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CHANGES IN SEXUAL BEHAVIOR AND A DECLINE IN HIV INFECTION AMONG YOUNG MEN IN THAILAND

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ABSTRACT

Background In Thailand the epidemic of human immunodeficiency virus (HIV) infection is of recent origin. Because of the high seroprevalence of HIV among sex workers, the Ministry of Public Health began a program in 1990 and 1991 to promote the use of condoms during commercial sex. We evaluated the effect of this and other programs to prevent HIV infection in Thailand.

Methods Using direct interviews, we studied five cohorts of 21-year-old men from northern Thailand who were conscripted into the army by a lottery in 1991, 1993, and 1995. In all, 4311 men were tested for HIV antibodies by enzyme-linked immunosorbent assay, with confirmation by Western blot assay.

Results In the 1991 and 1993 cohorts, the prevalence of HIV infection was 10.4 to 12.5 percent. In 1995, it fell to 6.7 percent ($P < 0.001$). The seroprevalence was only 0.7 percent among men who did not have sexual relations with a sex worker before 1992. Over the study period, the proportion of men who reported having sexual relations with a sex worker fell from 81.4 percent to 63.8 percent ($P < 0.001$). From 1991 to 1995, the men's reported use of condoms during the most recent sexual contacts with sex workers increased from 61.0 percent to 92.5 percent ($P < 0.001$); and in 1995, 15.2 percent of men had a history of a sexually transmitted disease, as compared with 42.2 percent in 1991 ($P < 0.001$).

Conclusions Public health programs in Thailand have led to substantial changes in sexual behavior among young men, especially an increased use of condoms, and the rate of new HIV infections has declined. (N Engl J Med 1996;335:297-303.)

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IN Thailand, the epidemic of human immunodeficiency virus (HIV) infection and the acquired immunodeficiency syndrome (AIDS) is of recent origin.^{1,2} In response to surveys indicating a dramatic increase in the prevalence of HIV among injection-drug users in Bangkok in early 1988, the Ministry of Public Health established a semiannual surveillance program in June 1989 to detect HIV infection in several populations throughout the country.³⁻⁵ This surveillance found the highest HIV seroprevalence among persons from the northern provinces of Thailand, especially female sex workers.^{5,6}

In response to the surveillance data, the ministry instituted a program to promote safer sexual practices in commercial sex establishments — the so-called 100 percent condom campaign⁷ — to prevent HIV transmission. This program included the distribution of condoms to brothels and other sex establishments, a media campaign to promote condom use, and an enforcement program to ensure compliance.

To evaluate trends in high-risk behavior and rates of HIV infection, we analyzed data on five cohorts of 21-year-old men from northern Thailand who were conscripted between 1991 and 1995 to serve in the Royal Thai Army. Since military conscription is done by a lottery from which men are not excluded

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ed automatically because of homosexuality, illicit drug use, or positivity for HIV, the data from our study are applicable to the general population of healthy young men in northern Thailand.⁸

METHODS

The study population consisted of 21-year-old men from six contiguous provinces of northern Thailand (Chiang Mai, Chiang Rai, Mae Hong Son, Lamphun, Lampang, and Phayao) who were selected by lottery in April 1991, 1993, and 1995 for two years of service in the Royal Thai Army. We studied five cohorts of conscripts that included all the men inducted in May 1991, November 1991, May 1993, November 1993, and May 1995. In addition, we present HIV-antibody data on a cohort inducted in November 1995. Soon after induction, each man donated a serum specimen that was tested for HIV antibodies by enzyme-linked immunosorbent assay (ELISA) with standard methods and licensed commercial reagents (Behring, Somerville, N.J., or Organon Teknika, Durham, N.C.). Specimens reactive on the initial ELISA were retested in duplicate, with confirmation by a Western blot assay using licensed reagents (Biotech-Dupont, Wilmington, Del.). The serum samples were also tested for syphilis antibodies with a Venereal Disease Research Laboratory (VDRL) test, with reactivity confirmed by a *Treponema pallidum* hemagglutination assay.

