ORIGINAL CONTRIBUTION

Neuropsychologic Impairment in Early HIV Infection

A Risk Factor for Work Disability

Steven M. Albert, PhD; Karen Marder, MD, MPH; George Dooneief, MD, MPH; Karen Bell, MD; Mary Sano, PhD; George Todak, MSW; Yaakov Stern, PhD

Objective: To explore the functional significance of incident neuropsychologic impairment among initially asymptomatic subjects infected with human immunodeficiency virus.

Design: Prospective, observational cohort study of homosexual and bisexual men to examine the incidence of work disability related to the onset of neuropsychologic impairment.

Setting: A university clinical and behavioral research site in New York City.

Participants: Sample of 207 homosexual and bisexual men; 123 were seropositive and 84 were seronegative.

Principal Outcome Measures: Incident work disability in the course of 4.5 years of follow-up, with disability defined as a persistent (≥24 months) change in work hours (from 20 or more to less than 20 h/wk).

Results: Compared with seronegative control subjects (n=72), the relative risk of work disability among initially asymptomatic seropositive men (n=44) was 2.76 (95% confidence interval, 1.2 to 6.5), nearly a threefold increase. Proportional hazards models show that this increased risk is attributable to the development of major neuropsychologic impairment in a subset (eight of 44) of the initially asymptomatic men, which is significantly associated with incident work disability (6/8 [75%]). Adjusting for symptom status and $CD4^+$ cell count at the time of disability did not eliminate the increased risk associated with neuropsychologic impairment.

Conclusions: In this cohort, the increased risk of work disability among initially asymptomatic human immunodeficiency virus–positive men was related to incident neuropsychologic impairment; such impairment predicted work disability independently of symptom status and $CD4^+$ cell count over the follow-up period. Neuropsychologic impairment in the course of human immunodeficiency virus infection may indicate increased risk for poor outcomes over and above that associated with systemic disease.

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From the Gertrude H. Sergievsky Center and Departments of Neurology (Drs Albert, Marder, Dooneief, Bell, and Sano) and Psychiatry (Dr Stern), College of Physicians and Surgeons, Columbia University, and the HIV Center for Clinical and Behavioral Research, New York State Psychiatric Institute (Mr Todak and Dr Stern), New York.

WHILE neuropsychologic impairment in asymptomatic human immunodeficiency virus (HIV) infection has not been universally reported,[1-9] abnormal neuropsychologic performance may represent an independent source of morbidity and mortality in the progression of HIV infection. In one study,[10] the presence of neuropsychologic impairment in seropositive (HIV+) individuals at baseline significantly increased the risk of mortality in 3 years of follow-up, even after adjusting for the progressive immunologic and systemic effects of HIV.

Neuropsychologic deficit in asymptomatic HIV disease was singled out for research because it is likely to have important functional consequences. Deficits in memory, attention, retrieval of information, and planning, for example, are likely to interfere with performance of daily tasks. For the patient infected with HIV who is otherwise physically asymptomatic, these deficits may result in significant morbidity, in the sense that patients may be unable to perform important tasks (eg, driving, work tasks), or may voluntarily withdraw from such activities because of concerns that they will be unable to perform them competently. Because medical care and drug therapies have allowed patients with HIV infection to live longer, HIV has become less an acute disease than a chronic one, in which morbidities of this sort must be addressed for the important goal of tertiary prevention, ie, prevention of excess disability.

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SUBJECTS AND METHODS

SUBJECTS

The sample for this investigation included 207 homosexual and bisexual men (123 seropositive and 84 seronegative), the first of whom were enrolled in 1988. Subjects were enrolled through advertisements placed in newspapers with a homosexual clientele and in sites frequented by homosexual and bisexual men. To be eligible, subjects had to know their serostatus (owing to sensitivity regarding the acquired immunodeficiency syndrome [AIDS] research at the time) and not yet meet the clinical criteria for AIDS (because the research focused particularly on the natural history of HIV infection). Complete information regarding recruitment and study design for this "Columbia cohort" has been reported elsewhere.[11] Baseline analyses of the cohort with regard to neuropsychologic performance,[3] psychiatric diagnoses,[12] and behavioral risk factors for HIV infection[13] have also appeared.

