EFFECTS OF HIV INFECTION, PERCEIVED HEALTH AND CLINICAL STATUS ON A COHORT AT RISK FOR AIDS

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Abstract—Data from a general population sample of 621 healthy homosexual men are used to evaluate the social and emotional effects of HIV antibody status, clinical signs detected by medical examination, and subjectively perceived symptoms. Participants are unaware of their serologic status at the time of data collection, thus allowing the effects of the virus to be separated from reactions to the knowledge of serologic status.

The data show that seropositivity for HIV is not associated with elevated levels of social or emotional impairment. Clinical signs lead to impairment in baseline data, but these effects do not persist at a second wave. This weakening suggests that the effects are mediated by psychological pathways rather than biologic ones. This suspicion is confirmed in further analyses, which show that the effects of clinical signs are mediated by subjectively perceived symptoms.

These results show that neither social nor emotional impairment is likely to be a prodromal sign of HIV infection in otherwise healthy homosexual men. The substantial levels of distress found among these men is more directly influenced by psychological determinants than biologic ones. This suggests that physicians should be aware of the psychological toll imposed on gay men who develop health problems in the current atmosphere of uncertainty regarding risk of AIDS.

Key words—AIDS, human immunodeficiency virus (HIV), perceived stress, distress

Numerous clinical reports have documented neurologic and psychiatric impairment associated with infection due to the Human Immunodeficiency Virus (HIV) [1, 2]. As a result, physicians are becoming increasingly sensitized to the possibility that patients in high risk groups (e.g. homosexually active men or intravenous drug users) presenting with a variety of psychiatric syndromes may be manifesting organic brain dysfunction rather than a functional psychiatric disorder [3].

The prevalence of neurologic and psychiatric sequelae of HIV infection in the much larger population of those who, although infected, have not developed AIDS is not known. This is a significant issue as it is estimated that between one and two million individuals in the United States are HIV seropositive [4]. The vast majority of these are asymptomatic and it remains unclear how many will develop AIDS; current estimates are that 10–40% may eventually do so, although considerable variability is being observed [5–7]. Furthermore, it is conceivable that this transition will take many years to occur and the latency period is estimated to be as long as 62 months [8]. During this time the individuals who experience HIV-related symptoms will have little way

of predicting whether their symptoms will stabilize, remit, or evolve.

There is every reason to believe that individuals who experience AIDS-related symptoms will suffer the same kinds of intense emotional distress that we know to characterize people who have been diagnosed with cancer [9] or other life-threatening illnesses [10]. Furthermore, there is also likely to be distress caused by knowledge that one is at risk for AIDS. This provides a potentially difficult clinical and scientific problem: to what extent does psychiatric symptomatology in at risk populations arise from HIV infection, and to what extent is it the result of the stress of the epidemic? To address this issue requires a large nonclinical sample of individuals who are not yet diagnosed with AIDS but for whom HIV serologic status is determined. Ideally, participants should be unaware of their serologic status so that any effects of virus infection, *per se*, could be separated from reactions to the knowledge of one's serologic status. Furthermore, it would be desirable to quantify both subjective and objective measures of health status. The former would provide a measure of AIDS-related health concern while the latter would assess AIDS-related symptoms. In this paper we use a sample with these characteristics to explore the relationship of HIV antibody status, health, and perceived health to multiple measures of psychiatric symptomatology and social dysfunction.

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Table 1. Demographic and background characteristics of the cohort (n = 621)*

Characteristics	Survey 1 $\bar{x}$	Survey 1 SD	Survey 2 $\bar{x}$	Survey 2 SD
Age in years	35.4	9.1	—	—
Education in years	16.3	2.3	—	—
Homosexually active in years	16.3	9.6	—	—
Income in thousands of dollars	24.5	12.4	—	—
Race, % white	92.6	—	—	—
In primary relationship, %	51.9	—	53.1	—
Religion:				
Jewish, %	5.2	—	—	—
Catholic, %	23.0	—	—	—
Protestant, %	31.6	—	—	—
Thinks of oneself as				
exclusively homosexual, %	65.7	—	75.0	—
Previous month's sexual behavior:				
Monogamous, %	15.0	—	21.9	—
Celibate, %	6.9	—	9.0	—
No. of partners	6.2	8.7	4.4	6.7
No. of exposures to particular risk activities†	14.6	14.8	11.9	13.6

*825 men completed the questionnaire at survey 1 and 831 at survey 2. 673 men completed the questionnaire at both waves; 36 were deleted from analyses for this paper because they either reported being paid for sex or provided missing data on our survey question about being paid for sex. In addition 16 seroconverters are omitted from the descriptive measures above.

†Number of risk activities was calculated by summing the number of times men engaged in receptive anal sex, performed fellatio, and engaged in active oral–anal sex.