In addition to the serologic screening for antibodies to HIV and syphilis, each recruit was interviewed face to face by a specially trained civilian interviewer. The interview included questions about the recruit's socioeconomic status and demographic variables; sexual experiences with male and female partners at any time and recently (during the year before induction); use of condoms; medical history, including any history of sexually transmitted disease; surgery; blood transfusions and tattooing; use of illicit drugs, by injection or otherwise; and use of alcohol and tobacco. The interviews were conducted privately, and the confidential data were removed from the military base for the analysis. The research protocols were reviewed and approved by the institutional review boards of Johns Hopkins University, Chiang Mai University, and the Royal Thai Army.

Data on the prevalence of HIV infection among the men at the time of their induction, risky behavior they reported, and its association with HIV infection were studied to detect trends in behavior presenting a risk and rates of infection from 1991 through 1995. The association of risk factors with the prevalence of HIV was compared within and among cohorts with contingency tables and univariate logistic regression. The chi-square test, Fisher's exact test, and the chi-square test for trend were used as needed to determine statistical significance. Multivariate models were fitted to ascertain the independent association of variables that were found to be significantly associated with the prevalence of HIV infection in the univariate analysis.

RESULTS

The prevalence of HIV in the men inducted in 1991 and 1993 ranged from 10.4 percent to 12.5 percent at the time of their induction; these rates did not differ significantly from one another (chi-square = 2.4, 3 df; $P = 0.49$). However, among the men inducted in May 1995 the prevalence of HIV infection decreased to 6.7 percent (chi-square = 17.2, $P < 0.001$) (Table 1). Men inducted in 1994 and November 1995 were not interviewed about their sexual behavior, but their HIV-seroprevalence rates were as follows: for those inducted in May 1994, 8.7 percent; November 1994, 9.3 percent; and November 1995, 6.8 percent. The prevalence of reactive se-

TABLE 1. PREVALENCE OF HIV INFECTION AMONG YOUNG MEN IN NORTHERN THAILAND CONSCRIPTED AT THE AGE OF 21 IN 1991, 1993, AND 1995.*

DATE OF INDUCTION	No. INDUCTED	No. HIV-POSITIVE (%)
1991		
May	935	97 (10.4)
November	888	111 (12.5)
1993		
May	869	107 (12.3)
November	798	92 (11.5)
1995		
May	821	55 (6.7)
November†	745	51 (6.8)

*When the 1991 and 1993 cohorts were compared with each other, chi-square = 2.4, with 3 df ($P = 0.49$). When these cohorts were compared with the May 1995 cohort, chi-square = 17.2, with 1 df ($P < 0.001$). When the 1991 and 1993 cohorts were compared with both 1995 cohorts, chi-square = 42.6, with 1 df ($P < 0.001$).

†Because only HIV-seroprevalence data were available on the men in this cohort, behavioral-risk data are not included in the primary analyses reported in this paper.

rologic tests for syphilis also decreased, from 3.3 percent in 1991 to 1.8 percent in 1993 and 1.3 percent in 1995 ($P < 0.001$).

We found progressive reductions from 1991 to 1995 in several types of behavior presenting a high risk of HIV infection. The proportion of men whose sexual activity began before the age of 17 years remained relatively stable during this period (Table 2). Although the proportion who reported having had sexual relations by the age of 21 declined only slightly (from 92 percent in 1991 to 87 percent in 1995), the proportion who had sexual relations with a female sex worker fell from 81.5 percent to 63.8 percent ($P < 0.001$). However, there was a greater reduction in the proportion of men who reported having sex with a female sex worker during the year before their conscription — from 57.1 percent in 1991 to 44.3 percent in 1993 and 23.8 percent in 1995 (Table 2).

