of the cross-sectional studies that did not find an association in the adjusted analysis, did find an association between high SES and risk for HIV infection in the univariate analysis (Ryder *et al.*, 1990; Serwadda *et al.*, 1992; Ayisi *et al.*, 2000; Gregson *et al.*, 1996; Kapiga *et al.*, 2002). Twenty-five of 30 cross-sectional studies had sample sizes in excess of 700 participants (with the exclusion of Serwadda *et al.*, 1992; Chao *et al.*, 1994; Gregson *et al.*, 1995; Kapiga *et al.*, 2002; Msuya *et al.*, 2002) with eleven studies in excess of 4000 participants.

Of the ten studies that found an association between high SES and risk for HIV (including one ecological study to be discussed in the section below: Armstrong, 2000), four found an association based on SES measures for male partners and six found associations based on measures for females. Among the four that found an association between high SES for partners and HIV risk, three found an association between partner's occupation/income (Allen *et al.*, 1991; Dallabetta *et al.*, 1993; Wannan *et al.*, 1997) and one found an association between partner's educational status and HIV infection (Kapiga *et al.*, 2000). Three studies found an association between a woman's educational status (Kapiga *et al.*, 1994; Fylkesnes *et al.*, 1997; Smith *et al.*, 1999), one found an association between a woman's occupational status/monthly income (Barongo, 1992) and one found an association between a woman's educational and occupational status and HIV risk (Chao *et al.*, 1994). The magnitude of the association was between 2- and 4-fold for many of the studies (Dallabetta *et al.*, 1993; Chao *et al.*, 1994; Fylkesnes *et al.*, 1997). Some of these studies used multiple strata to measure SES, with women in the highest stratum being at increased risk indicating increasing risk with trend (e.g. for partner's educational level, the study by Kapiga *et al.* (2000) found $p=0{\cdot}005$ for trend and the study by Smith *et al.* (1999) found a χ^2 test for trend for increasing risk ($p<0{\cdot}0001$) for increasing educational attainment for women). Seven out of the ten positive studies used a measure of male SES (Allen *et al.*, 1991; Dallabetta *et al.*, 1993; Chao *et al.*, 1994; Kapiga *et al.*, 1994, 2000; Wannan *et al.*, 1997; Smith *et al.*, 1999).

Of the seven negative cross-sectional studies reviewed (Lagarde *et al.*, 2001; Mbizvo *et al.*, 1996; Auvert *et al.*, 2001b; Fylkesnes *et al.*, 2001; Gregson *et al.*, 2002; Kapiga & Lugalla, 2002; Seeley *et al.*, 1994), one was ecological (Auvert *et al.*, 2001a) and will be discussed in the section below; three found an association between a woman's low educational status and increased risk (Fylkesnes *et al.*, 2001; Kapiga & Lugalla, 2002; Gregson *et al.*, 2002); one found an association with partner's low educational status (Mbizvo *et al.*, 2001); one found an association with a woman *and* her partner's low educational status (Lagarde *et al.*, 2001) and one found an association with low income at the household level (Seeley *et al.*, 1994). The strength of association was similar to that of the positive studies and ranged from an OR of 2·8 (95%CI 1·1–11·0) for increased risk based on partner's low educational status to a protective OR of 0·3 (95%CI 0·2–0·5) for women with secondary school education and above (Kapiga & Lugalla, 2002). The study by Kapiga and Lugalla also found a linear trend, with women having more education increasingly likely to not engage in risky sexual practices ($p_{\text{trend}}=0{\cdot}0001$). Only three of these studies included a measure of male SES in addition to female measures of SES (3/7) (Lagarde *et al.*,

2001; Mbizvo *et al.*, 2002; Kapiga & Lugalla, 2002), which is the similar to the ten positive cross-sectional studies (4/10 included a measure of male SES).

Of the twelve cross-sectional studies that found no association, six examined the role of female education or literacy on risk of HIV infection (Hunter *et al.*, 1994; Mati *et al.*, 1995; Gregson *et al.*, 1995, 1996; Auvert *et al.*, 2001a; Kapiga *et al.*, 2002) and two looked at female education *and* occupation (Ayisi *et al.*, 2000; Serwadda *et al.*, 1992). Two looked only at male and female occupation (Ryder *et al.*, 1990; Lallemant *et al.*, 1992), only female occupation (Moses *et al.*, 1994) or the education of the male partner (Msuya *et al.*, 2002). Similar to the negative studies, only three of these studies (out of twelve) included a measurement of male SES (Ryder *et al.*, 1990; Lallemant *et al.*, 1992; Msuya *et al.*, 2002).

Ecological studies

Some have argued that the SES of the surrounding communities is a more significant predictor of HIV status than SES (as measured by income or educational status) at the individual level (Armstrong, 2000). Furthermore, others have argued that it is necessary to examine the impact of SES at the community level in addition to the individual level in order to better understand risk-taking (Krieger *et al.*, 1997; Johnson & Budlender, 2002). Only two ecological studies met the inclusion criteria for this review. Both studies found an association between community SES and HIV infection in women (Armstrong, 2000; Auvert *et al.*, 2001b). Auvert *et al.* found a negative association and Armstrong *et al.* found a positive association. For Auvert *et al.*, South African women living in squatter, informal settlements in Carletonville had an increased risk (OR 1·6, 95%CI 1·1–2·3). In 33 sentinel sites in Zimbabwe, Armstrong (2000) found an increased HIV seroprevalence for women living in areas of high SES ($p=0·006$, with SES for the community defined using a composite index that included (1) mean annual household income, (2) mean site score for goods owned by household, (3) percentage of urban residents in area, (4) mean years of husband's education) and also in areas with high knowledge of condoms and STDs ($p<0·0001$)).