METHODS

Subjects

Participants in this study were recruited from a cohort of 1102 homosexual men enrolled in the Chicago site of the Multicenter AIDS Cohort Study (MACS). This collaborative biomedical study, funded by NIAID and NCI, is designed to investigate the natural history of AIDS by collecting semiannual medical and laboratory data from those participating in it [11]. All participants in the Chicago MACS were asked to give their informed consent to enroll in the psychosocial investigation described here, with enrollment taking place between June 1984 and August 1985. Just over 95% of MACS participants consented to complete the supplemental psychosocial assessment and 90% returned completed questionnaires [12]. Analyses reported here are confined to that subset of men who were enrolled at the initial survey (S_1) and who completed the second survey (S_2) 6 months later. Because approximately one-third of the cohort was not enrolled until the time of the second survey, there are a total of 637 men for whom data are available from both S_1 and S_2 and who meet the inclusion criteria. Results are confined to those men not diagnosed with AIDS and who reported they were not paid for sex. This subset, described in Table 1, closely resembles the larger cohort.

The majority of MACS respondents (roughly 60%) were recruited to the study through advertisements placed in Chicago's gay-oriented magazines. An additional 20% were recruited through appeals to local organizations of particularly young or old gay men— such as campus groups or seniors' groups. Another 9% had previously participated in a Hepatitis B vaccine trial through the Howard Brown Memorial

Clinic. About 5% were affiliated with the same clinic as staff, volunteers, or friends, and about 6% were recruited through miscellaneous other sources. As the solicitation to campus and seniors' groups might suggest, the study attempted to recruit participants whose ages ranged widely. Other than this no effort was made to recruit a representative sample of homosexually active men. Although our respondents are undoubtedly unrepresentative of all homosexual men living in Chicago, there is no clear way to define such a population, and therefore no way to determine the representativeness of any sample (cf. Walter) [13]. The participants do, however, resemble other homosexually active men being studied in other cities [11].

Assessment of serologic status and symptoms

Analysis reported below use three classes of variables which describe the health of the study participants: self-reports of selected symptoms, the results of physical examinations, and serologic status. Methods for the assessment of these variables are discussed in this section.

In each semiannual MACS visit, serologic testing was done to assess HIV antibody status. Duplicate ELISA antibody testing was performed, followed by confirmatory Western Blot testing. Only 2.5% of the participants described in this paper seroconverted between S_1 and S_2, while 63.2% were consistently seronegative and 34.2% consistently seropositive. An important feature of our study is that participants did not know their serologic status as of the data collection at S_2.

At the beginning of each semiannual MACS visit, each study participant completed a self-report checklist of symptoms that might be indicative of infection and that he recognized since the last medical examination. A subsequent standardized physical examination independently assessed the participants' clinical status.

The self-report provides a measure of subjectively perceived health, and presumably of AIDS-related concern in those whose physical examination was negative. The medical examination provides an objective assessment of health status. We confine our analysis of subjectively perceived symptoms to that subset of symptoms which can be objectively verified by examination (weight loss, fever and lymphadenopathy), and exclude consideration of perceptions about symptoms (such as sleep disturbance) which cannot be verified by examination. This allows us to create a measure of the extent to which participants perceived symptoms accurately.

Information about symptoms obtained from the physical examinations was used to create a three-category summary measure of physical examination results. Symptom level one (SL1) is defined as the absence of any detectable confirming signs at examination. Symptom level 2 (SL2) is defined as the absence of lymphadenopathy but the presence of one other symptom of possible or potential infection. Symptom level 3 (SL3) is defined as the existence of either lymphadenopathy and/or at least two other symptoms of possible infection (such as night sweats, diarrhea, or fever).

At S_1, 56.4% of the cohort were asymptomatic, 11.5% were at SL2, and the remaining 32.1% were at

Table 2. Relationship of self-reported symptoms to physical examination results: survey 1 and survey 2

Physical examination results	n	Percentage of these participants whose self-report concurs with physical examination
Survey 1		
Lymphadenopathy present	183	14.2
Fever present	38	2.6
Lymphadenopathy absent	453	95.6
Fever absent	596	99.8
Survey 2		
Lymphadenopathy present	214	8.9
Fever present	26	0.0
Weight loss present	19	0.0
Lymphadenopathy absent	421	97.6
Fever absent	609	100.0
Weight loss absent	615	99.8

SL_3. At S_2, the comparable percentages were 48.0% (SL1), 14.3% (SL2) and 37.7% (SL3). Although not intended to serve as a clinical or diagnostic classification, this system appears generally to distinguish those who are more and less ill, as will be demonstrated later.

Self-reports of the three symptoms that respondents could detect and we could verify by examination—fever, weight loss, and lymphadenopathy—were much less common. We therefore distinguish only two levels of self-reported symptoms: any versus none. Only 15.7% of the men at S_1 and 9.5% at S_2 reported one or more of these three symptoms.