Sexual relations with someone other than a sex worker were somewhat more frequent in the more recent cohorts. The proportion of men who reported having sex with a girlfriend increased from 23.1 percent in 1991 to 27.0 percent in 1993 and 28.1 percent in 1995. Sexual relations with a male partner were uncommon, but this behavior increased as well; the proportion of men reporting sex with a male partner was 2.8 percent in 1991, 3.8 percent in 1993, and 4.8 percent in 1995. The proportion of men who were married remained relatively stable during the study, at 25 to 30 percent. Injection-

drug use was quite uncommon; of 4307 men in the five study cohorts, only 60 (1.4 percent) reported ever having injected themselves with illicit drugs (Table 2).

During the study period, the proportion of men who reported using a condom during their most recent sexual encounter with a sex worker increased, from 61.0 percent in 1991 to 92.6 percent in 1995. The increase in condom use is reflected in the decrease in the proportion of men with a history of sexually transmitted disease, which declined from 42.2 percent in 1991 to 15.7 percent in 1995 (Table 2). Although the causes of specific reported sexually transmitted diseases could not be studied because we lacked microbiologic confirmation of the organisms involved, the proportion of men who reported a history of genital ulceration decreased from 19.5 percent in 1991 to 3.4 percent in 1995. The proportion who reported having had urethral discharges decreased from 36.0 percent to 15.0 percent.

There were important changes over time in the association of risk-associated behavior with the prevalence of HIV infection (Table 3). Sexual activity before the age of 17 was associated with an increased rate of HIV infection in all the cohorts. However, among the men in the May 1995 cohort whose sexual activity began at the age of 17 or older, the prevalence of HIV was only 3.6 percent (Table 3). The prevalence of HIV among men whose sexual activity began earlier remained in the range of 11.0 percent to 15.4 percent during the study period (Table 3).

Sexual relations with a female sex worker continued to be an important risk factor for HIV infection throughout the study period; this behavior was associated with a more than fourfold increase in the prevalence of HIV infection throughout the study. However, there was a slight decrease in the prevalence of HIV among men who reported having had sexual relations with a female sex worker, from about 14 percent in the 1991 and 1993 cohorts to 9.2 percent in the men recruited in May 1995 (Table 3).

Among men conscripted in 1991 and 1993, those who reported not using a condom during their most recent sexual relations with a sex worker did not have a higher prevalence of HIV in the univariate analysis than those who used condoms (Table 3). However, not using a condom during sex with a sex worker was associated with a higher prevalence of HIV in the 1995 cohort. Although the use of condoms during sex with female sex workers had become the norm by 1995, those who reported not using condoms had about twice the rate of HIV infection of those who did (Table 3).

Men who reported sexual relations with a girlfriend had moderately higher rates of HIV infection than those who said they had not had sex with a girlfriend. However, this difference was significant

TABLE 2. HIGH-RISK BEHAVIOR REPORTED BY THE 21-YEAR-OLD MILITARY CONSCRIPTS IN THE 1991, 1993, AND 1995 STUDY COHORTS.

TYPE OF BEHAVIOR	1991	1993	1995
	(N = 1819)	(N = 1667)	(N = 821)
	no. positive (%)		
Sexual activity			
Any	1679 (92.3)	1553 (93.2)	716 (87.2)
Before the age of 17 yr	660 (36.3)	775 (46.5)	345 (42.0)
Visits to sex workers*			
Ever	1482 (81.5)	1346 (80.7)	524 (63.8)
In past year	1039 (57.1)	738 (44.3)	195 (23.8)
Condom used on most recent visit†	904 (61.0)	1125 (83.6)	485 (92.6)
Sexual activity with others*			
With girlfriend	421 (23.1)	451 (27.1)	231 (28.1)
With male partner	51 (2.8)	63 (3.8)	39 (4.8)
Sexually transmitted disease at any time*	767 (42.2)	539 (32.3)	129 (15.7)
Any use of illicit injection drugs*	20 (1.1)	17 (1.0)	23 (2.8)

*P≤0.001 for the comparison between cohorts by the chi-square test for trend.