Case-control studies

The single case-control study included in the review used HIV prevalence as an outcome measure (Quigley *et al.*, 1997). In multivariate analysis, those having partners employed in manual/office or business environments had an OR of 2·20 (95%CI 1·22–3·95); this was the only variable that independently predicted HIV serostatus. This result was similar to that of the cross-sectional results where high male partner SES independently predicts HIV infection.

Prospective cohort studies

Of the five cohort and nested case-control studies, three found no association for high SES (Bulterys *et al.*, 1994; Kapiga *et al.*, 1998; Quigley *et al.*, 2000), one found a positive association (Senkoro *et al.*, 2000) and one found a negative association (Mbizvo *et al.*, 2001). All of the studies had sample sizes above 350, with two having

sample sizes above 1000 (Bulterys *et al.*, 1994; Kapiga *et al.*, 1998), except for Quigley *et al.* (2000) which had data on 133 women. Similar to the case-control and cross-sectional studies, the cohort studies used measurements of SES that focused primarily on a woman's education, woman's employment status, partner's education and partner's employment status. One study used two measurements of SES (woman's employment status and education; positive result: Senkoro *et al.*, 2000), two studies included the woman and her partner's educational status (negative result and no association; Kapiga *et al.*, 1998; Mbizvo *et al.*, 2001), one study measured only a woman's educational status (no association; Quigley *et al.*, 2000) and one study measured a woman's educational status and total household income (no association; Bulterys *et al.*, 1994). In contrast with the cross-sectional studies, studies that found no association in the multivariate or age-adjusted analysis between SES and incident HIV infection also found no association at the univariate level (Bulterys *et al.*, 1994; Kapiga *et al.*, 1998; Quigley *et al.*, 2000). Three out of five of the studies used measures of male SES or total household income (Kapiga *et al.*, 1998; Bulterys *et al.*, 1994; Mbizvo *et al.*, 2001).

Discussion

In contrast with the assertion that impoverished women are at increased risk of HIV infection, twelve (out of 36) of the studies reviewed suggest that high SES women, measured either by female employment status/educational level and/or male educational status/employment, are at increased risk of HIV infection (Allen *et al.*, 1991; Barongo *et al.*, 1992; Chao *et al.*, 1994; Kapiga *et al.*, 1994, 2000; Dallabetta *et al.*, 1993; Fylkesnes *et al.*, 1997; Quigley *et al.*, 1997; Wannan *et al.*, 1997; Smith *et al.*, 1999; Senkoro *et al.*, 2000; Armstrong, 2000). Of these twelve studies, three found an association between female employment status and risk of HIV infection (Barongo *et al.*, 1992; Chao *et al.*, 1994; Kapiga *et al.*, 2000); six studies found an association between female educational status and risk of HIV infection (Chao *et al.*, 1994; Kapiga *et al.*, 1994; Fylkesnes *et al.*, 1997; Wannan *et al.*, 1997; Smith *et al.*, 1999; Senkoro *et al.*, 2000) and six found an association between male high educational or employment status and increased risk of HIV infection (Allen *et al.*, 1991; Dallabetta *et al.*, 1993; Quigley *et al.*, 1997; Wannan *et al.*, 1997; Armstrong, 2000; Kapiga *et al.*, 2000). Studies that included a variable to measure female employment status/educational level may be better equipped to examine how much access to resources a woman may have in a relationship (or this is often the premise of micro-credit and other intervention programmes).

Study design

Most of the studies reviewed in this paper use a cross-sectional study design, which is not useful in establishing a temporal relationship between exposure and outcome (Last, 1995). In the case of SES as a risk factor for HIV infection, studies have indicated that individuals with high SES have longer survival rates (due to better diet, access to health services, more support, etc.) than HIV+ individuals of lower SES and as such cross-sectional studies could erroneously link high SES as a risk factor

for HIV infection risking the internal and external validity of the study (Hogg *et al.*, 1994; Longo-Mbenza *et al.*, 1998; Piketty *et al.*, 1999; Schechter *et al.*, 1994). As a greater number of cross-sectional studies, in general, found an association between high SES and increased HIV prevalence, it is possible that results were reflecting elements of survival. However, as neither high nor low SES women had access to HAART or other HIV therapies in sub-Saharan Africa at the time that these studies were conducted, it is not clear to what extent differential survival rates might be influenced by SES. In the event that high SES improves survival due to better nutrition and access to primary care, it is not clear whether survival differences are sufficient to explain the association found between high SES and risk of HIV infection in some of the cross-sectional studies as these studies do not control for access to care or nutrition.

SES: definitions and use

All but one of the 36 studies (Mbizvo *et al.*, 2001) included in the review used some measure of SES that incorporated a woman's employment, educational status or direct access to funds, in addition to other potentially less precise measures of women's SES such as partner's employment or educational status. As measures of SES (education versus income or employment) have resulted in different health outcomes in other studies, it is important to evaluate the effect of education and income/occupation separately. Comparing those cross-sectional studies that looked only at female educational level (with or without partner's SES measured) and those that examined educational level and/or employment status, of those that looked just at female's educational or literacy level ($n=10$), seven found no association (Hunter *et al.*, 1994; Mati *et al.*, 1995; Gregson *et al.*, 1995, 1996, 2002; Auvert *et al.*, 2001b; Kapiga *et al.*, 2002), one found a positive association (Fylkesnes *et al.*, 1997) and two found a negative association (Fylkesnes *et al.*, 2001; Kapiga & Lugalla, 2002). In contrast, of those cross-sectional studies that examined occupation alone ($n=6$) or female occupation and educational status ($n=13$) including two ecological studies (total $n=19$), six studies found no association (Ryder *et al.*, 1990; Lallemant *et al.* 1992; Serwadda *et al.*, 1992; Moses *et al.*, 1994; Msuya *et al.*, 2002; Ayisi *et al.*, 2000), nine found a positive association (Allen *et al.*, 1991; Barongo *et al.*, 1992; Dallabetta *et al.*, 1993; Kapiga *et al.*, 1994, 2000; Chao *et al.*, 1994; Wannan *et al.*, 1997; Smith *et al.*, 1999; Armstrong, 2000), four found a negative association (Seeley *et al.*, 1994; Mbizvo *et al.*, 1996; Auvert *et al.*, 2001a; Lagarde *et al.*, 2001) and one was mixed (Kirigia & Muthuri, 1999; see Tables 1 and 2). Among those studies that only examined female occupation (and did not include educational status) (see Table 2), two studies found a positive association (Armstrong, 2000; Kapiga *et al.*, 2000), one was negative (Seeley *et al.*, 1994) and three found no association (Lallemant *et al.*, 1992; Moses *et al.*, 1994; Ryder *et al.*, 1990).

