Sexual partners, penetrative sexual partners and HIV risk

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This paper argues that the notion of sexual partners *per se* is insufficient for estimating levels of HIV risk behaviour or changes in HIV risk over time, even though it is a crucial element of most epidemiological models of HIV. The concept of a penetrative sexual partner (PSP) is introduced as a considerably more accurate measure of HIV risk. Using data from a longitudinal study of 930 homosexually active men in England and Wales, this paper demonstrates that variation in numbers of PSPs (and thus HIV risk) is not related to variation in the gross numbers of sexual partners.

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Introduction

Homosexually active men are the largest group in the reported figures of AIDS cases in the UK [1] and are likely to remain so for some time [2]. Predictions of the spread of HIV through male-to-male sexual contact are based on two parameters [3]: rate of partner change and infectivity, the empirical estimation of which is based on studies carried out predominantly on genito-urinary medicine clinic samples [4,5]. Since different sexual practices carry different probabilities of transmitting HIV [6], the estimation of the infectivity parameter depends on the mix of sexual practices in the homosexual repertoire. Crucially, it depends on the proportion of men who engage in anal intercourse, the single sexual act most likely to lead to transmission of HIV [7]. The assumption is that as the numbers of partners rise the mix of sexual acts remains the same.

It is by now well documented that homosexually active men in the United States have made significant and substantial changes to their sexual behaviour in response to HIV infection [8–10], particularly with regard to anal intercourse. While information on the sexual behaviour of men who have sex with men in the UK is sparse [11–13], declining rates of infection with rectal gonorrhoea and other sexually transmitted diseases (STDs) suggest that similar changes have taken place [14,15]. Recently, however, there have been reports of an increase in these indicators for homosexual men (McManus T.J. personal communication 1990 and [16]) related to an increase in unsafe sexual behaviour among homosexually active men [17]. In this paper we report on a longitudinal study of homosexual men's sexual behaviour and demonstrate that the numbers of sexual partners is a poor measure of risk to HIV. We introduce a concept of penetrative sexual partners (PSPs) as a more accurate indicator of the level of risk.

Methods

Project SIGMA (Socio-Sexual Investigations of Gay Men and AIDS) is a longitudinal study of a non-clinic based cohort of homosexually active men. In total, 930 respondents were recruited by a variety of means including (1) response to a postal questionnaire in the gay press, (2) recruitment in gay pubs, clubs and social and political organizations, and (3) contacts of the above. These three sources each provided about one-third of respondents. Respondents lived in and around 10 main sites across England and Wales: London, Cardiff, Newcastle, Teesside, Portsmouth, Leeds, Norwich, Birmingham, Liverpool, and Bristol. No respon-

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dents were recruited from genito-urinary medicine clinics.

In 1988, 930 men were interviewed; 691 (74.3%) were re-interviewed in 1989. The interviews asked about their sexual history, social attitudes and behaviour, health, knowledge and attitudes towards condom use and AIDS/HIV generally. It also focused on detailed sexual activity by asking about specific sexual acts and about the numbers of partners.

Pilot work has revealed so much variation in what was understood by the term 'sexual partner' [18] that the project provides respondents with a definition as follows: 'A sexual partner is any person with whom you had sexual contact, where the aim was orgasm for one or both of you'. We further define a penetrative sexual partner (PSP) as: 'A sexual partner whom you fucked (either anally or vaginally) or who fucked you'. Each respondent was asked on both occasions to estimate both the numbers of sexual partners and penetrative sexual partners in his lifetime, last 5 years, last year and last month.

Respondents were asked, but not required to provide blood and/or saliva for testing for HIV. Refusal to provide blood did not exclude respondents from the study.

Without a denominator study it is, of course, impossible to assess exactly how representative such a cohort is [19], just as it is impossible *a fortiori* to judge the representativeness of clinic-based studies. However, this study remains the largest ever undertaken in the UK and the diversity of the recruitment sources gives grounds for believing that the cohort includes a wider cross section of the male homosexually active population, in terms of social and sexual activity, than those studies which recruit either exclusively or predominantly from clinics which are naturally biased towards those who are more sexually active.