ASSESSMENTS

After giving informed consent, subjects were examined at 6-month intervals, at which time a full medical examination, neurologic and neuropsychologic examination, psychiatric examination, laboratory assessment of immunologic function, and behavioral survey were undertaken. All examinations were performed by physicians and research staff who were shielded from the HIV status of subjects.

DETERMINATION OF HIV SYMPTOM STATUS

Based on the examination and medical history, symptoms related to HIV were scored using the HIV Center Medical Staging Scale.[14] In this scale, subjects with scores of 9 or less are considered physically asymptomatic; any symptoms reported are unrelated to HIV infection and are not severe enough to warrant clinical attention. A score of 10 through 19 indicates minimal HIV-related symptoms, such as generalized lymphadenopathy. A score of 20 through 29 indicates moderate symptomatic status, with serious constitutional symptoms. Scores of 30 or greater indicate that a subject meets the criteria for AIDS as defined by the Centers for Disease Control and Prevention (Atlanta, Ga). Subjects with baseline scores greater than 9 were considered symptomatic.

DETERMINATION OF IMPAIRED NEUROPSYCHOLOGIC PERFORMANCE

An extensive battery of neuropsychologic tests was administered to the cohort and is described in detail elsewhere.[3] Individual tests were grouped into areas of cognitive function, ie, general mental status, memory, language ability, executive function, visuospatial function, attention, and motor speed/praxis. Performance on each test was compared with norms derived from populations of the same age and education, allowing test scores to be considered normal, borderline (at least 1 SD below the mean), or defective (at least 2 SDs below the mean). Subjects were assigned a "global neuropsychologic performance score" of 0 (no performance deficit in any cognitive area), 1 (borderline performance in two or more areas), 2 (defective performance in one area), 3 (defective performance in two or more areas), or 4 (defective performance in memory and in two or more areas). For this analysis, neuropsychologic performance was considered to be defective if subjects scored 3 or greater, ie, test scores were in the defective range for two or more areas of cognitive function.

In addition to neuropsychologic testing, subjects were rated on neurologic symptoms, including cognitive and motor symptoms,[3] and on a modified expanded disability status scale, which served as a global neurologic performance score.[15]

DETERMINATION OF WORK DISABILITY

At each assessment, subjects were asked about their employment status, which was coded as full-time, full-time but limited in vocational function, not fully employed but half-time or more, between half-time and quarter-time, quarter-time or less, and not working. For this analysis, these scores were dichotomized, so that subjects working half-time or more (ie, $\geq$20 h/wk) were considered fully employed. This dichotomy seemed appropriate because a number of subjects in the cohort were self-employed and set their own hours. It is in any case a conservative approach to work disability, as it requires subjects to reduce their work time considerably before they are considered disabled.

As an additional constraint, subjects were considered to have experienced work disability only if they remained at less than half-time employment for 2 or more years. Subjects who reported less than half-time employment at one visit, but who reported more than half-time employment in the next assessment, were not considered in terms of work disability.

DATA ANALYSES

Time to onset of work disability and cumulative incidence of work disability were assessed using product-limit life-table analyses[16] and proportional hazards regression models,[17] implemented in the Statistical Analysis System. Both methods treat work disability as an end point and adjust for subjects who were not available for follow-up (ie, censoring). The primary analytic approach is to compare subjects who were seronegative or asymptomatic seropositive at baseline according to the cumulative incidence of work disability and to assess covariates that increase the risk of work disability. Proportional hazards models offer the advantage of using both baseline and time-dependent covariates in predicting onset of work disability.

These survival models generate risk ratios (or relative risks [RRs]) that specify the degree to which risk of work disability is elevated, relative to a reference group, given that a subject has certain baseline characteristics or other characteristics that appear in the course of follow-up. The SE associated with this RR is used to generate confidence intervals (CIs) for assessing the significance of any particular covariate, net of other covariates, in predicting work disability.