Much of the difference in results between studies using these different measures of SES may be explained by the inclusion of male SES as part of the overall measurement of SES. Only one of the studies that just looked at education alone (out of ten) included a measurement of partner's SES (Kapiga & Lugalla, 2002), in contrast with ten of the studies that looked at both female education and occupation

Table 1. Cross-sectional studies: education only variable measured for women

Study	Female educ./occup.	Statistical analysis	Result
Auvert *et al.* (2001b)	None	MV model[a]	**No association**
Fylkesnes *et al.* (1997)	None	MV model[b]	Higher education increases risk (female) Urban OR 2·46, 95% CI (1·89–3·20) Rural OR 4·23, 95% CI (3·08–5·80) **Positive**
Fylkesnes *et al.* (2001)	None	Bivariate, age-adjusted only	Low education increases risk (female) RR 0·76, 95% CI (0·66–0·88) **Negative**
Gregson *et al.* (1996)	None	MV model[b]	**No association**
Gregson *et al.* (1995)	None	MV model[c]	**No association**
Gregson *et al.* (2002)	None	MV model[a]	**No association**
Hunter *et al.* (1994)	None	MV model[d]	**No association**
Kapiga *et al.* (2002)	None	MV model[a]	**No association**
Kapiga & Lugalla (2002)	Educ. only	MV model[b]	OR 0·3, 95% CI (0·2–0·5) for secondary education and above (female): protective **Negative**
Mati *et al.* (1995)	None	MV model[d]	**No association**

[a]Adjusted for age, STDs, contraceptive use or number of sexual partners (at minimum).
[b]Adjusted for marital status and age (at minimum).
[c]Adjusted for age, marital status and place of residence or geographical location (at minimum).
[d]Adjusted for age, STDs, contraceptive use or number of sexual partners and marital status (at minimum).

Table 2. Cross-sectional studies: occupation (with or without education) measured for women

Study	Female educ./occup.	Male educ./occup.	Statistical analysis	Result
Allen *et al.* (1991)	Both	Both	MV model[a]	Increased risk for high SES partner OR 1·96, 95% CI (1·5–2·56) **Positive**
Armstrong (2000)	Occup. (ecological)	Educ. (ecological)	MV model[b]	Increased risk for high SES communities **Positive**
Auvert *et al.* (2001a)	Both (ecological)	No	MV model[b]	Negative association between impoverished area and increased risk OR 1·6, 95% CI (1·1–2·3) **Negative**
Ayisi *et al.* (2000)	Both	No	MV model[c]	**No association**
Barongo *et al.* (1992)	Both	No	MV model[a]	Increased risk for women employed in business OR 2·0, 95% CI (1·2–3·4) **Positive**
Chao *et al.* (1994)	Both	Occup.	MV model[a]	High household income OR 2·5, 95% CI (1·9–3·1); higher education (female) OR 1·5, 95% CI (1·0–2·1); supports herself OR 1·6, 95% CI (1·1–2·3) **Positive**
Dallabetta *et al.* (1993)	Both	Educ.	MV model[b]	Husband's education OR 2·23, 95% CI (1·93–2·56) **Positive**

Table 2. *Continued*

Study	Female educ./occup.	Male educ./occup.	Statistical analysis	Result
Lagarde *et al.* (2001)	Both	Both	MV model[a]	Higher educational level of male OR 3·32, 95% CI (2·11–5·53) Yaounde and female education OR 4·50, 95% CI (1·67–14·00) (Ndola) and Kisumu OR 2·60, 95% CI (1·20–5·67) (Kisumu) **Negative**
Kapiga *et al.* (1994)	Both	Both	MV model[b]	Higher educational level of woman increases risk OR 1·88, 95% CI (1·07–3·29) **Positive**
Kapiga *et al.* (2000)	Occup.	Educ.	MV model[d]	Husband's education is associated with risk: secondary education OR 5·6, 95% CI (1·6–19·5) **Positive**
Kirigia & Muthuri (1999)	Both	No	MV model[e]	Income increases for married women, protective for married women and education increases risk for single women **Mixed**
Lallemant *et al.* (1992)	Occup.	Occup.	Age-adjusted	**No association**
Mbizvo *et al.* (1996)	Both	No	MV model[a]	Unemployed women had greater risk: OR 2·1, 95% CI (1·0–4·3) **Negative**