Interviews involving self-reported homosexual behaviour over short recall periods have, in general, been shown to be reliable [20] and valid [21]. However, several factors influence the robustness of the reported numbers of sexual partners: the period of time we ask the respondents to consider, the volume of partners the respondent has had, the types of partner he has had and the willingness of the respondent not deliberately to distort the figures [22].

To examine the reliability of the reported lifetime numbers, the question on numbers of lifetime partners, first asked in wave 1, was repeated in the second interview (1989). If the reported estimates of partner numbers is reliable we would expect the lifetime estimate of partner numbers in the second interview minus the estimate of numbers of partners in the year before the second interview to equal the estimate of lifetime partners in the first interview [mathematically, lifetime estimate year 2 $-$(lifetime estimate year 1 + last year estimate year 2) = 0]. A one sample test on the difference of these estimates from zero shows that there are no significant differences for neither the male partner estimate ($t = 0.607$, $P = 0.54$) nor the PSPs estimate ($t = 0.568$, $P = 0.57$). This demonstrates some reliability between interviews, although it should not be inferred from this that the estimates of lifetime partners and PSPs are valid.

An internal check has also been carried out to assess the validity of the data. This test compares the reported frequencies of insertive and receptive anal intercourse in the month before interview. We hypothesize that if the data are valid, and assuming a closed system, the two estimates would be asymptomatically equal. An alternative hypothesis is that, given the stigma attached to receptive anal intercourse, there will be a systematic underestimate of this act. A Wilcoxon ranks test reveals that, at least in this data set, this is not the case ($z = 0.02$, $P = 0.98$); the reported frequency of receptive anal intercourse is not significantly different from that for insertive anal intercourse.

Finally, split-half reliability estimates (the sample being split randomly into two groups) of condom use (whether always used, sometimes used or never used for anal intercourse in the month before interview) show no significant differences between the groups (for insertive anal intercourse, $\chi^2 = 1.36$, d.f. = 2, $P = 0.51$ and for receptive, $\chi^2 = 0.15$, d.f. = 2, $P = 0.93$). A two-sample t-test on the split-half reliability of the estimates of numbers of sexual partners in the preceding year also yields no significant differences ($t = 0.311$, $P = 0.76$).

As a result of test-retest, consistency checks and split-half tests we are reasonably confident that the estimates provided by respondents are reliable and valid.

Results

While a more detailed description of the cohort can be found elsewhere [12] the basic demographic characteristics are summarized in Table 1. It should be noted that, in common with other studies of the sexual behaviour of gay men [9,11,23], the men in this cohort had educational qualifications higher than the population at large and have a higher proportion of men in the 21–39 year age group. However, in contrast to other studies this cohort had a relatively high proportion of blue-collar workers.

Tables 2 and 3 present the numbers of male sexual partners and PSPs for the lifetime and for the 5 years, year and month prior to the first interview (in 1988) and the summary statistics. It is important to note here that all the distributions considered are skewed towards the smaller numbers. There was a very small number of men who have considerably higher num-

Table 1. Characteristics of the men in our cohort.

Age in years	
Median	29
Mean	32
Range	15–81
Relationship type	
Closed monogamous	26.0%
Regular/s + others	31.6%
No regular partner	42.4%
Legal marital status	
Single, never married	88.2%
Married	4.1%
Divorced/Separated/Widowed	7.7%
Highest educational level	
'O' levels or less	33.2%
'A' levels and equivalent	32.6%
Degree or more	34.2%
Social class	
1 and 2	56.7%
3	20.2%
4 and 5	8.3%
Other*	14.8%
Sexual feelings†	
Exclusively or predominantly homosexual††	93.3%
Other‡	6.7%
STD clinic attendence	
Non-attender	69.1%
Regular attender	30.9%

STD, sexually transmitted diseases; * includes unemployed, students, disabled and retired; †rated using the 7-point scale of Kinsey; ‡Kinsey ratings 5 and 6; ††Kinsey ratings 0, 1, 2, 3 and 4.

bers of sexual partners that the majority of the cohort. For example, 7% reported more than 2 s.d. above the mean number of sexual partners in the past year. This affects the mean measure considerably and thus our preferred measure of level is the median and of spread, the interquartile range.

