Educational attainment and HIV-1 infection in developing countries: a systematic review

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Summary

Objectives: To assess whether educational status is associated with HIV-1 infection in developing countries by conducting a systematic review of published literature.

Methods: Articles were identified through electronic databases and hand searching key journals. Studies containing appropriately analysed individual level data on the association between educational attainment and HIV-1 status in general population groups were included.

Results: 27 articles with appropriately analysed results from general population groups in developing countries were identified, providing information on only six countries. Large studies in four areas in Africa showed an increased risk of HIV-1 infection among the more educated, whilst among 21-year old Thai army conscripts, greater duration of schooling was strongly protective against HIV infection. The association between education and schooling in Africa was stronger in rural areas and in older cohorts, but was similar in men and women. Serial prevalence studies showed little change in the association between schooling and HIV over time in Tanzania, but greater decreases in HIV prevalence among the more educated in Uganda, Zambia and Thailand.

Conclusions: In Africa, higher educational attainment is associated with a greater risk of HIV infection. However, the pattern of new HIV infections may be changing towards a greater burden among less educated groups. In Thailand those with more schooling remain at lower risk of HIV infection

Key words: HIV, education, schooling, risk factors, Africa, Thailand

Introduction

In the absence of a vaccine and widely available treatment, the primary focus for HIV control programmes must be on reducing transmission. While treatment of other sexually transmitted diseases has some effect (Grosskurth et al., 1995), the main method of reducing heterosexual transmission is by behaviour change.

Both behaviour and behaviour change are likely to be linked to educational level. Attendance at school may directly affect access to health services and exposure to health interventions (Kilian et al., 1999), as well as the type and scope of contact with others. In the longer term, increased educational attainment may improve the ability to understand and act on health promotion messages (Fylkesnes et al., 1997). However, the socioeconomic and lifestyle changes that accompany increased schooling may be associated with behaviours that increase the risk of HIV infection (UNAIDS, 1998). It has been postulated that early in the epidemic HIV risk is linked to higher socio-economic status and travel, but that this pattern may dissolve as the epidemic spreads in a given population (Over and Piot, 1993). Increasing education could therefore be associated with either an increase or a decrease in the risk of HIV infection depending on the balance of the different influences on behaviour. Any association between general education level and HIV status would have important consequences for health professionals, health policy makers and those wishing to model the economic impact of the HIV pandemic (Over et al., 1989). We conducted a systematic review of the published literature on the relationship between educational attainment and HIV-1 in developing countries.

Materials and Methods

We identified relevant peer reviewed articles using three methods. Conference abstracts were not included. First, we searched the major biomedical databases, EMBASE and PubMed (Medline) up to May 2001. The search strategy employed three independent search terms linked by "AND" statements. The exact terms depended on the database. These terms were (1) an indexed, fully exploded geographic term, encompassing Africa, Asia, South America, the Caribbean and Central America; (2) an indexed, fully exploded term covering HIV seroprevalence or HIV prevalence or HIV epidemiology or HIV prevention; and (3) a final term that was either an indexed term, covering risk factors or socioeconomic factors, or an unindexed term with wildcards including "litera*", "school*" and "educat*". There were no restrictions on language of publication. Second, the three main, subject-specific peer reviewed journals (*AIDS, International Journal of STD and AIDS*, *Journal of AIDS / Journal of AIDS and Human Retroviruses*) were searched in full by hand (all issues, all volumes and supplements) to identify articles of interest. Third, among articles identified for review by the above methods we checked reference lists to identify any further relevant references.

We identified articles containing data or text comparing individually-measured educational attainment or literacy and HIV status in population groups broadly representative of the general population. Studies referring to high risk groups and other unrepresentative sections of the population were excluded, eliminating studies on commercial sex workers, sexually transmitted disease clinic attenders, AIDS and other hospitalised patients, drug users, tuberculosis patients, truck drivers, family planning

clinic attenders, men who have sex with men, prisoners, discordant couples, refugees, husbands of women in a health study and blood donors. We used standardised forms to collect data from selected articles on the population under study, dates of data collection, levels of education compared, laboratory methods used to define HIV status, HIV type, statistical methods applied, and the crude and adjusted results of the analyses comparing education level and HIV status.