Table 2. *Continued*

Study	Female educ./occup.	Male educ./occup.	Statistical analysis	Result
Moses *et al.* (1994)	Occup.	No	MV model[f]	**No association**
Msuya *et al.* (2002)	Neither	Educ.	MV model[a]	**No association**
Ryder *et al.* (1990)	Occup.	Occup.	MV model[e]	**No association**
Seeley *et al.* (1994)	Occup.	No	Age-adjusted only	Poorer households at greater risk $p<0{\cdot}05$ **Negative association**
Serwadda *et al.* (1992)	Both	No	MV model[a]	**No association**
Smith *et al.* (1999)	Both	Both	MV model[a]	Higher education of women linked with increased risk OR 1·7, 95% CI (1·1–2·4) **Positive**
Wannan *et al.* (1997)	Both	Both	MV model[f]	Father's occupation and mother's educational level $p<0{\cdot}001$ and $p<0{\cdot}01$ **Positive**

[a]Adjusted for age, STDs (or history of STDs), contraceptive use or number of sexual partners and marital status (at minimum).
[b]Adjusted for age, STDs (or history of STDs), contraceptive use or number of sexual partners (at minimum).
[c]Adjusted for age and STDs (or history of STDs).
[d]Adjusted for age, STDs and marital status (at minimum).
[e]Adjusted for age and contraceptive use/number of sexual partners.
[f]Adjusted for marital status and age (at minimum).

or just female occupation (out of nineteen: Allen *et al.*, 1991; Armstrong, 2000; Chao *et al.*, 1994; Dallabetta *et al.*, 1993; Lagarde *et al.*, 2001; Kapiga *et al.*, 2000; Laliemant *et al.*, 1992; Ryder *et al.*, 1990; Smith *et al.*, 1999; Wannan *et al.*, 1997). Of the ten studies that included a measurement of male SES, three found a positive association based *only* on the partner's SES while three found an independent, positive association based on female's SES (with or without additional association based on the partner's SES: Chao *et al.*, 1994; Smith *et al.*, 1999; Wannan *et al.*, 1997). For the three studies that found independent associations, the associations were based on education (Smith *et al.*, 1999), occupation (Wannan *et al.*, 1997) and education and occupation (Chao *et al.*, 1994). Interestingly, there is some indication that access to increased funds for women may put them at increased risk for HIV infection – potentially by giving them access to more partners or opportunities for travel. Importantly, there also appears to be some evidence of an association between having a higher educational status and increased risk for HIV infection, possibly because educational status is correlated with better jobs, increased access to resources and more mobility or access to partners with mobility. Overall, however, these studies suggest high household income or male's occupational status is the strongest predictor of female HIV serostatus.

In addition to number, some of the strongest associations found were related to husband's level of education or earning power as opposed to woman's access to funds (employment). Potentially this is a more imprecise measure of a woman's SES as it does not necessarily indicate to what extent women have access to independent funds (e.g. OR 5·6, 95%CI 1·6–19·5 for husband's education above secondary: Kapiga *et al.*, 2000). However, these measures of SES give some indication of overall household income. In two (out of ten) of the positive cross-sectional studies, although a woman's employment status or education was significant at the bivariate level, once partner or husband's education or employment was included in a multivariate model, women's education or employment was no longer significant (Allen *et al.*, 1992; Dallabetta *et al.*, 1993). Four out of nine of the cross-sectional studies that found an association between female employment or educational status (high SES) and risk of HIV infection did not include male education or occupation in the multivariate analysis (Ryder *et al.*, 1990; Barongo *et al.*, 1992; Fylkesnes *et al.*, 1997; Kirigia & Muthuri, 1999). This is an important point to take into consideration as these studies may not have found an association (or the reverse association) with a woman's educational or income background if the partner/husband's income or educational status had been included in the model. Similarly, the cohort study by Senkoro *et al.*, which found an association between high SES (female education and employment) and HIV incidence (this is the only cohort study to find an association between high SES and HIV risk), did not include partner's employment or educational status in the model. In contrast, the three cohort studies (out of four) that did not find an association or a negative association included a measurement of male SES or household SES (Bulterys *et al.*, 1994; Kapiga *et al.*, 1998; Mbizvo *et al.*, 2001).

In general, however, the number of studies reviewed ($n=5$) is too small to draw conclusions about the different measurements of SES used and risk of HIV incident infection. However, the results are presented here for comparison purposes with the cross-sectional studies. Only one prospective study used male and female

education and occupational measures (Mbizvo *et al.*, 2001), two used male and female education (Kapiga *et al.*, 1998; Quigley *et al.*, 2000) and one used monthly household income and female education (Bulterys *et al.*, 1994). One study used only female SES measurements (education and employment; Senkoro *et al.*, 2000). In the one positive study, Senkoro *et al.* (2000) compared female factory workers (n=321) with spouses of male factory workers (n=559) using two measures of female SES (female's education and employment status). In univariate and bivariate analyses, they found that female spouses of factory workers had lower HIV incidence than female factory workers (1·5 and 2·7/100 person years for female spouses and female workers respectively) and that educational status increased risk for employed women and the wives of male workers (adjusted HR 4·0, 95%CI 1·4–11·3). These results correspond with the results from some of the cross-sectional studies that indicate that women who hold permanent positions or who ever have had to support themselves are at increased risk (Barongo *et al.*, 1992; Chao *et al.*, 1994; Kapiga *et al.*, 2000).

In some cases, female educational status also may be a stronger predictor of HIV risk than female income or occupation. For two out of eight of the cross-sectional, individual-level positive studies that measured both household income levels or female's employment type and educational level, although a woman's occupational status may have been significant in univariate or bivariate analysis, it falls out once female education is included in the model (Chao *et al.*, 1994; Smith *et al.*, 1999). Of note, a couple of studies found a stronger association between educational status and risk of HIV infection for women in the rural versus urban areas or rural versus main road trading centre/intermediate trading villages, although the association was significant in both (Fylkesnes *et al.*, 1997; Smith *et al.*, 1999). The possible effect modification of location in relation to SES and HIV risk should be evaluated in future studies.