Self-reported and examination-detected symptoms are far from perfectly correlated, as shown in Table 2. The vast majority of men failed to report symptoms observed in the examinations. Of the participants with demonstrated lymphadenopathy, only 14% at S_1 and 9% at S_2 reported the existence of swollen lymph nodes. Similarly, only 3% of those with a fever (99.8° or higher) at S_1 reported this symptom while none of the 26 men with a fever at S_2 did so. Finally, none of the 19 men who lost 10 lb or more between the two examinations reported weight loss. The rates of true positive symptom reports, also shown in Table 2, are highly accurate in comparision.

It is difficult to know exactly why this substantial failure to report symptoms exists. Some symptoms might be difficult for participants to detect. None-

theless, it is unlikely that the results can be explained completely by inability to detect symptoms. This is a highly educated and knowledgeable sample in which it is difficult to imagine that bilateral, multisite lymphadenopathy would not be noticed in the majority of cases; this is particularly true in light of the intense anxiety that is associated with AIDS risk. On some level, then, we suspect that these men are denying their symptoms rather than confronting them. As shown in Table 3, nearly 61% of the consistently seropositive participants had signs which were detected by physical examination at S_1 and over 73% at S_2. We also see that 34% of the consistently seronegative men had one or more signs of infection at S_1 and over 39% at S_2. The imperfect relationship between serologic status and the presence of fever, weight loss or lymphadenopathy which might be interpreted (correctly or not) as signs of ARC or AIDS allows us to examine the independent contributions of HIV serologic status and health status in promoting social and psychological impairment.

Assessment of social and emotional functioning

As described elsewhere, a psychosocial questionnaire appropriate for this population has been developed [14]. This self-administered questionnaire takes approx. 90 min to complete. It includes information about routine sociodemographic variables as well as behavioral, social, cognitive, and psychological responses to the threat of AIDS. Participants are given the questionnaire when they visit the study center for their semiannual MACS visit. They are asked to take the questionnaire home and complete it approx. 2 weeks later at one sitting. This delay is requested in order to avoid overestimating the impact of AIDS on distress in the cohort; an overestimate would be likely if, as pretesting suggested, MACS examinations are associated with increased attention to the issue of AIDS and attendant increases in psychological distress. Participants are also encouraged to complete the questionnaire in a private setting in their own envionment, as a way of obtaining data more typical of their daily functioning.

Our study is unusual in its inclusion of a wide range of measures in the questionnaire that assess social and emotional functioning. Forty-three items from the Hopkins Symptom Checklist (HSCL) are included to generate checklist screening scores of somatization, obsessive-compulsive behavior, inter-

Table 3. Relationship between serologic status and physical examination results at survey 1 and survey 2

Examination results	Serologic status		
	Seronegative survey 1 and survey 2	Seronegative survey 1 and seropositive survey 2	Seropositive survey 1 and survey 2
Survey 1			
SL3	22.2% (89)	25.0% (4)	50.7% (110)
SL2	12.2% (49)	12.5% (2)	10.1% (22)
SL1	65.5% (262)	62.5% (10)	39.2% (85)
Survey 2			
SL3	23.9% (96)	50.0% (8)	61.7% (134)
SL2	15.2% (61)	31.2% (5)	11.5% (25)
SL1	60.8% (244)	18.7% (3)	26.8% (58)

Table 4. Scales of emotional and social functioning

Outcomes	Example of scale items	Number of items	Survey 1			Survey 2		
			$\bar{x}$	SD	Alpha	$\bar{x}$	SD	Alpha
Hopkins Symptom Checklist (HSCL) Subscales:								
Somatization	During the past month, ... bothered by headaches.	12	10.2	9.8	0.819	9.8	9.9	0.827
Obsessive–compulsive	During the past month, ... difficulty making decisions.	8	17.7	16.1	0.869	16.9	15.1	0.876
Interpersonal sensitivity	During the past month, ... feeling critical of others.	6	20.9	18.3	0.853	19.2	16.7	0.841
Depression	During the past month, ... thoughts of ending your life.	11	21.0	17.4	0.902	19.7	16.5	0.904
Anxiety	During the past month, ... suddenly scared for no reason.	6	17.1	15.3	0.806	16.0	14.5	0.797
Impaired well-being	During the past month, how much have you enjoyed the things you do?	11	32.2	16.2	0.821	32.1	16.5	0.821
Social role impairment	I act more irritably with the men I'm closest to than before AIDS.	18	8.7	12.8	0.798	10.2	14.4	0.822
AIDS-related negative affect	During the past month, the AIDS problem has made me feel tense.	6	33.4	24.8	0.751	37.2	26.8	0.772
AIDS-related worry/concern	Worris/concerns about AIDS interfere with my ability to relax.	6	22.7	25.9	0.899	25.4	27.7	0.914
Neuropsychiatric Symptoms:								
Cognitive impairment	During the past month, ... trouble remembering things.	10	10.5	12.9	0.774	8.7	11.1	0.796
Enervation	During the past month, ... feeling low on energy or slowed down.	4	23.5	20.1	0.782	22.9	19.2	0.788