†Percentages shown for condom use were based on the numbers of men who reported any sexual relations with a sex worker.

only in the 1991 cohorts. Using condoms at any time during sex with a girlfriend was uncommon in any of the cohorts; only 31.9 percent of those who reported sexual relations with a girlfriend said they had ever used a condom with her. In contrast with the trend toward increasing condom use during sex with sex workers, the use of condoms during sex with girlfriends did not increase from 1991 to 1995. Although sex with a male partner was reported infrequently, in the 1995 cohort there was an increase in the prevalence of HIV among the men who reported such behavior.

In all the cohorts studied, a history of sexually transmitted disease was strongly associated with HIV infection. Urethral discharges were more frequent than other symptoms, but urethral discharge and genital ulcers were both associated with HIV infection (data not shown).

Although these men rarely used drugs, the prevalence of HIV infection was significantly higher among those who reported injecting illicit drugs than among those who did not (28 percent vs. 10.5 percent; odds ratio, 3.38; 95 percent confidence interval, 1.91 to 5.97). Furthermore, the odds ratio for HIV seropositivity associated with drug use increased from 1.37 in 1991 to 4.12 in 1993 and 8.52 in 1995.

The analysis by multiple logistic regression of the association of behavioral risk factors with HIV infection revealed that having sexual relations with a female sex worker was a very important risk factor in

TABLE 3. ASSOCIATION OF SEXUAL BEHAVIOR AND CONDOM USE WITH THE PREVALENCE OF HIV INFECTION AMONG THE MILITARY CONSCRIPTS IN THE 1991, 1993, AND 1995 STUDY COHORTS.

TYPE OF BEHAVIOR AND YEAR OF INDUCTION	NO. OF MEN	NO. HIV-POSITIVE (%)	ODDS RATIO (95% CONFIDENCE INTERVAL)
First sexual activity at age of <17 yr			
1991			
No	1159	106 (9.1)	1.0
Yes	660	102 (15.5)	1.82 (1.34–2.45)
1993			
No	892	87 (9.8)	1.0
Yes	775	112 (14.5)	1.56 (1.16–2.11)
1995			
No	476	17 (3.6)	1.0
Yes	345	38 (11.0)	3.34 (1.85–6.03)
Visits to sex workers			
1991			
No	337	5 (1.5)	1.0
Yes	1482	203 (13.7)	10.54 (4.3–25.8)
1993			
No	321	12 (3.7)	1.0
Yes	1346	187 (13.9)	4.16 (2.29–7.55)
1995			
No	297	7 (2.4)	1.0
Yes	524	48 (9.2)	4.17 (1.86–9.36)
Visits to sex workers in past yr*			
1991			
No	443	34 (7.7)	1.0
Yes	1039	169 (16.3)	2.34 (1.59–3.44)
1993			
No	608	74 (12.2)	1.0
Yes	738	113 (15.3)	1.30 (0.95–1.79)
1995			
No	329	29 (8.8)	1.0
Yes	195	19 (9.7)	1.12 (0.61–2.05)
Condom use during visits to sex workers			
1991			
Yes	1150	172 (15.0)	1.0
No	332	31 (9.3)	0.59 (0.39–0.88)
1993			
Yes	1231	177 (14.4)	1.0
No	115	10 (8.7)	0.57 (0.29–1.11)
1995			
Yes	503	44 (8.7)	1.0
No	21	4 (19.0)	2.45 (0.79–7.62)
Condom use during most recent visit to sex worker			
1991			
Yes	904	131 (14.5)	1.0
No	578	72 (12.5)	0.84 (0.62–1.14)
1993			
Yes	1125	154 (13.7)	1.0
No	221	33 (14.9)	1.11 (0.74–1.66)
1995			
Yes	485	42 (8.7)	1.0
No	39	6 (15.4)	1.92 (0.76–4.84)

*For each cohort, the past year was defined as the 12 months before induction into the army.

each study cohort (Table 4); the adjusted odds ratios ranged from 3.5 to 10.7 in that analysis. In addition, in this analysis a history of sexually transmitted disease was independently associated with HIV infection (Table 4). Other types of risky behavior were significantly associated with HIV infection in some cohorts. Having sexual relations with a girlfriend was a significant risk factor in the 1991 cohorts, sex with a male partner was a significant risk factor in the 1995 cohort, and injection-drug use was a significant risk factor in both the 1993 and 1995 cohorts (Table 4).