Of the whole cohort, 24 (2.6%) reported no male partners at all in their life and are included on the basis that they identify as gay or score more than zero on the Kinsey feelings scale. Eighty-three men (8.9%) reported no male penetrative partners ever. The median number of lifetime partners reported is 38 and, of PSPs, seven.

The figures for the 5 years before the first interview (i.e 1982–1987) indicated that although only a fairly small proportion of respondents had had no sexual partners (3.2%), as many as 14.2% reported no penetrative partners since 1982. Similarly, in the year before interview nearly one-third of the cohort (30.9%) had no PSPs while only 58 (6.3%) reported no sexual partners at all.

The month figures revealed a similar pattern, with 59.7% reporting no PSPs and 23.3% no partners. Just over 90% reported either one or no PSPs and nearly 95% reported fewer than five partners in the month.

The numbers of penetrative partners reported by respondents were lower than those of partners. The mean proportion of partners who were penetrative in the last year was 36.7% with a median of 25%. On either measure, the incidence of penetrative partners is lower than might be assumed from applying heterosexual assumptions to homosexual behaviour. However, the crucial questions for epidemiologists are (1) whether the proportion of partners who are penetrative remains stable as the numbers of partners rise and (2) whether the proportion is stable over time.

The ratio of PSPs to the number of partners is plotted against the number of partners for the last year (Fig. 1). If there is a consistent relationship between the proportion of partners who are penetrative and the number of partners we would expect a cluster of points around the mean proportion of PSPs to partners (i.e. at about 37%). We should find that there are as many points below this mean as there are above it. Up to about 10 partners this appears to be the case, although above 10 partners many more points appear below this mean figure than above and this disparity becomes more obvious as the number of partners increases. Thus, below 10 partners it might be possible to assume that the proportion of partners who are penetrative (and therefore the associated risk) remains constant, but above this level that there is a marked inverse relationship.

To test this the ratio of PSPs to partners for groups of partners (grouped in steps of 10 partners) has been examined. Analysis of variance reveals significant differences between the ratios for each group ($F_{6864} = 12.839$, $P < < 0.01$) with the ratio being the highest for the group with less than 10 partners and lowest for the groups above this level. Furthermore, even though the data below 10 partners may be consistent with the view that the proportion of PSPs is constant Fig. 1. reveals a wide variation around the mean, rendering the relationship of limited use for modelling purposes. The low correlation coefficient ($r^2 = 0.04$) confirms the lack of any relationship. Thus, rate of partner change combined with infectivity measures are unreliable in estimating risks of HIV infection.

Table 4 shows the changes in reported estimates of partners and PSPs for 1988 and 1989 for those interviewed on both occasions (n = 691). There was a large increase in the numbers of partners reported (up 35%) but a much smaller increase (up 5%) in the number of PSPs is reported. The ratio of PSPs to partners (that is, the proportion of partners with whom anal penetration occurred) was significantly lower for the monthly estimates (0.37 compared to 0.52, $t = 5.55$, $P < < 0.01$) and lower also for the past year, though this only approached significance (0.31 compared to 0.34, $t = 1.89$, $P = 0.06$).

Between 1988 and 1989 there was a rise in both the number of male sexual partners and PSPs (partners with whom anal intercourse occurs). The proportion of partners with whom anal intercourse occurs has

Table 2. Distribution of the reported numbers of male sexual partners and penetrative sexual partners in lifetime, last 5 years, last year and last month at first interview, (in 1988).