To examine the functionalsignificance of cognitive impairment in early HIV infection, we analyzed a cohort of asymptomatic seropositive individuals compared with a seronegative control group and determined the effect of incident neuropsychologic impairment on employment, a central component of everyday life. Work disability offers an excellent test of the functional significance of neuropsychologic deficit. Examining incident work disability among initially asymptomatic seropositive subjects may give a clearer picture of the functional significance of emerging defects in neuropsychologic performance related to HIV infection.

RESULTS

The number of subjects followed up in this natural history study and attrition in the cohort over the 10 assessments are shown in **Table 1**. The table also shows the percentage of seropositive subjects at each assessment. As part of the inclusion criteria for the study, no subject had AIDS at baseline. Only one subject seroconverted, and this occurred in year 5 of the study. At 54 months (visit 10), about half the cohort was not available for follow-up. There were 34 known deaths, a likely underestimate, since analyses show that sicker subjects were more likely to be unavailable for follow-up. However, unavailability for follow-up did not differ between seronegative subjects and subjects who were asymptomatic at baseline, the groups of primary interest in the analysis.

We first examined the extent to which baseline symptom status was associated with incident work disability. Eliminating subjects who were not fully employed at baseline left a sample of 185 subjects, who formed the risk set for this survival analysis. **Table 2** shows the breakdown of the full set of subjects by medical stage, the cumulative incidence of work disability for each group of subjects, and the RR associated with HIV medical stage, using the seronegative subjects as a reference group.

Table 1. Respondents in the Columbia Cohort

Visit No.	n	Seropositive, %
1	207	59.4
2	162	68.3
3	155	66.5
4	152	68.9
5	147	65.1
6	138	65.7
7	128	63.3
8	115	59.8
9	105	60.0
10	98	60.4

While the cumulative incidence of work disability in the seronegative group was 16%, it was 40% in the asymptomatic group, 53% in the minimally symptomatic group, and 48% in the moderately symptomatic group. Relative to the seronegative group, each of the HIV+ baseline symptom groups had a significantly elevated risk of work disability over the course of the follow-up period. The asymptomatic group was nearly three times more likely to experience work disability than was the seronegative reference group (RR, 2.76; 95% CI, 1.2 to 6.5).

A first attempt to determine the sources of this elevated risk for incident work disability is shown in **Table 3**, which compares seronegative and HIV+ asymptomatic subjects on baseline characteristics. The HIV+ asymptomatic group had a poorer immune profile and poorer neurologic symptom rating, but the groups did not differ significantly on any other parameter, including education, social class, disability rating, motor or cognitive function, or mean score on the global measure of neuropsychologic performance (though the two groups do differ in raw score performance on a number of the tests, as reported by Stern et al[3]). As depression and substance abuse disorders might also be confounded with HIV status and risk of incident work disability, these also were investigated. As shown in Table 3, the groups were comparable in the proportion of subjects with syndromal depressive disorders and substance abuse diagnoses (as established by the criteria of the *Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition*[18]).

Entering the baseline characteristics that distinguished the groups as covariates in a proportional hazards model did not yield significant predictors of work disability. For example, the RR for baseline $CD4^+$ cells was not significant in a model that also included HIV status. Similarly, neurologic rating was not a significant predictor of work disability independent of HIV status.

Because baseline covariates did not predict time to onset of work disability, time-dependent covariates were introduced. We were particularly interested in assessing the role of incident neuropsychologic deficit in the asymptomatic HIV+ group as a potential source of work disability, given results from prior research.[10] We used the measure of defective neuropsychologic performance described above, ie, test scores in the defective range in at least two areas of cognitive function, as a time-dependent covariate. The time-dependent approach assesses the relationship between defective neuropsychologic performance at each assessment and incident work

Table 2. Cumulative Incidence of Work Disability by Baseline HIV Medical Stage*

Stage	n	Cumulative Incidence	Censored, %	Beta Estimate	RR	95% CI
HIV−	72	0.16	0.89	...	1.00	...
Asymptomatic HIV+	44	0.40	0.66	1.017	2.76	1.2-6.5
Minimally symptomatic HIV+	28	0.53	0.54	1.399	4.05	1.6-9.8
Moderately symptomatic HIV+	41	0.48	0.68	1.112	3.04	1.3-7.4