The proportion of men who reported not having had any sexual relations by the age of 21 was higher in the 1995 cohort (12.8 percent) than in the 1991 and 1993 cohorts (7.7 percent and 6.8 percent, respectively) (Table 5). However, the age distribution of the men in the study when their sexual activity began remained quite similar between the 1991 cohort and the 1995 cohort (Table 5). The prevalence of HIV infection among the men in the 1993 and 1995 cohorts whose first sexual activity took place in 1993 or later was dramatically lower than that among men who were sexually active before that time. Of 138 men who reported having no sexual relations with a female sex worker until after 1992, only 1 (0.7 percent) was HIV-positive at the time of induction. This contrasts with an HIV prevalence of 11.5 percent in the five cohorts among men who reported their first sexual relations to have occurred in 1992 or earlier (Table 5). The decreasing prevalence of HIV among men at the time of their induction appeared to begin in men whose first sexual relations occurred in 1991 or later, a date that coincides with the start of the 100 percent condom campaign (Table 5).

DISCUSSION

HIV infection and AIDS have spread rapidly in Thailand since the first reports of epidemic transmission in 1988 and 1989.¹⁻⁶ Surveillance data have shown a recent leveling off or decrease in the prevalence of HIV among some populations.^{6,9} These surveys have allowed the geographic spread of HIV infection to be estimated roughly, as well as the extent of infection in some populations at special risk. However, surveillance data are not especially useful in documenting recent changes in the rates of HIV infection in general populations, since sentinel populations are neither randomly selected nor representative of the population as a whole.¹⁰ Furthermore, no data on behavioral risks are collected during the sentinel surveys.

In contrast, rates of HIV infection among military conscripts are more readily applicable to the larger population of young men, because of the random method of conscription. When men reach the age of 21, they must report to the local military station for selection by a lottery. Because they are 21 years old

TABLE 4. ADJUSTED ODDS RATIOS AND 95 PERCENT CONFIDENCE INTERVALS FOR HIV INFECTION IN THE STUDY POPULATION ACCORDING TO BEHAVIORAL RISK FACTORS, 1991–1995, AS DERIVED BY MULTIPLE LOGISTIC REGRESSION.

RISK FACTOR*	YEAR OF INDUCTION		
	1991	1993	1995†
odds ratio (95 percent confidence interval)			
History of STD not included in the analysis			
Sexual relations			
With sex worker	10.78 (4.40–26.42)	4.07 (2.24–7.40)	3.53 (1.56–8.00)
With girlfriend	1.54 (1.11–2.13)	0.99 (0.71–1.39)	0.79 (0.41–1.52)
With male partner	0.77 (0.32–1.83)	1.65 (0.57–2.36)	3.27 (1.38–7.80)
Injection-drug use	1.16 (0.33–4.02)	3.60 (1.30–9.99)	6.29 (2.36–16.78)
History of STD included in the analysis			
Sexual relations			
With sex worker	4.05 (1.59–10.30)	2.03 (1.08–3.81)	2.78 (1.19–6.45)
With girlfriend	1.49 (1.06–2.08)	0.91 (0.65–1.29)	0.86 (0.45–1.66)
With male partner	0.62 (0.26–1.51)	0.79 (0.38–1.64)	2.78 (1.14–6.50)
Injection-drug use	0.79 (0.22–2.27)	3.70 (1.25–11.00)	5.10 (1.85–14.11)
History of STD	5.11 (3.53–7.40)	4.75 (3.40–6.64)	2.51 (1.34–4.70)

*STD denotes sexually transmitted disease.