We employed a pairwise deletion of cases to obtain the above figures. For means and standard deviations, those cases with missing data on more than one-third of the times were deleted. Missing data for remaining cases were replaced with the average score of other items on the index. The *n*'s of individual items range from 595 to 637. With this replacement rule, index *n*'s range from 596 to 637.

personal sensitivity, depression, and anxiety [15]. In keeping with recommendations of earlier writers such as Jahoda [16] and Bryant and Veroff [17], we also obtained measures of role performance (conceptualized here as social role impairment) and well-being. Mindful of the strains of this particular crisis, we also assessed AIDS-related negative affect and AIDS-related worry/concern. Finally, we included two measures of neuropsychiatric symptomatology selected for their frequent appearance in HIV-related organic brain dysfunction: cognitive impairment and enervation. All of these measures were scaled so that each score ranges theoretically from 0 (no checklist items are endorsed) to 100 (all items are endorsed). Means, standard deviations, reliability coefficients (alphas), and examples of items in each scale are presented in Table 4.

RESULTS

Extent of impairment

It is not possible to evaluate rigorously the impact of the AIDS epidemic on the psychological and social functioning of these men because baseline data on typical functioning prior to the onset of the epidemic are unavailable. However, we were able to determine that the levels of impairment experienced by members of this sample are markedly higher than those in the general population. This evaluation was made for the HSCL scales by comparing the levels of distress reported by our respondents with the norms established by Derogatis [19] for the general population and for psychiatric outpatients. This comparison is presented in Table 5. The data show clearly that the average HSCL scores for the MACS cohort are intermediate between those of the general population and those of a mixed psychiatric outpatient sample. In 9 out of 10 comparisons (each of the five HSCL scales at each of two time points), MACS distress scores are significantly greater, at the 0.05 level, than those in the general population sample.

Table 5 also presents two columns labeled '% case' for the S_1 and S_2 MACS cohort scores. The numbers reported in these columns report the % of men in the cohort with levels of the HSCL symptoms that are greater than or equal to the averages of the psychiatric outpatient sample reported in the same table. For example, the 11.3 reported under '% case' for the S_1 MACS sample score on somatization

means that 11.3% of the cohort at the first assessment reported a somatization score at least as large as the psychiatric outpatient mean (0.87).

Inspection of the 10 coefficients computed in this way shows that between 9% and 18% of the MACS participants report levels of somatization, obsessive-compulsive behavior, depressed mood, anxious mood or interpersonal sensitivity that meet or exceed those found among psychiatric outpatients. Taken together, calculations not shown in the table document that 29% of the cohort at S_1 and 26% at S_2 report distress equivalent to outpatients on at least one of these five dimensions.

It is important to realize that we cannot interpret this distress as due to the AIDS epidemic. As noted above, data on the prevalence of distress prior to the time when the AIDS epidemic began would be required to make such an interpretation. No such data are available. The comparisons we have made with general population norms do not help in this respect, because it is conceivable that rates of distress were higher among gay men than in the general population even before the epidemic began.

Despite this limitation, though, the results show clearly that a substantial percentage of the men in this cohort experience clinically significant emotional impairment. Yet, at the same time, it is striking to find that the vast majority have managed to maintain relatively normal emotional functioning despite the danger, loss, and uncertainty which the AIDS epidemic entails. Some measure of these stresses can be documented in the findings that 45% of the men report they know someone who has AIDS, 17% report that one of their past sexual partners has AIDS, and 35% know someone who has already died of AIDS.

The stresses brought on by AIDS are not limited to the loss of loved ones and the possibility of one's own death. Forty percent of the cohort report that people at work have expressed hostility toward homosexuals and 28% report interpersonal problems with their families. Smaller numbers report a variety of more extreme problems that are likely to be AIDS-related, including discrimination in work advancement (3%); discrimination by rental agents, bankers or other service personnel (6%); police harassment (6%); and physical violence or attempted violence from heterosexuals (6%). In the face of these problems, it is striking that rates of emotional impairment among these men are not even higher than reported here.

Table 5. Average HSCL impairment scores in the cohort: comparison with psychiatric outpatient and nonpatient samples

Outcomes	Psychiatric outpatient sample		General population sample		MACS cohort survey 1			MACS cohort survey 2		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	% 'Case'	$\bar{x}$	SD	% 'Case'
Somatization	0.87	0.75	0.36	0.42	0.41*	0.39	11.3	0.39	0.46	11.0
Obsessive-compulsive	1.47	0.91	0.39	0.45	0.71*	0.64	12.1	0.67*	0.60	10.7
Interpersonal sensitivity	1.41	0.89	0.29	0.39	0.83*	0.73	18.1	0.77*	0.67	14.9
Depression	1.79	0.94	0.36	0.44	0.84*	0.70	11.9	0.79*	0.66	9.9
Anxiety	1.47	0.88	0.30	0.37	0.68*	0.61	11.8	0.64*	0.58	10.2

*Significant at $P = 0.05$.
Outpatient and nonpatient norms are taken from Ref. [18], Table 20. The norms apply to mixed sex samples. Possible scores ranged from 0 to 4; for this analysis, screening scale scores in the cohort were also scaled to range from 0 to 4. Sample sizes are as in Table 4. A 'case' is defined as an individual whose score meets or exceeds the psychiatric outpatient mean.