Despite the large number of studies including information on schooling and HIV, this association itself has rarely been the focus of analysis, so the results presented frequently do not allow thorough assessment of the role of education. Both the risk of HIV infection and the likely level of schooling reached vary substantially by socio-demographic factors, particularly age, sex and setting. Appropriate statistical analysis must control for such factors. However, any effect of general education on risk of HIV infection is likely to be exerted through its effect on other risk factors, such as sexual behaviour. Statistical analysis should take account of the hierarchical nature of this association (Victora et al., 1997). Specifically, multivariate analyses should not adjust for sexual behaviour as the results may obscure a true effect of education. Ideally measurement of the effect of education distinct from other measures of socio-economic status would be desirable. However the high degree of correlation between education and these factors makes results difficult to interpret. In practice, many studies adjusted simultaneously for all measured risk factors for HIV, and only presented results for those that achieved statistical significance in the final model. The appropriately adjusted effect of schooling was therefore not always clear from the published results.

Only articles that presented appropriately analysed information on the association of schooling and HIV were reviewed in full. Appropriately analysed articles either included statistical adjustment at least for age and sex, or presented analyses restricted by age and sex. Inappropriately analysed articles were those containing univariate analysis alone (without sex and age restriction) or multivariate analysis that adjusted for factors, including sexual behaviour, that are likely to mediate any true effect of education ("overadjustment").

We hypothesized that the association between schooling and HIV status may differ, and may be differently mediated, in different contexts. We wished to examine differences in the relationship observed between different geographical and cultural regions, between the two sexes and between populations from different types of community (urban or rural). In order to assess whether the relationship has changed over time we compared data from the same region at different time periods. Incidence studies provide data on associations with newly acquired infections. In the absence of incidence data, results among different age groups are useful, as infections among the youngest groups are likely to have been acquired recently. Given the variability between studies in measures of schooling level used, and the expected heterogeneity in the results by setting, stage of the epidemic, age and sex, no formal meta-analysis has been conducted.

Results

Over 2000 articles were identified through database searching. Approximately half of these were rejected on the basis of the title and abstract alone, while around 900 were

selected to be reviewed in full. Only 39 (4.3%) of these articles were not located. This search strategy combined with full text searches of relevant journals identified a total of 66 articles that satisfied the primary selection criteria of cross tabulation of individual HIV status with educational attainment among a general population group. No further articles were identified in reference lists. Studies with fewer than 300 individuals (11), relating to HIV-2 infection (2) and those without a specific measure of schooling (4) were then excluded, leaving 49 articles.

Of the 49 articles, 14 (12 from Africa, 2 from Thailand) presented univariate analyses only. Of these, three (all from Africa) reported a statistically significant increased risk of HIV among the more educated, one (from Thailand) reported the opposite association and ten reported no association. A further eight articles (7 from Africa, 1 from Haiti) reported univariate analyses and the results of overadjusted multivariate analyses. Of these, in univariate analyses, four African studies reported a statistically significant increased risk of HIV with increasing educational status, one African study and the Haitian study reported the opposite association, and two reported no association. None of the studies showed a significant association between education and HIV status in the overadjusted multivariate analyses. Finally, 27 articles with appropriate analysis were left for review, of which three reported cohort studies in which HIV incidence was measured. Five articles examined data from a population that had been analysed more fully in another selected paper. Some of the retained articles reported data on populations that overlapped (Tables 1 and 2).

There were no data from studies fulfilling the selection criteria from countries outside Africa, except Thailand, and within Africa information was only available from studies

conducted in five countries. In Africa, the selected studies were conducted among general population samples, women attending antenatal clinics, factory workers and residents of a sugar estate. In Thailand, appropriate data have been collected from 21-year old male conscripts who are selected by national lottery and inducted into the army twice a year (Sirisopana et al., 1996).

All but two of the studies used ELISA for primary detection of HIV antibodies. Positive and/or indeterminate results were confirmed with Western blot techniques or further tests in all but two of these studies. Studies in Zambia used the Capillus Rapid Test for detection of HIV, and performed quality control analysis (Fylkesnes et al., 1997; Fylkesnes et al., 2001). Educational attainment was measured either by level achieved (for example, primary or secondary) or years of schooling. Most studies identified at least three levels of education and were able to assess whether a trend existed. Studies conducted among women attending antenatal clinics used unlinked anonymous HIV testing, and did not seek consent to perform the test. Response rates were high in these studies. Studies conducted amongst army recruits in Thailand also reported very high response rates (>95%). Among general population studies the overall response rate was usually high, though with some exceptions (Table 1). Of the two cohort studies conducted among army recruits, one did not report a follow up rate, whilst the rate of follow up was low (40%) in the other. In the cohort study in Tanzania 63% of the study population were still enrolled at the end of the study, or had died (Senkoro et al., 2001).