Partners		Penetrative partners	
n	%	n	%
Lifetime			
0	2.6	0	8.9
1	1.3	1	8.6
2–10	19.6	2–10	42.6
11–50	35.0	11–50	23.6
51–500	11.1	51–100	6.6
101–500	21.2	101–500	7.1
501–1000	3.3	501–1000	1.6
>1000	5.8	>1000	1.0
Past 5 years			
0	3.2	0	14.2
1	3.8	1	15.1
2–10	34.7	2	12.7
11–50	38.8	3	11.0
51–100	8.3	4	7.8
101–200	6.0	5	5.3
>200	5.2	6–10	14.4
		11–50	15.1
		>50	4.4
Last year			
0	6.3	0	30.9
1	14.6	1	31.2
2–10	56.2	2–10	34.5
11–50	20.1	11–50	3.3
>50	2.8	>50	0.1
Last month			
0	23.4	0	59.7
1	39.3	1	31.6
2	15.6	2	6.2
3–5	15.2	>2	2.5
>5	6.5		

Table 3. Summary statistics for reported number of male sexual partners and penetrative partners at first interview, (in 1988).

	Life time	5 years	Past year	Last month
Sexual partners				
Median	38	16	4	1
Lower quartile	12	5	2	1
Upper quartile	181	40	10	2
Mean	279	52	11	2
s.d.	1101	126	22	3
Penetrative sexual partners				
Median	7	3	1	0
Lower quartile	2	1	9	0
Upper quartile	25	9	2	1
Mean	79	12	2	1
s.d.	459	36	5	1

fallen between the two interviews. Men are thus individually having high-risk sex with a lower fraction of their sexual contacts and, although the number of high-risk encounters has increased overall, it has increased by less than would be estimated from the rate of change of partners alone.

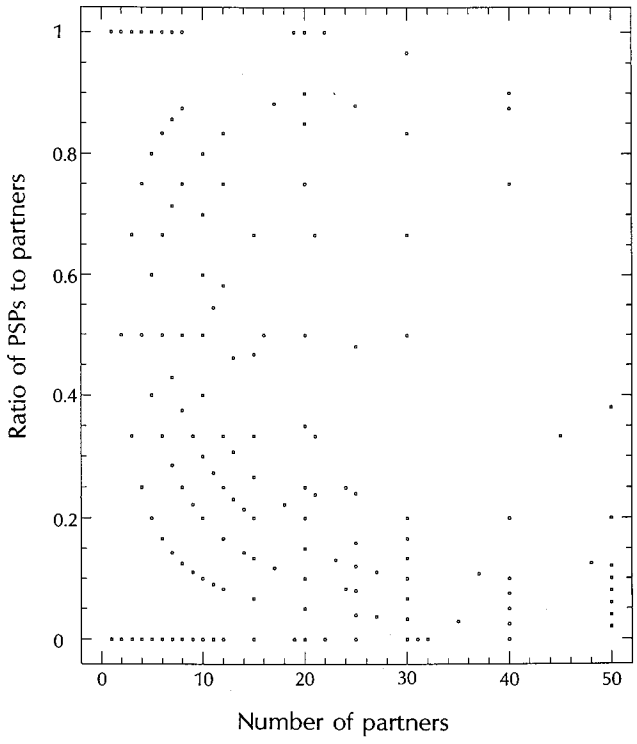

Fig. 1. Plot of ratio of numbers of penetrative sexual partners (PSPs) to partners against number of partners in last year, 1988.

Table 4. Median (and mean) number of male sexual partners and penetrative sexual partners (PSPs) in 1988 and 1989.

	Wave 1	Wave 2	% Change*
Partner last year	4 (11.6)	5 (15.6)	+35.1
PSP last year	1 (2.1)	1 (2.2)	+4.7
Partner last month	1 (2.2)	1 (2.5)	+13.0
PSP last month	0 (0.5)	0 (0.6)	+11.1

*Based on means.

Discussion

Among our earliest contributions to the debates about AIDS in this country, was a comment on the problems involved in reconciling the slow spread of HIV through homosexual contact with the large — indeed, in some cases, staggering — numbers of sexual partners reported in studies of gay men carried out before AIDS was recognized [22]. For example, Bell and Weinberg [24] report that over a half of their white male sample had had more than 25 sexual partners in the year before interview. If all of these encounters were penetrative, then the rate of transmission would, of course, be considerably faster than it actually appeared to be.