Table 6. Average distress scores at survey 1 and survey 2, by serologic status

	Serologic status								
	Consistently seronegative			Seroconverters			Consistently seropositive		
	S_1	S_2	S_2/S_1	S_1	S_2	S_2/S_1	S_1	S_2	S_2/S_1
HSCL Subscales:									
Somatization	10.1	9.6	0.95	9.8	12.3	1.26	10.5	10.1	0.96
Obsessive–compulsive	18.0	17.1	0.95	14.3	17.4	1.22	17.1	16.4	0.96
Interpersonal sensitivity	21.9	20.0	0.91	14.8	16.4	1.11	19.4	17.9	0.92
Depression	21.8	20.0	0.92	15.4	17.3	1.12	19.7	19.3	0.98
Anxiety	18.4	16.1	0.88	12.5	15.1	1.21	15.0	15.9	1.06
Impaired well-being	32.9	32.8	1.00	27.6	26.8	0.97	31.1	31.1	1.00
Social role impairment	8.3	9.5	1.14	4.4	10.5	2.39	9.6	11.5	1.20
AIDS-related negative affect	32.9	36.4	1.11	18.7	33.7	1.80	35.4	39.5	1.12
AIDS-related worry/concern	22.1	24.2	1.10	16.7	27.1	1.62	24.4	27.7	1.14
Neuropsychiatric Symptoms:									
Cognitive impairement	10.3	8.4	0.82	6.8	11.4	1.68	11.1	9.0	0.81
Enervation	23.9	23.4	0.98	23.1	22.9	0.99	22.6	21.7	0.96
(*n*)	(372–401)			(15–16)			(206–217)		

n's for these descriptive measures vary in accordance with the missing data rule described in Table 4. Calculations in this table are based on samples of between 372 and 401 consistently seronegative men, between 15 and 16 seroconverters and between 206 and 217 consistently seropositive men.

The effect of serologic status

Our first concern was to assess if HIV infection leads to social or emotional impairment. Such an assessment is considerably more powerful in this sample than in others because none of the study participants was aware of his serologic status as of S_2. Thus we can separate the effects of HIV infection itself from those of meanings attached to sero-reactivity in the climate of intense fear and uncertainty surrounding AIDS.

Only 16 men in the cohort seroconverted between S_1 and S_2. If HIV causes social and emotional impairment, the impairment of seroconverters would increase more over time than that of men whose serologic status was consistently seronegative. Table 6 shows that this is exactly what we find in the data. Emotional impairment generally declined among men whose serologic status was consistently positive or negative, while it increased among those who seroconverted between the two examinations. The three scales specifically associated with the threat of AIDS—social impairment, worries/concerns and stresses—increased in all three subsamples over time. However, these increases were considerably more pronounced among seroconverters (S_2 scores between 1.6 and 2.4 times greater than S_1 scores) than among men whose serologic status was consistent over time (S_2 scores between 1.1 and 1.2 times greater than S_1 scores). Cognitive impairment, a possible indication of neuropsychiatric involvement, also showed a large increase among seroconverters. In contrast, enervation did not change much in any of the three subsamples. This last result is consistent with a result reported by Ostrow and colleagues [20].

There are at least two ways of interpreting this pattern. One is that HIV infection directly leads to emotional and social dysfunction. This explanation would require, however, that recent infection (seroconversion) more powerfully influence outcomes than longer-standing infection (stably seropositive). This would be surprising given our emerging understanding of HIV natural history. The second interpretation is that physical symptoms associated with

infection are interpreted by our respondents as evidence of exposure to the virus, and that the meanings attached to this interpretation produce social and emotional dysfunction for reasons only indirectly related to the biologic effects of the virus.

In order to discriminate between these two interpretations, we inspected more closely the data provided by seroconverters. Although based on an extremely small sample, this analysis showed clearly that increased impairment among seroconverters was confined to those 7 men who developed symptoms of infection between S_1 and S_2. No increase in psychological or social impairment was noted in the 9 participants who seroconverted but whose health did not deteriorate. This means that the onset of symptoms, rather than seroreactivity itself, accounts for increased social and emotional impairment. The question then arises whether HIV infection is implicated in a fundamental way or whether the presence of symptoms alone—even in the absence of HIV infection—would lead to the same social and emotional effects. Fortunately, given the imperfect relationship between serologic status and symptom manifestation reported above, we are able to investigate this issue.