Among the African studies, only one, among sugar estate residents in Ethiopia (Fontanet et al., 2000), reported a protective effect of increased general schooling on

HIV infection in any time period. Large-scale studies in four areas found a significantly increased risk of HIV among those with more schooling. This was seen in both men and women from Rakai, Uganda in 1990 and 1992 (Smith et al., 1999; Kirunga and Ntozi, 1997), and from Mwanza, Tanzania in 1991-96 (Grosskurth et al., 1995; Quigley et al., 1997; Senkoro et al., 2001), and in women attending antenatal clinics in Fort Portal, Uganda in 1991-4 (Kilian et al., 1999) and in Zambia in 1994 and 1998 (Fylkesnes et al., 2001; Fylkesnes et al., 1998). Other studies found no association of schooling with HIV status in appropriately adjusted analysis (Table 1).

Conversely, very large studies conducted among 21-year old Thai army conscripts from 1991-1995 found a consistently statistically significant protective effect of increasing duration of education on HIV risk (Mason et al., 1998; Mason et al., 1995; Sirisopana et al., 1996; Nelson et al., 1993; Theetranont et al., 1994; Carr et al., 1994). Only one HIV prevalence study and one incidence study, both conducted in Northern Thailand where HIV prevalence is highest, found no such effect (Nopkesorn et al., 1993; Dobbins et al., 1999; Celentano et al., 1996).

In Africa, four population surveys and a factory cohort study collected data from both men and women and analysed them separately (Senkoro et al., 2001; Barongo et al., 1992; Smith et al., 1999; Grosskurth et al., 1995, Fylkesnes et al, 2001). There was little evidence of any difference in the relationship between education and HIV status between men and women in any of the surveys (Table 3). However, in the Tanzanian cohort the increase in HIV risk with education was seen only among the women (Senkoro et al., 2001).

Three African studies investigated the relationship between schooling and HIV status in both rural and urban communities and provided appropriately adjusted data that could be compared directly (Table 3) (Kwesigabo et al., 1998; Fylkesnes et al., 1997; Fylkesnes et al., 2001). In Kagera, Tanzania, and in Zambia in 1994 there was an increased risk of HIV infection among the more educated, and in both studies the odds ratio for the association of HIV with educational status was higher in the rural areas than in the urban areas (Table 3). In Zambia in 1999, among young adults the risk of HIV decreased with increased schooling in the urban area, but not in the rural area, though the difference was not significant (Fylkesnes et al., 2001). Two other studies included in the final analysis provided some further information on this question. In Rakai, Uganda, in 1990, the pattern of increased HIV risk among those with more schooling was significant in both unadjusted and overadjusted analyses among rural village populations, but not in main road trading centres or other trading villages (Smith et al., 1999). In Mwanza, Tanzania in 1991-92, univariate analysis suggested no relationship between education status and HIV infection in urban centres for either males or females, whilst a significantly increased risk of HIV among the more educated was seen for both men and women from roadside villages and for men from rural villages (Barongo et al., 1992). In all these studies, individuals from urban areas had received higher average levels of education than their rural counterparts.

Serial cross-sectional studies were available from several areas (Table 3). In Kagera, Tanzania, no relationship between schooling and HIV status was seen in urban areas in either 1987 or 1993. However, in rural areas there was a non-significant increase in HIV risk among the most educated in both 1987 and 1996, though the association was weaker in the later study (Kwesigabo et al., 1998). Among women attending antenatal

clinics in Fort Portal, Uganda, there was a significantly increased risk of HIV infection associated with secondary education compared to those with no formal education in 1991-94, but no such relationship in 1995-97, although confidence intervals for the odds ratios presented for the two periods overlap (Kilian et al., 1999). Similarly, in Zambia the increased risk of HIV associated with education for more than 7 years seen in antenatal clinic attenders in 1994 was lost by 1998 (Fylkesnes et al., 1997; Fylkesnes et al., 2001) (Table 3). In Rakai, Uganda, HIV infection was associated with increased schooling in 1990 and 1992 in both adjusted and unadjusted analyses (Smith et al., 1999; Kirunga and Ntozi, 1997), but no such association was seen among men in 1994 in unadjusted analysis (no adjusted analysis or data for women were presented) (Kelly et al., 1999). In Malawi, unadjusted analyses of data from women attending antenatal clinics showed that the higher risk among the more educated persisted from 1990-1995 (Taha et al., 1998, data not shown). In Thailand the protective effect of increased educational attainment increased slightly between 1992 and 1995 among 21-year old male conscripts (Mason et al., 1998; Mason et al., 1995).