Marital status

Of the studies included in the review, three investigated the relationship between marital status (or having a steady partner), access to independent funds and risk of HIV infection (Ryder *et al.*, 1990; Chao *et al.*, 1994; Kirigia & Muthuri, 1999). The study by Kirigia & Muthuri (1999) found that married women may be at lower risk for HIV if they have access to independent funds but single women do not have lower risk (as a single woman's income increases by one South Africa rand, the probability of asking a new partner to use a condom decreases by 0·002%, but the probability for married women increases by the same amount). In the study by Ryder *et al.* (1990), female workers at two businesses (a bank and textile factory) had a higher prevalence of HIV infection than did wives of male workers (p=0·001; although it is not clear if the wives were employed). Furthermore, married female workers had an HIV seroprevalence rate of 6·5%, which was lower than the 9·4% rate found in unmarried workers (p<0·01). These differences were not significant in a multivariate model controlling for other confounding variables.

Lastly, the study by Chao *et al.* (1994) concluded that legally married women are at increased risk of HIV infection with increased education but for high-risk women

(more than one sexual partner in the last five years), the association between educational level and risk of HIV infection is not significant. In the same study, having a household income greater than 2500 Rwandan francs had a positive association for both groups of women, but was stronger for married women (OR 3·6, 95%CI 2·2–6·0) than for unmarried ones (OR 1·8, 95%CI 1·2–2·7). However, it is not clear if the married women were employed and to what extent this may attenuate risk, although Chao *et al.* concluded that a woman 'having ever had to support herself' has a risk of HIV infection (OR 1·6, 95% CI 1·1–2·3).

Confounder and interactions: STDs, marriage, location and time of study

It has been documented that a number of factors may influence a woman's risk for HIV infection, including number of sexual partners, history of STDs, exchanging sex for money, partner's frequenting of prostitutes and oral contraceptive use (Simonsen *et al.*, 1990; Malamba *et al.*, 1994; Chao *et al.*, 1994; Webb, 1997; Quigley *et al.*, 1997). History of STDs, number of sexual partners and exchanging sex for money are associated with lower SES, and partner's frequenting of prostitutes may be linked with higher household SES or higher partner's SES. Some of the studies reviewed treated these elements as potential confounders and adjusted for them, which would have decreased any positive association found. However, STDs, use of condoms and number of sexual partners are on the causal pathway under investigation for HIV infection and rather than adjust for these variables, it is the opinion of the author that these variables should be measured in relation to the predictor and outcome variables. Twenty-three of the studies (out of 36) controlled for STD (current or past) infection or number of partners or both in the multivariate model (Allen *et al.*, 1991; Barongo *et al.*, 1992; Serwadda *et al.*, 1992; Dallabetta *et al.*, 1993; Bulterys *et al.*, 1994; Chao *et al.*, 1994; Kapiga *et al.*, 1994, 2000, 2002; Quigley *et al.*, 1997; Smith *et al.*, 1999; Auvert *et al.*, 2001b; Mbizvo *et al.*, 2001; Kapiga & Lugalla, 2002; Msuya *et al.*, 2002; Ryder *et al.*, 1990; Gregson *et al.*, 2002; Mati *et al.*, 1995; Armstrong, 2000; Ayisi *et al.*, 2000; Lagarde *et al.*, 2001; Kirigia & Muthuri, 1999; Mbizo *et al.*, 1996).

Twenty of the studies that controlled for STDs/number of partners were cross-sectional; eight found a positive association, three found a negative association and nine found no association. Interestingly, a greater proportion of studies found a positive association even after controlling for STDs/number of partners than in the cross-sectional studies as a whole. One cohort study (Mbizvo *et al.*, 2001) found a protective effect for high SES after adjusting for history of STDs and sexual relations with other partners. None of the studies analysed potential interaction between SES status, STDs/number of sexual partners, other risky behaviours and HIV serostatus. Another study controlled for history of commercial sex work as a confounder, finding an association between HIV risk and high SES (Chao *et al.*, 1994). Women may be more or less likely to use condoms with partners in sex work, and low SES potentially also pushes women into commercial sex work (Chao *et al.*, 1994).

Male sexual practices associated with high SES (as defined by household or partner's employment or education) include husband/partner's visiting of sex workers or husband's number of partners. Five studies adjusted for these variables as

confounders (Allen *et al.*, 1991; Dallabetta *et al.*, 1993; Bulterys *et al.*, 1994; Kapiga *et al.*, 1994; Musya *et al.*, 2002). Out of these five studies, three found an association with high SES. Again, as with the above analysis of STD history in women, it is argued here that sexual practices such as visiting a commercial sex worker or other markers of sexual activity such as STDs should not be adjusted for as confounders but rather are on the causal pathway under investigation. The interaction between these variables, SES and risk for HIV could be examined in future studies. Furthermore, living in an urban area has been linked to increased risk for HIV and other studies have found location to be strongly linked to risk of HIV infection in women (particularly those areas that are located next to a major road, trading centre or intersection: Obbo, 1993). Only five of the studies reviewed have adjusted for these confounders by stratifying or controlling for locations near trading centres or main roads (Barongo *et al.*, 1992; Bulterys *et al.*, 1994; Mnyika *et al.*, 1994; Fylkesnes *et al.*, 1997; Smith *et al.*, 1999). Other studies controlled for location (urban versus rural) or community where the research was conducted. In multivariate models, location near main roads can be one of the strongest associations for HIV infection (Petry & Kingu, 1996; Serwadda *et al.*, 1992; Gregson & Garnett, 2000; Wilkinson *et al.*, 2000). In the study by Serwadda *et al.*, 1992, living near a trading centre or main road has an adjusted odds ratio of 7·2 (95% CI 3·3–16·0) for HIV infection. Cross-sectional studies could have overestimated or underestimated the effect due to confounding from residence next to a trading centere or main road if residence was not adjusted for in analysis.