Part of the reason for this disparity lies in the distinction between 'partner' and PSP. Indeed, even Bell and Weinberg's figures [24] suggest that insertive anal intercourse was more than an occasional activity only for 62% of the white men, and in the receptive mode for just 49%. What they do not, of course, report is the number of partners with whom these activities occurred, what we have termed PSPs.

The notion of a PSP is an extremely important and powerful one in understanding homosexual behaviour in general and the epidemiology of HIV in particular. Its main advantage lies in distinguishing partners with whom high-risk behaviour occurs from those with whom it does not. A question which simply asks the respondent to estimate how often he has engaged in anal intercourse with his partners is open to several interpretations [18]. By asking directly about PSPs comparisons between different time periods is facilitated and a clearer picture of the epidemiological consequences of behaviour change emerges.

A second advantage of using estimates for PSPs is that comparisons can be more readily made with other studies, particularly those of heterosexual behaviour where it is often assumed that the majority of female partners are also penetrative. This assumption may be found wanting if the PSP distinction is drawn, although in the SIGMA study analysis of data about the heterosexual behaviour of the men in the cohort indicates that a higher proportion of female partners are penetrative than male partners [25]. The general population study currently being undertaken in the UK with funding from the Wellcome Foundation (London, UK) should provide a clearer picture of norms of heterosexual behaviour. Although cross-study comparisons are fraught with difficulties, not least because of different sampling techniques and differing social and age structures, it is nonetheless interesting to compare the median average figure of seven lifetime penetrative partners in this cohort of homosexually active men to figures for sexual partners quoted by recent studies of heterosexual men. Forman and Chilvers [26] implies a mean number of lifetime female partners of 9.6 and a median of 5, and the European Study Group [27] implies a mean and median of over four women partners in the previous 5 years. The implication may be that levels of PSP change (rather than simply partner change) by men who have sex with men is not much different from that for heterosexual men. It would therefore be extremely surprising, *ceteris paribus*, if the HIV epidemic did not spread within the heterosexual community in a similar manner as has been observed in the gay community.

A further advantage of using the notion of penetrative partners arises from work on reliability of estimates which suggests that smaller numbers are more easily and accurately recalled [20]. Since the number of penetrative partners is substantially lower than that for partners it is reasonable to assume that they can be more accurately recalled, allowing more reliable implications to be drawn. In this study respondents were asked to indicate how sure they were of their estimates of PSPs on a scale of 0 to 100. For the lifetime men PSP number almost half said that they were between 90 and 100% sure of their estimates and about one-fifth said they were less than 50% sure of their estimate. The median 'sureness' percentage was 90. For the last year and last month the proportion reporting a higher sureness is greater (as expected). For the last year 88% and for the last month 99% were between 90 and 100% sure of their estimate. Not only may smaller numbers of (penetrative) partners be more easily recalled, but the fact that they are penetrative may be significant in that recall. Anal penetration, as Prieur [28] argues, has meanings beyond HIV disease and may therefore be more accurately recalled than sex with partners which did not involve penetration.

The notion of a penetrative partner may not only be more theoretically important in modelling the epidemiology of HIV but may also be a more reliable indicator of risk. Indeed, as we have reported in an earlier paper [29], the HIV status of respondents in London is associated with number of lifetime PSPs ($F_{1181} = 12.18$, $P << 0.01$), number of PSPs in the last year ($F_{1198} = 3.52$, $P = 0.05$) and number of PSPs in the past month ($F_{1198} = 5.75$, $P < 0.05$) but, crucially, not with the numbers of partners.

This paper has demonstrated the use of PSPs in understanding changes in risk behaviour. Although it is shown that there was an increase in the number of partners reported between 1988 and 1989 the numbers of penetrative partners has not increased significantly. It cannot be assumed that because a person has higher numbers of partners his level of risk is also higher, not can it be assumed that a reported increase in numbers of partners between two time periods indicates a rise in risk behaviour. Higher numbers of PSPs, however, may indeed indicate increased risks.

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