Four African studies provided data allowing comparison of the relationship between educational attainment and risk of HIV among different age groups (data not shown). In Rakai, Uganda, in 1990, primary and secondary educated individuals of both sexes were at increased risk of HIV infection compared to those with no schooling in all age groups (13-19, 20-29, 30-44, ≥45) (Smith et al., 1999). Increased schooling was associated with increased HIV risk among women aged 25-49 attending antenatal clinics in Fort Portal, Uganda, in 1991-94, but not among those aged 15-24 years. The same pattern was seen in 1995-97, with the greatest decreases in HIV prevalence having occurred among the most educated groups (Kilian et al., 1999). Among women

attending antenatal clinics in both urban and rural areas of Zambia in 1994 there was little relationship between years of schooling and risk of infection with HIV in the youngest age group (15-19), whilst in older age groups (20-24, 25-29, 30-44) HIV infection was more common among those with more years of schooling (Fylkesnes et al., 1997). By 1998 no association between years of schooling and HIV was seen in 20-24 year olds in urban areas (Fylkesnes et al., 2001).

Discussion

Most of the currently available data, predominantly collected before 1996, suggest that increased schooling was either not associated with HIV infection or was associated with an increased risk of HIV infection among men and women from both rural and urban communities in Africa. The association was stronger in rural areas and in older cohorts, but was similar in men and women. Conversely, increased duration of schooling was strongly protective against HIV infection among 21-year old men in Thailand.

There was a lack of data from much of Asia and from Latin America. We systematically searched the main biomedical databases, and hand searched three subject specific journals, attempting to minimise bias in article identification. Nevertheless, language and publication biases have previously been described in systematic reviews (Dickersin, 1990; Egger et al., 1997), and data may exist that have not been identified in our search.

For most of the identified studies examination of the association of schooling and HIV status was not the primary aim, so appropriate analyses for this purpose were often not presented. Crude, unadjusted analyses can give misleading results. Schooling level and HIV status both vary by age, sex and area as well as over time. Adjustment (or restriction) at least for age, sex and setting (urban or rural) is required. From published studies it was not possible to determine whether other potential confounders such as ethnic group, religion or marital status are also important in some populations. "Overadjusted" analyses, including behavioural factors, may have masked some true associations. Six overadjusted analyses on data from Africa and Haiti removed an apparent effect of education on risk of HIV infection seen in univariate analysis.

We restricted the review to studies carried out in the general population or in population groups that are likely to be representative of the general population. In the general population studies the main source of bias is low response rate. Individuals may fail to be included because they are not at home or because they refuse. Since these individuals may differ from others both in their educational status and (independently) in their risk for HIV, the estimates of the association of schooling level and HIV status could be biased. The studies in conscripts in Thailand under-represent men of higher educational status since most secondary schools offer a military course which precludes entering the conscription lottery (Sirisopana et al., 1996), but this should not bias the estimate of the association of schooling level with HIV status among those included. Antenatal clinic data are more likely to be biased. Not all pregnant women attend antenatal clinics (though in Africa attendance rates are usually high) and fertility and attendance rates may both vary with educational level.

Furthermore, HIV infection reduces fertility, directly and indirectly, so HIV-infected women will be under-represented in the antenatal clinics (Zaba and Gregson, 1998).

Further possible biases arise when considering the different associations between schooling and HIV status in different age groups. In the youngest group many may still be in school so the level of education reported may not fully reflect the final level to be obtained. Three of the four studies in which we could assess the association in different age groups presented data from antenatal clinics. All three of these studies found no association in the youngest age group but increased risk of HIV with increasing schooling in the older groups. However, the different biases in antenatal clinic data at different ages make them hard to interpret. Among young women HIV prevalence in antenatal clinics is higher than that in the population since not all women are sexually active (Fylkesnes et al., 1998). Since pregnancy at a young age may preclude higher education, those with more education may not be seen in antenatal clinics. Among older women attending antenatal clinics, HIV prevalence is lower than that in the population because of the association between HIV and decreased fertility (Zaba and Gregson, 1998).