Lastly, other studies have suggested that marital status is protective for women due to the economic security it provides; others have argued that marriage is a good proxy for sexual behaviour and married women are at increased risk due to the sexual activity of their partners/husbands. Twenty studies reviewed adjusted for marital status as a confounder (Melbye *et al.*, 1986; Allen *et al.*, 1991; Barongo *et al.*, 1992; Bulterys *et al.*, 1994; Chao *et al.*, 1994; Kapiga *et al.*, 1994, 2000; Fylkesnes *et al.*, 1997; Quigley *et al.*, 1997; Smith *et al.*, 1999; Kirigia & Muthuri, 1999; Kapiga & Lugalla, 2002; Lagarde *et al.*, 2001; Mati *et al.*, 1995; Hunter *et al.*, 1994; Msuya *et al.*, 2002; Serwadda *et al.*, 1992; Smith *et al.*, 1999; Wannan *et al.*, 1997; Gregson *et al.*, 1976). As discussed above, few studies were careful to differentiate the effect that SES has on single versus married women. Only three cross-sectional studies looked specifically at the difference in the relationship between SES and risk of HIV infection in married versus single women through stratified analysis of SES on risk for married and unmarried women (Kirigia & Muthuri, 1990; Ryder *et al.*, 1990; Chao *et al.*, 1994). It is likely that SES levels will have a differential effect on risk for married versus single women or a differential effect based on number of sexual partners. One study suggests that SES will have an inverse effect on risk for married and single women (Kirigia & Muthuri, 1990), which should be investigated in future studies.

Other researchers have suggested that in the early years of the epidemic, high SES individuals were disproportionately affected in sub-Saharan Africa, but that as the epidemic has progressed, it has moved into poorer communities (Whiteside & Sunter, 2000). The different results observed between studies reviewed might be a function of the stage of the epidemic in that country (e.g. early epidemic and higher SES individuals affected in contrast with a later epidemic). In order to assess the potential

confounding effect of the stage of the epidemic or time and geographic region, the studies have been stratified by geographic region and time period and then again by rural/urban location within geographic region and time period (see Tables 3 and 4). Looking at the studies along these lines, no patterns emerge with respect to time period. However, it appears that geographic location may significantly affect the relationship between risk of HIV and socioeconomic status with increased risk of finding a negative association in Southern Africa and an increased risk of having no association or a positive association in East–Central Africa.

In a review of demographic, socioeconomic, biomedical and behavioural risk factors for HIV infection in South Africa, Johnson & Budlender (2002) note that increases in income may first increase risk, then have a plateau effect and eventually decrease risk. They note: 'Individuals who have some income are often at a greater level of risk than individuals without any income (particularly in the case of men), but at higher income levels individuals are likely to find it easier to avoid infection, and are more likely to be in a stable relationship'. As most of the studies reviewed in this critical review were conducted in low GDP countries with disseminated poverty comparing low or no-income individuals with higher income individuals (but still low income), it is possible that many of the positive associations can be explained as the studies were conducted in this very low-income range. However, Southern Africa has a greater number of people in the higher income earner category and greater income inequalities, explaining the greater likelihood of seeing a negative association in Southern Africa, particularly urban South Africa, Botswana, Namibia and Zimbabwe. Of note, two out of three of the studies that found an association between high SES and HIV risk in Southern Africa were from poorer Southern African countries including Malawi (Dallabetta *et al.*, 1993) and Zambia (Fylkesnes *et al.*, 1997) (Table 4). The GNP *per capita* for these countries were: $1120 (Botswana), $3020 (South Africa), $2030 (Namibia) and $460 (Zimbabwe). By contrast, East and Central Africa countries have lower GNPs *per capita*: $300 (Uganda), $350 (Kenya), $270 (Tanzania), Burundi ($110), Rwanda ($230) (World Bank, 2002). South Africa, Zimbabwe and Zambia also have high levels of income inequality, as indicated by the highest Gini coefficients in sub-Saharan Africa (ranging from 59·3 for South Africa to 56·8 for Zimbabwe to 49·8 for Zambia; Jenkins & Thomas, 2000). Lastly, South Africa, Namibia, Swaziland and Botswana are the highest-ranking sub-Saharan African countries (other than Cape Verde and Mauritius) using UNDP's Human Development Index 2002 (UNDP, 2002).

Other sociocultural practices that potentially put women at risk for, or that are protective against HIV may also be associated with a certain socioeconomic status such as dry sex (Sandala *et al.*, 1995), circumcision status, widow inheritance and sexual cleansing (Malungo, 2001). It is not clear if some of these practices are performed more frequently by some ethnic groups, in certain areas, or if there is any association between specific practices and SES groups. The interaction between ethnic groups, sociocultural practices, SES and HIV risk needs to be explored. Only two cross-sectional studies controlled for partner's circumcision status (Serwadda *et al.*, 1992; Chao *et al.*, 1996) and none explored the relationship between circumcision, SES and HIV risk. None of the studies reviewed examined these other variables.