**Seronegative respondents serve as reference group. Human immunodeficiency virus (HIV) medical stage defined according to Columbia University HIV Center Medical Staging Scale (Gorman et al[14]): asymptomatic, minimally symptomatic, moderately symptomatic. No respondents had acquired immunodeficiency syndrome at baseline (see text). RR indicates risk ratio; CI, confidence interval; minus sign, negative; and plus sign, positive.*

Table 3. Baseline Characteristics of Fully Employed Seronegative and Asymptomatic HIV+ Respondents in the Columbia Cohort*

	Seronegative (n=72)	HIV+ Asymptomatic (n=44)	*t* Ratio/χ^2	*P*
$CD4^+$/mL	817.76	397.30	8.97	<.001
$CD8^+$/mL	526.54	671.52	−3.40	.001
$CD4^+/CD8^+$	1.67	0.64	10.18	<.001
NP global score	1.18	1.31	−0.62	NS
Neurologic rating	1.04	2.61	−2.82	.006
Motor function	0.11	0.34	−1.82	NS
Cognitive function	0.45	0.75	−1.37	NS
Depressive disorder, %	6.94	13.64	1.32	NS
Substance abuse disorder, %	6.94	4.54	0.18	NS
Disability scale	1.11	1.19	−0.61	NS
Education, y	16.72	16.12	1.25	NS
Social class scale	6.96	6.39	1.67	NS

**Neuropsychologic performance (NP) global score assesses defective performance in neuropsychologic domains based on age- and education-adjusted norms (range, 0 to 4, with 4 indicating defective performance [z≤2] in memory and two other domains; see Stern et al[8]). Neurologic rating is an overall symptom index based on neurologic examination of motor, behavior, and cognitive performance. Motor and cognitive functions are subscales of the overall index. High scores indicate poorer function. Diagnosis of depressive and substance abuse disorders (alcohol and illicit drugs) is based on* DSM-III-R *criteria. The disability scale is an expanded version of the Kurtzke Disability Scale (Kurtzke[15]). The social class scale is Hollinghead's revised version, with scores ranging from 1 (menial) to 9 (professional). HIV+ indicates human immunodeficiency virus positive.*

Table 4. Cumulative Incidence of Work Disability Among Seronegative and Asymptomatic HIV+ Respondents According to Time-Dependent Neuropsychologic Status*

Group	n	Cumulative Incidence	Censored, %	Beta Estimate	RR	95% CI
HIV−, NP normal	60	0.15	0.90	...	1.00	...
HIV−, NP defective	12	0.25	0.10	0.665	1.95	0.4-9.6
HIV+, asymptomatic, NP normal	36	0.30	0.27	0.792	2.21	0.8-6.2
HIV+, asymptomatic, NP defective	8	0.75	0.25	2.147	8.47	2.7-26.5

**Defective neuropsychologic performance (NP) defined as defective scores (z≤2, for age- and education-adjusted norms) in two or more domains (Stern et al[3]). This measure of defective NP performance was introduced as a time-dependent covariate in the Cox proportional hazards regression model. HIV indicates human immunodeficiency virus; minus sign, negative; plus sign, positive; RR, risk ratio; and CI, confidence interval.*

disability. This analysis showed that neuropsychologic deficit in a subset of the asymptomatic HIV+ subjects is responsible for the elevated risk of work disability. **Table 4** presents this finding in detail.

Table 4 divides seronegative and asymptomatic HIV+ subjects according to whether subjects demonstrated defective neuropsychologic performance during the follow-up period. As shown in Table 4, asymptomatic HIV+ subjects who scored in the normal range of neuropsychologic performance did not have a significantly elevated risk of work disability (RR, 2.21; 95% CI, 0.8 to 6.2); unity is included in the CI. Only those with defective neuropsychologic performance had a significantly elevated RR of 8.47 (95% CI, 2.7 to 26.5); 18.2% (8/44) of the initially asymptomatic HIV+ subjects experienced neuropsychologic impairment in the course of follow-up, and 75% (6/8) of these subjects also experienced work disability. Of the 36 subjects who did not develop neuropsychologic impairment, nine experienced work disability (cumulative incidence of 30%).