Despite these problems, it seems that in African studies up to the mid 1990s increased schooling was associated with increased risk of HIV. This review was restricted to assessment of the association of general schooling with HIV infection, not the role of health education programmes. It cannot be assumed that those with more schooling have received more HIV-related health education at school since the extent of integration of sex education into the school curriculum is insufficient in most African countries (Mann and Tarantola, 1996).

Level of educational attainment is highly correlated with socio-economic status and has been used in many studies as a marker for socio-economic status . Risk of HIV infection may be associated with both education and socio-economic status through a number of pathways. From the published studies it was not possible to separate these effects. Education has been associated with later sexual debut and marriage (Grunseit, 1997), and may facilitate changes in behaviour in response to health promotion (Fylkesnes et al., 1997) including condom use (Lagarde et al., 2001). Women of lower socio-economic status may be more likely to enter into commercial sex work. However, those of higher socio-economic status, particularly men, may also have greater disposable income, increased leisure time, increased ability to travel and increased opportunity to use commercial sex workers (Quigley et al., 1997; Berkley et al., 1989; Dallabetta et al., 1993). It appears that the socio-economic and life-style factors that accompany education and increase the risk of exposure to HIV have not been counterbalanced by changes in behaviour that would decrease HIV risk.

The association between higher socio-economic status and risk of exposure to HIV may apply particularly to men, yet little difference was seen in the relationship between educational status and HIV risk in men and women. Marriage predominantly occurs between men and women of similar socio-economic circumstances and consequently women from higher socio-economic groups may be at increased risk through their husband's behaviour. An increase in a woman's risk of HIV has been associated with her husband's educational status (Dallabetta et al., 1993; Allen et al., 1991). The increased risk of HIV associated with increased education is more pronounced in rural

areas. Highly educated individuals from rural areas are likely to have received their higher education in urban areas, where the prevalence of HIV infection is higher than in rural areas. In Zambia, the most educated women from rural areas had the same prevalence of HIV infection as those with equivalent schooling from urban areas, despite large urban-rural differences in HIV prevalence for those with lower levels of education (Fylkesnes et al., 1997).

The long latent period of HIV infection and HIV-associated mortality may hide different patterns among those recently infected. It might be expected that health education messages would have their first impact among the most educated, and even in populations in which those with higher socioeconomic status and education levels are at particularly high risk of HIV, the association between schooling and HIV status might change over time. Many millions of HIV infections in Africa were acquired before public health information was made available or before the scale of the problem had been recognised. In contrast the epidemic in Thailand, originally confined to core groups, emerged in full view of established surveillance programmes (Sirisopana et al., 1996), and since the Thai data came from 21-year olds, any behaviour change should be quickly detected.

In Africa, higher educational attainment was associated with a greater risk of HIV infection. There is some evidence from the available data that newly acquired HIV infections in Africa may be occurring in a different pattern. Studies on younger cohorts in Uganda and Zambia found no association between education level and HIV. Serial data from Uganda and Zambia also suggest a shift away from the previous pattern, though the picture was not as clear in Tanzania, and unadjusted data from Malawi

showed no such change (Table 3). In Thailand the protective effect of schooling has remained, and strengthened slightly from 1992 to 1995. Behaviour change may be expected to occur more rapidly among more educated groups, and this may explain the shift seen in some younger cohorts in Africa. Further work may now be needed to target HIV prevention at the less educated and to increase education levels.

Table 1: Results of studies comparing educational attainment and HIV status in Africa.