†Data for 1995 include only the cohort inducted in May.

at that time, the onset of their sexual activity (if any) is relatively recent. Thus, prevalence rates of HIV infection reflect the cumulative incidence of such activity over only a few years, a period in which the details of sexual and other risk-associated behavior can be recalled with reasonable reliability. However, there are substantial limitations to the use of such data to estimate rates of HIV infection and changes in risk-related behavior among women or persons of a different age from that of the conscript population. Our earlier studies of the general populations of villages in northern Thailand and of selected populations of sex workers, patients in sexually transmitted disease clinics, and men before and after discharge from the military suggest that the annual incidence of HIV infection may range from 2.0 percent to 5.0 percent or above in these populations.^{11–16}

Our data suggest that beginning about 1991, there have been substantial changes in the sexual behavior of adolescents and young men in northern Thailand. One important change was a dramatic increase in the use of condoms by men having sexual relations with female sex workers. The men's age at the start of such relations remained relatively unchanged during the study period. However, the proportion of men in the 1995 cohort who reported having sex with a sex worker during the preceding year was substantially lower than that in earlier cohorts. This reduction in the use of sex workers may partly be due to the witnessing by young men of the clinical effects of HIV infection in acquaintances, as well as to widespread publicity about AIDS in Thailand.

In association with these behavioral changes, the number of men in the 1995 cohort who reported ever having a sexually transmitted disease decreased by a factor of three as compared with the 1991 cohorts, and the prevalence of HIV decreased by a factor of two. The prevalence of HIV infection among men who reported sexual relations with a sex worker only in the two years before induction was considerably lower in the 1995 cohort (0.7 percent) than it was in the entire study population (6.7 percent). These data suggest that the prevalence of HIV among future conscripts may be lower than it was in 1995, if the recent salutary changes in behavior are maintained.

It seems that the recent decrease in rates of HIV infection and sexually transmitted disease is due in part to the increased use of condoms during commercial sex.¹⁷ Our data document the efficacy of regular condom use in preventing HIV transmission during high-risk sexual activity. Our data are consistent with those of a European study of couples with discordant HIV status¹⁸ and those of studies in other populations,¹⁹ which indicate that condoms are highly effective when used regularly during sexual relations with an HIV-infected partner. It is curious that lower HIV-infection rates among condom users during commercial sex were found only in the 1995 cohort. In earlier cohorts with lower rates of condom use, men who reported using condoms were also more likely to have used sex workers frequently before the 100 percent condom campaign. Therefore, recent use of condoms by these men also may

TABLE 5. RELATION OF THE INCIDENCE OF HIV INFECTION TO THE MAN'S AGE AT THE TIME OF FIRST SEXUAL RELATIONS AMONG MEN CONSCRIPTED IN NORTHERN THAILAND, 1991–1995, ACCORDING TO THE CALENDAR YEAR WHEN SEXUAL ACTIVITY BEGAN.*

YEAR SEXUAL ACTIVITY BEGAN	MEN CONSCRIPTED IN 1991			MEN CONSCRIPTED IN 1993			MEN CONSCRIPTED IN 1995			ALL MEN STUDIED	
	AGE (YR)	NO. OF MEN (%)	NO. HIV-POSITIVE (%)	AGE (YR)	NO. OF MEN (%)	NO. HIV-POSITIVE (%)	AGE (YR)	NO. OF MEN (%)	NO. HIV-POSITIVE (%)	NO. OF MEN	% HIV-POSITIVE
1985	≤15	402 (22.1)	63 (15.7)	—	—	—	—	—	—	402	15.7
1986	16	258 (14.2)	39 (15.1)	—	—	—	—	—	—	258	15.2
1987	17	390 (21.4)	51 (13.1)	≤15	496 (29.8)	82 (16.5)	—	—	—	886	15.0
1988	18	328 (18.0)	28 (8.5)	16	279 (16.7)	30 (10.8)	—	—	—	607	9.6
1989	19	166 (9.1)	21 (12.7)	17	327 (19.6)	49 (15.0)	≤15	219 (26.7)	19 (8.7)	712	12.5
1990	20	111 (6.1)	6 (5.4)	18	241 (14.5)	27 (11.2)	16	126 (15.3)	19 (15.1)	478	10.9
1991	21	24 (1.3)	0	19	128 (7.7)	4 (3.1)	17	167 (20.3)	13 (7.8)	319	5.3
1992	—	—	—	20	58 (3.5)	2 (3.4)	18	90 (11.0)	2 (2.2)	148	2.7
1993	—	—	—	21	24 (1.4)	0	19	61 (7.4)	0	85	0
1994	—	—	—	—	—	—	20	41 (5.0)	0	41	0
1995	—	—	—	—	—	—	21	12 (1.5)	1 (8.3)	12	8.3
No sexual relations		140 (7.7)	0	—	114 (6.8)	5 (4.4)	—	105 (12.8)	—		
Total		1819 (100)	208 (11.4)	—	1667 (100)	199 (11.9)	—	821 (100)	54 (6.6)		