The joint effects of serologic status and symptoms

We pursued this issue in analyses of men whose serologic status remained unchanged between the two data collections. Separate multiple regression equations were constructed at S_1 and S_2 to estimate the joint effects of serologic status and health in predicting psychological and social functioning. Each prediction equation had the expectation

$$0 = b_1 \text{SL3} + b_2 \text{SL2} + b_3 \text{SS}, \qquad (1)$$

where 0 is the outcome variable, SL3 is a dummy variable coded 1 for respondents with examination symptom scores at the third level of severity and 0 for all others, SL2 is a dummy variable coded 1 for respondents with examination symptom scores at the second level of severity and 0 for all others, SS is a dummy variable coded 1 for respondents who are

Table 7. Effects of physical examination ratings (SL2 and SL3) and serologic status (SS) on psychological and social impairment: standardized partial regression coefficients obtained from cross-sectional analyses

	Predictor variables			
	SL3	SL2	SS	R^2
SURVEY 1 OUTCOMES				
HSCL Subscales:				
Somatization	0.135*	0.086*	−0.019	0.019*
Obsessive–compulsive	0.104*	0.087	−0.041	0.013*
Interpersonal sensitivity	0.116*	0.072	−0.090*	0.017*
Depression	0.171*	0.079	−0.112*	0.030*
Anxiety	0.158*	0.101*	−0.143*	0.036*
Impaired well-being	0.111*	0.056	−0.090*	0.015*
Social role impairement	0.099*	0.044	0.029	0.012
AIDS-related negative affect	0.122*	0.074	0.011	0.017*
AIDS-related worry/concern	0.119*	0.051	0.009	0.014*
Neuropsychiatric Symptoms:				
Cognitive impairment	0.076	0.105*	0.020	0.014*
Enervation	0.143*	0.076	−0.069	0.020*
SURVEY 2 OUTCOMES				
HSCL Subscales:				
Somatization	0.079	0.017	0.003	0.006
Obsessive–compulsive	0.070	0.012	−0.047	0.004
Interpersonal sensitivity	0.026	−0.017	−0.068	0.004
Depression	0.067	0.026	−0.042	0.004
Anxiety	0.060	0.018	−0.033	0.003
Impaired well-being	0.025	0.054	−0.044	0.004
Social role impairment	0.058	0.047	0.044	0.008
AIDS-related negative affect	0.113*	0.078	0.022	0.015*
AIDS-related worry/concern	0.110*	0.063	0.018	0.013*
Neuropsychiatric Symptoms:				
Cognitive impairment	0.087	0.077	0.000	0.009
Enervation	0.075	0.002	−0.073	0.007

*Significant at $P = 0.05$.
For Tables 7–9 we deleted cases missing on any one of the predictor variables outcome scales in addition to applying the missing data rule stated in Table 4. Because we also tested for robustness of these under demographic controls, this somewhat lowered n; n's for Tables 7–9 range from 545 to 597.

seropositive and 0 for those who are seronegative, and b_1, b_2, and b_3 represent standardized partial repression coefficients which describe the effects of the predictors on the outcome. This model assumes that the joint effects of examination results and serologic status are additive, an assumption that is relaxed in a later analysis.

Information from 22 separate multiple regression equations (each of 11 outcomes at each of two time points) is reported in Table 7. Several clear patterns can be observed among these equations. First, the relationships are considerably more powerful at S_1 than S_2. Ten of the 11 equations are significant at the 0.05 level at S_1 compared to only two at S_2. It is unclear why this should be the case, but it seems likely that the explanation involves sociocultural processes rather than biologic ones; a biologic effect of symptoms or HIV infection would generally be expected to persist or even increase over time rather than decrease.

Second, at S_1 seropositive men unexpectedly experience lower levels of psychological and social impairment than seronegative men with the same examination results. It is impossible to imagine that the significant negative coefficients within this pattern represent a true effect of HIV infection. A more likely interpretation is that seroreactive men share some other characteristics which are associated with better functioning: greater involvement in sexual activities, a longer period of time as a homosexual, or any

number of other variables could explain this finding. This pattern attenuates at S_2, although negative signs still appear in the coefficients which were significant at S_1.

Third, we find a consistently positive relationship between symptoms and outcomes. The magnitude of this relationship is much smaller at S_2 than at S_1, but the positive sign and the dose–response relationship (with impairment consistently somewhat greater among men at SL3 than at SL2) are apparent at both time points.

The weakening of the symptom effects at S_2 leads us to believe that these effects are mediated by psychosocial pathways rather than biologic ones. Biologic effects would have either remained stable or increased in magnitude over time. Another result consistent with our interpretation was discovered in interactive multiple regression equations which relaxed the additivity assumption present in equation (1). These analyses found that the impact of symptoms on the various outcome variables is equally strong among seronegative and seropositive men. This means that HIV infection is not involved in the effects of symptoms on emotional and social functioning.