Location	Group	Education levels compared	Adjustment for confounders	Year	Response Rate	HIV +	Sex	Setting	N	Results
Sugar estate, Ethiopia (Fontanet et al., 2000)	Wor	<1y, 1-6y, 7-11y, > 11y	Age, sex, residence, migration, occupation	1995-96	79%	3%	Both	Rural	1239	--[--]
Kagera, Tanzania (Kwesigabo et al., 1998)	Pop	None, 1-4, 5-7, ≥secondary	Age, sex, religion, occupation, marital status	1987	86%	24%	Both	Urban	553	=
				1987	90%	10%		Rural	538	+
				1993	66%	18%		Urban	653	=
				1996	70%	7%		Rural	1728	+
Mwanza, Tanzania (Barongo et al., 1992)	Pop	<4y, ≥4y	Age, area of residence	1990-91	80%	5%	Male	Mixed	2000	=
						7%	Female	Mixed	2161	=
Mwanza, Tanzania (Grosskurth et al., 1995; Quigley et al., 1997)	Pop	<Standard 4, ≥standard 4	Age, community	1991-92	80%	4%	Male	Rural	5857	++ [++]
						4%	Female		6643	++ [++]
Mwanza Tanzania (Senkoro et al., 2001)*	Fac	< secondary, ≥ secondary	Age	1991-96	63%	11%	Male	Urban	1594	=
						15%	Female		880	++ [+]
Arusha, Tanzania (Mnyika et al., 1996)	Pop	None, primary, secondary	Age, marital status, area of residence	1992	56%	8%	Female	Mixed	567	= [=]
Masaka, Uganda (Nunn et al., 1996)	Pop	None, primary incomplete, junior incomplete, junior complete	Age, sex	1989-90	72%	9%	Both	Rural	2331	= [++]
Rakai, Uganda (Serwadda et al., 1992)	Pop	None, primary, secondary	Age, area of residence, marital status, travel, occupation	1989	67%	15%	Male	Rural	585	= [++]
						24%	Female	Rural	693	= [++]
Rakai, Uganda (Smith et al., 1999; Konde-Lule JK et al., 1997)	Pop	None, primary, secondary	Age	1990	90%	16%	Male	Rural	1397	++ [++]
						22%	Female	Rural	1707	++ [++]

Location	Group	Education levels compared	Adjustment for confounders	Year	Response Rate	HIV +	Sex	Setting	N	Results
										[continued]
Rakai, Uganda (Kirunga and Ntozi, 1997)	Pop	None, some primary, completed primary, secondary+	Age, sex, area of residence, occupation, wealth	1992	26%	22%	Both	Rural	1784	++ [++]
Fort Portal, Uganda (Kilian et al., 1999)	ANC	Illiterate, primary, secondary	Age, marital status, year	1991-94	NA	22%	Female	Urban	1769	=++ [++]
				1995-97		19%	Female	Urban	1493	= [=]
Zambia (Fylkesnes et al., 1997)	ANC	0-4y, 5-6y, 7y, 8-9y, ≥10y	Age, marital status	1994	89%	13%	Female	Rural	6058	++ [++]
						28%		Urban	5251	++ [++]
Zambia (Fylkesnes et al., 2001)	ANC	0-4y, 5-6y, 7y, 8-9y, ≥10y	Age	1998	NA	10%	Female	Rural	2762	=++[++]
						27%		Urban	3139	=++[++]
						27%		Lusaka	2212	=++[++]
Manicaland, Zimbabwe (Gregson et al., 1997; Gregson et al., 1995)	ANC	None, primary, secondary	Age, marital status, parity, geographic location.	1993-94	97%	19%	Female	Rural	470	= [+]
Mutasa & Nyanga districts Zimbabwe (Gregson et al., 2001)	Pop	< secondary, ≥ secondary	Age, sex, marital status, employment, spousal separation	1998	66%	23%	Both	Rural	689	= [-]

Footnote to tables 1 and 2. * Cohort study – Response rate here refers to the percentage of individuals not lost to follow up

Pop = General Population Sample, ANC = Women attending antenatal clinics, Wor = estate workers and residents, Fac=factory workers, Army = Army Conscripts, NA = Not Available.

If overlapping or identical data were reported in more then one article, all articles have been cited. The results of unadjusted analysis are given in brackets where available.

++	Statistically significant increase in HIV risk in those of *higher* educational status
+	Non significant increase in HIV risk in those of *higher* educational status
=	No relationship
-	Non significant increase in HIV risk in those of *lower* educational status
--	Statistically significant increase in HIV risk in those of *lower* educational status.
=++	No relationship seen in younger age groups, statistically significant increase in HIV risk in those of *higher* educational status in older age groups.

Table 2: Results of studies comparing educational attainment and HIV status in Thailand.