Table 3. Urban/rural location and time of study (chronological): East–Central Africa

Study	Location and time	Result
	Urban	
Lallemant *et al.* (1992)	Brazzaville, Congo May 1987 to May 1988	**No association**
Ryder *et al.* (1990)	Kinshasa, Zaire 1987–88	**No association.**
Allen *et al.* (1991)	Kigali, Rwanda March–August 1988	**Positive** OR 1·96 (1·5–2·56)
Hunter *et al.* (1994)	Nairobi, Kenya October 1989–May 1991	**No association**
Mati *et al.* (1995)	Nairobi, Kenya October 1989–May 1991	**No association**
Chao *et al.* (1994)	Butare, Rwanda October 1989–December 1991	**Positive** OR 2·5 (1·9–3·1): monthly income OR 1·5 (1·0–2·1): has to support herself
Barongo *et al.* (1992)	Mwanza, Tanzania 1990–91	**Positive** OR 2·0 (1·2–3·4) for women in business
Serwadda *et al.* (1992)	Uganda (rural Rakai) 1989	**No association**
Smith *et al.* (1999)	Uganda (rural) 1999	**Positive** Primary education (female) OR 1·7 (1·1–2·4)
Moses *et al.* (1994)	Kenya (Nairobi) April 1991–January 1992	**No association.**
Kapiga *et al.* (1994)	Dar es Salaam, Tanzania February 1991–June 1992	**Positive** OR 1·88 (1·07–3·29): some education increases risk for women
Bulterys *et al.* (1994)	Butare, Rwanda October 1991–93	**No association**
Kapiga *et al.* (1998)	Dar es Salaam, Tanzania October 1992–August 1995	**No association**
Kapiga *et al.* (2000)	Dar es Salaam, Tanzania March–September 1995	**Positive** OR 5·6 (1·6–19·5): husband's education associated with risk
Ayisi *et al.* (2000)	Kisumu, Kenya June 1996–November 1997	**No association**
Msuya *et al.* (2002)	Moshi, Tanzania 1999	**No association**
Kapiga *et al.* (2002)	Moshi, Tanzania June–October 2000	**No association**

Table 3. *Continued*

Study	Location and time	Result
	Rural	
Quigley *et al.* (1997)	Tanzania (rural SW) 1991–92	**Positive** OR 2·2 (1·22–3·95) male employment status
Senkoro *et al.* (2000)	Tanzania (rural) 1991–94	**Positive** HR 4·0 (1·4–11·3) higher education
Quigley *et al.* (2000)	Uganda (rural) 1990–97	**No association**
Seeley *et al.* (1994)	SW Uganda (rural) (not stated)	**Negative** Poorer households, $p<0·05$
	Mixed	
Kapiga & Lugalla (2002)	Tanzania (urban and rural) 1996	**Negative** OR 0·3 (0·2–0·5): education of women
Wannan *et al.* (1997)	Zaire (3 clinics urban and rural) November 1990–February 1991	**Positive** Father's occupation ($p<0·001$) and mother's educational level ($p<0·01$)

Sexually transmitted diseases and SES

Interestingly, studies that have looked at the relationship between the risk of getting an STD and sociodemographic variables also do not necessarily find a correlation between the risk of disease and low or high SES in sub-Saharan Africa. Although it was not the explicit aim of this study to review all existing material on risk for STDs in African women, some recent studies elucidate the complexity of the relationship. Additionally, the relationship between SES and risk of STD may be different for men and women and could differ depending on the type of STD under study (Newell *et al.*, 1993; Dallabetta *et al.*, 1993 Gertig *et al.*, 1997).

Access to resources could potentially increase the treatment of STDs, resulting in a protective association between high SES and HIV risk as many symptomatic STDs (including *Trichomonaisis vaginalis*, HSV-2 and genital ulcer disease (GUD)) act as co-factors increasing risk for HIV infection (Auvert *et al.*, 2001a; O'Farrell, 2001; Sorvillo *et al.*, 2001). However, there does not appear to be a unilateral relationship between risk for STDs and SES in women in Central, Eastern and Southern Africa.

Conclusions and future directions for public health research

Given the high numbers of women infected by HIV in sub-Saharan Africa, it is important to understand the sociocultural and socioeconomic risk factors that make

Table 4. Urban/rural location and time of study (chronological): Southern Africa

Study	Location and time	Result
	Urban	
Dallabetta *et al.* (1993)	Urban Malawi October 1989–October 1990	**Positive** OR 2·23 (1·93–2·56) (partner's education)
Mbizvo *et al.* (1996)	Harare, Zimbabwe 1994–95	**Negative** Unemployment OR 2·1 (1·0–4·3)
Mbizvo *et al.* (2001)	Harare, Zimbabwe 1994–95	**Negative** OR 2·8 (1·1–11·0) absence of partner's education
Auvert *et al.* (2001a)	South Africa (Carletonville) August 1999	**Negative** (ecological) OR 1·6 (1·1-2·3) living in a squatter settlement
	Rural	
Gregson *et al.* (1995)	Zimbabwe (rural) 1993–94	**No association**
Gregson *et al.* (2002)	Zimbabwe (rural) July 1998–Jan 2000	**Negative** OR 0·7 (0·6–0·9) women with secondary education
Gregson *et al.* (1996)	Zimbabwe (rural) 1994–5	**No association**
	Mixed	
Fylkesnes *et al.* (1997)	Zambia (rural & urban) August–November 1994	**Positive** OR 2·46 (1·89–3·20) more than 10 years of school (female)
Kirigia & Muthuri (1999)	South Africa (urban & rural) 1994	**Mixed** Income increases risk for married women but is protective for single women
Fylkesnes *et al.* (2001)	Zambia (rural & urban) Two times (1995–6; 1998–9)	**Negative** OR 3·3 (1·46–7·46) women out of school had increased risk
Armstrong (2000)	Zimbabwe 1998–99	**Positive** Increased risk for women living in high SES areas (p=0·006) and in areas with high knowledge of condoms and STDs (p<0·0001)
	Multi-site studies	
Auvert *et al.* (2001b)	Benin (Cotonou), Cameroon (Yaounde), Zambia (Ndola), Uganda (Kisumu) 1997–98	**No association**

Table 4. *Continued*

Study	Location and time	Result
	Multi-site studies	
Lagarde *et al.* (2001)	Benin (Cotonou), Cameroon (Yaounde), Zambia (Ndola), Uganda (Kisumu) 1997–98	**Negative** Higher educational levels are associated with more condom use Kisumu OR 2·60 (1·20–5·67) Ndola OR 4·50 (1·67–14·00) Yaounde OR 3·32 (2·11–5·53)

women particularly vulnerable (Glynn *et al.*, 2000; Killewo *et al.*, 1993; Santos Ferreira *et al.*, 1990). To a large extent, in the public health literature, there is a general consensus that poorer women may be at increased risk for HIV infection and this has important ramifications for how public health workers are trained and how interventions and prevention messages are structured.