*Because of rounding, not all percentages total 100.

have been a marker for earlier high-risk sex during which condoms were not regularly used. Despite recent reductions in HIV-infection rates among men using sex workers, the prevalence of HIV continues to be 50 percent or higher among female sex workers at brothels in northern Thailand.^{6,12,20,21} The high prevalence of HIV among such women may persist for several reasons. The women often have extremely high rates of exposure to the virus. Reports of 5 to 10 customers or more per night are not uncommon. Many HIV infections among sex workers may antedate the protection afforded by the campaign for increased condom use. Condoms are often not used by sex workers during sexual relations with men who are not paying customers²²; also, condoms are used infrequently even with regular customers (who may be seen more as regular partners than as clients) or when the woman has an active sexually transmitted disease.^{21,23} Sexually transmitted diseases, which may be important cofactors for HIV transmission, are quite frequent among sex workers in brothels.^{14,24} Also, condom-breakage rates of 4 percent or higher have been reported in brothels in northern Thailand.²⁵ Since men with lower risks of HIV have decreased the frequency of their visits to sex workers, the remaining clients may be at higher risk for transmitting HIV to sex workers than was the case in previous years.

The success of the 100 percent condom campaign suggests that environmental interventions may be more effective public health strategies in preventing HIV infection in developing countries than strategies that rely solely on health education targeted at

the behavior of individuals.^{26,27} The campaign in northern Thailand involved providing condoms to every establishment where sex was sold and encouraging and enforcing their use, as well as educating people to reduce sexual behavior that could place them at high risk. The dramatic success of this public health intervention in quickly reducing the very high rates of HIV infection in a general population of heterosexual adolescents and young men within a few years after their first sexual activity is unprecedented, to our knowledge. Although there were similar reductions in the incidence of HIV among homosexual men in the United States in the early 1980s,²⁸ that change involved a population with higher levels of education, community organization, and awareness that reinforced the need for changed behavior. Nevertheless, there are some parallels between the HIV-prevention efforts among homosexual men in the United States and those among young heterosexual men in Thailand, in that increasing the regular use of condoms was essential in both populations. Also, structural interventions were critically necessary in both populations for intervention to succeed; in the homosexual community, bathhouses were closed or monitored,²⁹ and in the heterosexual community in Thailand, brothels were monitored to encourage and enforce condom use.⁷

There is an urgent need to develop and evaluate additional public health strategies to control the spread of HIV infection. Since the epidemic in northern Thailand now affects large numbers of married couples, methods of increasing the use of condoms and other barriers, physical or chemical, by those

couples and others engaging in noncommercial sexual relations are essential. This challenge will be a difficult one. Developing and evaluating safe, effective, and culturally acceptable topical virucides that can be used by women at high risk is extremely important.^{30,31} An effective HIV vaccine would be of great value in controlling the spread of the epidemic. While these important research efforts continue, we hope that people making public health decisions elsewhere in the world³² will profit from the remarkable success of the condom-promotion campaign in northern Thailand.

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