Location	Group	Education levels compared	Adjustment for confounders	Year	Response Rate	HIV +	Sex	Setting	N	Results
Thailand (Sirisopana et al., 1996)	Army	≤6y, 7-9y, 10-12y, 13-16y	Region of residence, marital status, rural/urban, year	1991-93	96%	4%	Male	Mixed	114868	-- [--]
Thailand (Mason et al., 1995)	Army	≤6y, 7-9y, 10-12y, 13-16y	Restriction by age only	1992	97%	4%	Male	Mixed	28787	[--]
				1994		3%	Male	Mixed	26513	[--]
Thailand (Mason et al., 1998)	Army	≤6y, 7-9y, 10-12y, 13-16y	Age, marital status, area of residence, urban/rural	1992	97%	4%	Male	Mixed	59578	-- [--]
				1995		2%	Male	Mixed	55191	-- [--]
Northern Thailand (Nopkesorn et al., 1993; Dobbins et al., 1999)	Army	<Primary, primary, secondary, high, vocational, university	Restriction by age only	1991	NA	7%	Male	Mixed	1115	[=]
Northern Thailand (Nelson et al., 1993; Theetranont et al., 1994)	Army	≤4y, >4y	Restriction by age only	1991	NA	12%	Male	Mixed	2417	[--]
Northern Thailand, Bangkok (Carr et al., 1994)*	Army	≤6y, 7-9y, >9y	Region of birth, current region, marital status	1991-93	40%	4%	Male	Mixed	10665	-- [--]
Northern Thailand (Celentano et al., 1996)*	Army	≤4y, >4y	Restriction by age only	1991	NA	NA	Male	ND	1932	[=]

Table 3: Results of studies examining the relationship between educational attainment and HIV status among groups of different sex, from different settings and at different time periods.

Study	Educational Groups		Adjusted odds ratio for HIV in different contexts[1]	
	Referent	**Comparison**		
By Sex			**Males**	**Females**
Rakai, 1990 (Smith et al., 1999)	None	Secondary	2.8 (1.5-5.5)	2.8 (1.8-4.6)
Mwanza, 1990-1 (Barongo et al., 1992)	< 4 years	$\geq$ 4 years	1.1 (0.8-1.7)	1.2 (0.7-2.3)
Mwanza, 1991-2 (Grosskurth et al., 1995)	< Standard 4	$\geq$ Standard 4	1.7 (1.2-2.4)	1.9 (1.4-2.5)
Zambia 1999, 15-24 yrs (Fylkesnes et al., 2001)	years of schooling	urban	0.85 (0.74-0.98)	0.93 (0.85-0.99)
		rural	1.0	1.0
Setting			**Urban**	**Rural**
Kagera, 1987 (Kwesigabo et al., 1998)	None	Secondary	0.5 (0.2-1.3)	3.3 (0.8-13.3)
Zambia, 1994 (Fylkesnes et al., 1997)	0-4 years	$\geq$10 years	2.5 (1.9-3.2)	4.2 (3.1-5.8)
Zambia 1999, 15-24 yrs (Fylkesnes et al., 2001)	years of schooling	men	0.85 (0.74-0.98)	1.0[2]
		women	0.93 (0.85-0.99)	1.0[2]
Time Period			**Early**	**Late**
Fort Portal, Uganda, ANC (Kilian et al., 1999)			**1991-94**	**1995-97**
	None	Secondary	1.5 (1.1-2.2)	0.9 (0.6-1.4)
Kagera, Tanzania (Urban) (Kwesigabo et al., 1998)			**1987**	**1993**
	None	Secondary	0.5 (0.2-1.3)	0.6 (0.3-1.6)
Kagera, Tanzania (Rural) (Kwesigabo et al., 1998)			**1987**	**1996**
	None	Secondary	3.3 (0.8-13.3)	2.1 (0.7-6.3)
Zambia, ANC, 20-24 yrs (urban) (Fylkesnes et al., 2001)			**1994**	**1998**
	< 7 years	> 7 years	2.1 (1.5-2.8)	1.0 (0.79-1.3)
Thailand (Mason et al., 1995)			**1992**	**1994**
	0-6 years	13-16 years	0.45 (0.18-1.04)	0.21 (0.06-0.69)
Thailand (Mason et al., 1998)			**1992**	**1995**
	0-6 years	13-16 years	0.22 (0.12-0.39)	0.17 (0.10-0.30)

[1]Odds Ratio adjusted as stated in Table 2.

[2] No confidence intervals given in the paper

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