In designing future research agendas, it is important to clarify the effect modification that access to independent funds, household funds and educational status in relation to marriage (or number of partners) will have on a woman's HIV risk. Only a few studies reviewed in this paper assess these relationships and the results are inconclusive; however, the preliminary results from the studies reviewed indicate that the effect on access to independent funds may differentially affect married versus single/unmarried women. Furthermore, other variables such as STDs and specific sociocultural practices including circumcision should be examined in relationship to SES and HIV risk and not simply adjusted for as confounders.

In order for public health professionals to generate adequate information about the progression of the HIV pandemic in sub-Saharan Africa, it is important to understand why certain groups may be at particular risk for HIV infection. Although African women are clearly disadvantaged economically in many contexts, increasing women's access to employment and public health interventions that focus on micro-credit programmes may not have direct impacts on reducing the risks of HIV infection among women. Rather, as some of the studies reviewed in this paper indicate, increasing a woman's access to funds or education in the short term may increase risk, particularly in certain parts of sub-Saharan Africa (e.g. Kirigia & Muthuri, 1999; Ryder *et al.*, 2000). Intervention scientists and policymakers need to take into consideration numerous measures of SES in relation to HIV risk (e.g. at the individual, household or neighbourhood level) as well as levels of inequality within the country or region. Additionally, as this review has pointed out, some of the strongest predictors of women's HIV serostatus include partner's SES. Micro-credit programmes need to take cognizance of the fact that some studies suggest that male SES is the strongest independent predictor of female serostatus after controlling for female education and employment level.

Other studies have indicated that access to economic resources may actually increase the risk of violence that African women face and empowerment through micro-credit programmes or educational programmes could potentially place women at increased risk. The argument is that increasing access to resources facilitates role changes and the empowerment of women, which could potentially engender conflict between men and women (S. Y. P. Cho, unpublished). Reporting the results of ethnographic research on micro-credit programmes in Bangladesh, Schuler *et al.* (1998) note that 'providing women with access to resources – loans – can in some cases reduce and in others cases exacerbate men's tendency to use violence against their wives' (p. 153). In a study of predictors of rape in the Central African Republic, women in other professions outside of agriculture were at increased risk of rape ($p = 0{\cdot}0002$; Chapko *et al.*, 1999). Nonetheless, these programmes may be the first step in challenging broader, structural factors that disempower women, such as cultural norms, which could have longer-term, broader effects. As Laver *et al.* (1997) demonstrate in a study of farm workers in Zimbabwe, women with no education have lower levels of self-efficacy in regard to their sexual choices and HIV/AIDS. In the short term, however, providing women with access to resources may not address the fundamental inequalities between the North and South that has resulted in a much higher seroprevalence of HIV/AIDS in generally impoverished countries. Brooke Schoepf (1993 p. 93) argues the following: 'Unless the underlying struggles of millions to survive in the midst of poverty, powerlessness and hopelessness are addressed, and the meanings of HIV/AIDS understood in the context of gender relations, HIV will continue to spread'. Based on the results of this review, it is not certain that micro-credit programmes address the poverty and powerlessness that women face in the developing world as described by Schoepf in such a way so as to stop the spread of HIV. Measurements of poverty should be taken at the individual, household and community/neighbourhood levels with the understanding that increases in resources at the individual level versus the neighbourhood or community levels may have different outcomes.

In designing future research, it is important to have more, well-designed prospective cohort studies that can clearly characterize the incident rates of HIV infection in women while carefully demonstrating to what extent female and male employment, access to funds and education affect women's risk of HIV infection. Although Paul Farmer's (1999) work brilliantly illustrates the situation that a majority of poor, uneducated and disempowered women face in sub-Saharan Africa and other parts of the developing world, in areas where widespread poverty exists and the majority of the population lives below the poverty line, marginally increasing select women's access to funds may have the unintended result of increasing risk. Recent work on the epidemiology of HIV/AIDS in sub-Saharan Africa suggests that the received wisdom about the role of heterosexual transmission in sub-Saharan African populations should be re-examined, given the increasing number of anomalies that challenge this paradigm (Brewer *et al.*, 2003). Although it is argued here the association found between high SES and HIV/AIDS risk in some studies may be a function of how SES was measured and performs in different contexts, the fact that HIV infection continues to be associated with high SES in the sub-Saharan African context may also suggest disparities between the epidemiology of HIV infection in sub-Saharan Africa and other areas of the industrialized world, which requires further study.

Researchers working on issues related to SES suggest that SES should be measured at the individual and community level (Krieger *et al.*, 1997; Johnson & Budlender, 2002). Only two studies reviewed here looked at how ecological level factors could influence risk in contrast with numerous ($n=34$), individual-level studies. Future studies should examine SES at the individual and ecological level, as few studies have been conducted on how SES at the ecological level affects risk-taking behaviour. Interventions that are directed at improving resources and well-being at the community level (e.g. access to safe water supplies, waste disposal systems) need to be investigated in terms of how they affect risk at the individual level. Lastly, SES measures may perform differently in relation to health outcomes in areas that have widespread poverty as opposed to areas with extreme income inequalities.

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