It should be noted that the interpretation of the results in Table 7, as indicating causal influences of examination results and serologic status on social and emotional functioning, assumes that these outcomes have no causal influences on the predictors. We

confirmed the validity of this assumption in cross-lagged longitudinal analyses. The unbiasedness of the regression coefficients also depends on the assumption that the unmeasured causes of the outcome variables are unrelated to the predictors included in equation (1). This assumption is impossible to verify empirically in the absence of data on all causes of social and emotional functioning. We have no such comprehensive battery of measures in the survey nor, indeed, does theory specify what all these predictors should be. As a result, the magnitude estimates in Table 7 cannot unequivocally be interpreted as the true causal effects of examination results and serologic status. It is of some importance to note, though, that more detailed analyses, which controlled for demographic variables (income and educational level) and general indicators of homosexual activity (years of homosexual activity) had no effect on the coefficients in Table 7.

The mediating effects of subjective symptom perception

Research on adjustment to stressful situations shows clearly that an important mediating influence is played by subjective appraisal processes, including recognition of the stressful situation, interpretation of it as threatening, and evaluation of options for reducing risk [21]. As described earlier, men in the MACS cohort have sufficient experience with AIDS in their social networks that the perception of symptoms as threatening should be universal, as should the evaluation of risk as serious and the realization that options for reducing risk once symptoms have appeared are few. Therefore, the most critical component in appraisal should be the initial step of symptom recognition.

We noted earlier that many of the men who objectively had lymphadenopathy, weight loss or fever on the basis of physical examination do not think of themselves as having symptoms of HIV infection. Furthermore, a few men think that they have symptoms which could not be verified by examination. This imperfect relationship between actual physical evidence and perceptions allows us to investigate the hypothesis that perceptions mediate the influence of symptoms on social and emotional functioning. If this hypothesis is correct, the associations between examination results and the outcome would be reduced when we controlled for perceived symptoms.

The statistical model used to evaluate this hypothesis has the expectation

$$0 = b_1 SL3 + b_2 SL2 + b_3 PS, \qquad (2)$$

where 0, SL3, and SL2 are defined as in equation (1), and PS is a dummy variable coded 1 for respondents with self-reported symptoms and 0 for those with no self-reported symptoms.

Results of analyses making use of this model are reported in Table 8. The results confirm the hypothesis. The effects of examination results (SL3 and SL2) are considerably smaller here than when perceived symptoms are not controlled. Furthermore, the relationships between perceived symptoms and the outcomes are considerably larger and more consistent than the relationships involving examination results. These findings, furthermore, hold even when several demographic controls are introduced into the analysis, including age, income, educational level and number of years of homosexual activity. The results of analyses making use of the control variables are

Table 8. Effects of physical examination ratings and perceived symptoms on psychological and social impairment: standardized partial regression coefficients obtained from cross-sectional analysis

	Predictor variables			
	SL3	SL2	PS	R^2
SURVEY 1 OUTCOMES				
HSCL Subscales:				
Somatization	0.054	0.044	0.242*	0.069*
Obsessive–compulsive	0.051	0.045	0.162*	0.034*
Interpersoal sensitivity	0.064	0.034	0.095*	0.016*
Depression	0.102*	0.039	0.123*	0.031*
Anxiety	0.054	0.057	0.189*	0.046*
Impaired well-being	0.048	0.013	0.135*	0.024*
Social role impairment	0.100*	0.031	0.067	0.018*
AIDS-related negative affect	0.107*	0.071	0.115*	0.033*
AIDS-related worry/concern	0.100*	0.028	0.113*	0.028*
Neuropsychiatric Symptoms:				
Cognitive impairment	0.057	0.062	0.141*	0.030
Enervation	0.085	0.051	0.158*	0.040*
SURVEY 2 OUTCOMES				
HSCL Subscales:				
Somatization	0.048	0.000	0.262*	0.075*
Obsessive–compulsive	0.048	−0.026	0.125*	0.021*
Interpersonal sensitivity	−0.012	−0.046	0.063	0.006*
Depression	0.026	−0.004	0.135*	0.020*
Anxiety	0.041	0.006	0.133*	0.021*
Impaired well-being	−0.019	0.011	0.083	0.007
Social role impairment	0.075	0.039	0.071	0.012
AIDS-related negative affect	0.110*	0.103*	0.085*	0.026*
AIDS-related worry/concern	0.106*	0.075	0.077	0.021*
Neuropsychiatric Symptoms:				
Cognitive impairment	0.078	0.046	0.112*	0.022*
Enervation	0.045	−0.027	0.127*	0.021*

*Significant at $P = 0.05$.
Refer to note in Table 7 for a discussion of the sample size used in this analysis.

not reported because they are very similar to those in Table 8.

Analyses not reported here also show that perceived symptoms create the same levels of social and emotional impairment whether or not the physical examination is confirmatory. Symptomatic people who fail to detect their symptoms are as free of social and emotional impairment as people who are asymptomatic. These results are consistent with the view that the gross effects of symptoms are mediated primarily by psychological appraisal processes rather than by biologic processes.

Longitudinal confirmation of the basic patterns

We also examined longitudinal data to determine whether the patterns observed at each point in time can be detected when we study *change* in functioning as the outcome. A wide variety of specifications was considered, including those in which we examined the possibility of reciprocal effects between the predictors and outcomes.

It is worth noting that there was no evidence in these analyses that elevated levels of social or emotional impairment cause subsequent changes in physician-detected symptoms of infection. This means that such symptoms *affect* rather than *reflect* the ability of respondents to fullfill normal role obligations and maintain emotional equilibrium.

The most parsimonious of the longitudinal specifications is presented in Table 9. Because of the relative stability of psychological and social functioning, it is important to include S_1 measures of the outcome measures as covariates in the regression model. When this is done, physical signs no longer significantly affect any of the outcomes while perceived symptoms still do. Perceived symptoms affect somatization most strongly, while also significantly affecting obsessive-compulsive behavior, anxiety, and depression. As with the cross-sectional analyses, the general pattern of these findings holds up when controls are introduced for demographic factors.

It is noteworthy that the effects of perceived symptoms on AIDS-related worries/concerns and stresses, while significant in cross-sectional analyses, are not significant in the longitudinal analyses. This suggests

that S_1 AIDS-related worries and stresses might affect S_1 symptom perceptions. This order of causality is very plausible. Indeed, in focused interviews conducted prior to the development of our questionnaire, we found that worries and concerns about AIDS lead some homosexual men to be extremely vigilant in monitoring bodily signs of illness. At times, this leads to overreactions on the basis of relatively minor symptoms [14]. It is important to note that this kind of vigilant coping with the threat of AIDS is less common than denial of the sort suggested in the results of Table 2.

DISCUSSION

Several important implications follow from the results reported above. Perhaps the most comforting one for those treating healthy homosexual men is that neither social nor emotional impairment is likely to be a prodromal sign of HIV infection. Evidence presented in this report clearly indicates that serologic status is not significantly associated with these kinds of impairment among men who have not developed AIDS. Indeed, even symptoms known to be associated with HIV infection seem to affect social and emotional functioning largely through mechanisms that have nothing to do with HIV infection. This suggests that physicians should be aware of the possible additional psychological toll imposed on gay men who develop health problems. Whether HIV seropositive or seronegative, these men may require support in understanding and coping with their situation. In the current atmosphere of extended uncertainty regarding risk of AIDS, such health problems are likely to be especially salient.

We have demonstrated that among men who do not know their physical status, perceived symptoms affect emotional and social functioning while actual physical status does not affect these things. This suggests that distress among these men is more directly influenced by social or psychological determinants than biological ones. Yet the perception of symptoms is not enough to explain the high level of distress found in this cohort. This raises the question whether other experiences associated with the AIDS

Table 9. Effects of physical examination ratings and perceived symptoms on psychological and social impairment: standardized partial regression coefficients obtained from longitudinal analyses

	Predictor variables				
Survey 2 outcomes	Same outcome at S1	SL3 at S2	SL2 at S2	Perceived symptoms at S2	R^2
HSCL Subscales:					
Somatization	0.662*	0.015	0.012	0.164*	0.502*
Obsessive-compulsive	0.698*	-0.009	-0.033	0.066*	0.502*
Interpersonal sensitivity	0.719*	-0.034	-0.048	0.031	0.521*
Depression	0.647*	-0.014	-0.029	0.084*	0.434*
Anxiety	0.651*	0.018	-0.001	0.086*	0.442*
Impaired well-being	0.632*	-0.034	0.005	0.044	0.405*
Social role impairment	0.529*	0.006	-0.014	0.037	0.285*
AIDS-related negative affect	0.593*	0.043	0.037	0.016	0.365*
AIDS-related worry/concern	0.586	0.063	0.043	0.038	0.360*
Neuropsychiatric Symptoms:					
Cognitive impairment	0.615*	0.001	0.015	0.074*	0.392*
Enervation	0.650*	-0.023	-0.032	0.057	0.433*

*Significant at $P = 0.05$.
Refer to note in Tabel 7 for a discussion of the sample size used in this analysis.

epidemic need to be considered for a more complete understanding. We think so. As noted earlier, almost half our respondents know someone who has died of AIDS. Nearly as many respondents told us of problems at work, in the community, or with their families that can be traced to concerns about AIDS. We believe that the emotional impact of the epidemic on gay men can be attributed, at least in part, to these changing experiences. Indeed, it might well be that these stresses are as important as perceptions of personal risk of the illness in explaining the distribution of social and emotional functioning in this cohort. We are now beginning to pursue this line of investigation.

Results presented here should not allow us to lose sight of the fact that neurologic and psychiatric complications are common among those infected with HIV. Patients in high risk groups presenting with symptoms that might otherwise be interpreted as evidence of a functional psychiatric disorder must be evaluated for organic dysfunction when appropriate. Yet it is also important to have some perspective on the problem and note that extreme emotional distress is widespread among men who are at risk of AIDS. Among men like those we have studied here, who are not showing any frank organic impairment, this distress is much more likely to be linked to adjustment reactions and to concern about the meaning of symptoms than to the virus itself.

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