It is worth noting that the proportion of subjects who scored in the defective range of neuropsychologic performance at any assessment did not significantly differ between seronegative and seropositive subjects; for example, 16.7% (12/72) of the seronegative subjects had at least one assessment with a score in the defective range. However, seropositive subjects who scored in the defective range at a particular visit were likely to score in the defective range at subsequent visits as well, while defective performance in seronegative subjects was "sporadic," ie, more variable across visits. Also, for asymptomatic HIV+ subjects, defective performance was a predictor of incident work disability (as indicated by the significantly elevated RR); for seronegative subjects, it was not.

The association between neuropsychologic deficit and work disability in the initially asymptomatic subjects may reflect the progress of systemic disease, rather than an independent predictive significance for neuropsychologic impairment. To assess this possibility, the number of HIV-related symptoms was entered as a time-dependent covariate; this allows the influence of progressive systemic disease to be assessed relative to neuropsychologic impairment in predicting incident work disability. As shown in **Table 5**, such adjustment did not reduce the predictive significance of neuropsychologic impairment, nor did additional adjustment for baseline $CD4^+$ cells and neurologic rating. The adjusted RR for subjects initially asymptomatic who developed neuropsychologic deficits was 5.47 (95% CI, 1.08 to 27.7).

Repeating the analysis for the $CD4^+$ cell count as a time-dependent covariate showed similar results. Even with such adjustment, asymptomatic subjects who developed neuropsychologic deficit showed a significantly increased risk of work disability (RR, 4.69; 95% CI, 1.04 to 21.14). Seropositive subjects who failed to develop neuropsychologic deficits did not show a significantly elevated risk.

Table 5. Work Disability Risk Ratios for HIV Status and NP Impairment Adjusted for Covariates: Final Model (Time-Dependent Symptom Stage, Baseline Neurologic Symptom Status, Baseline CD4+)*

Group	n	Beta Estimate	RR	95% CI
HIV−, NP normal	60	...	1.00	...
HIV−, NP defective	12	0.664	1.89	0.38-9.4
HIV+, asymptomatic, NP normal	36	0.403	1.50	0.37-6.1
HIV+, asymptomatic, NP defective	8	1.70	5.47	1.08-27.7

*HIV indicates human immunodeficiency virus; minus sign, negative; plus sign, positive; NP, neuropsychologic performance; RR, risk ratio; and CI, confidence interval.

Table 6. Incident Neuropsychologic Deficit and Work Disability Among Subjects Asymptomatic at Baseline: Proportion Remaining Asymptomatic at Time of Disability or Last Follow-up*

Baseline HIV+ Asymptomatic Subjects (N=44)		
With Incident Neuropsychologic Deficit, No.	With Incident Work Disability, No.	Remaining Asymptomatic, No. (%)
Yes, 8	Yes, 6	2 (33)
	No, 2	0 (0)
No, 36	Yes, 9	4 (44)
	No, 27	6 (22)

*F test for asymptomatic status (analysis of variance) is not significant. HIV+ indicates human immunodeficiency virus positive.

These results show that incident neuropsychologic deficit in this group of initially asymptomatic seropositive men predicts work disability, even taking into account the worsening symptom stage and the $CD4^+$ cell count over time. **Table 6** shows this result in an alternative format. The table is limited to subjects initially asymptomatic and shows the percentage remaining asymptomatic at the time of work disability (or at the last follow-up for those not reaching the disability end point), cross-classified by neuropsychologic status.

After 4.5 years of follow-up, 27% (12/44) of the initially asymptomatic men remained asymptomatic. The proportion of subjects who remained asymptomatic was not significantly different among the four groups defined by incident work disability and neuropsychologic status. More specifically, among subjects experiencing work disability, those with and without defective neuropsychologic performance did not significantly differ in the proportion remaining asymptomatic (33% and 44%, respectively). Similar results were obtained for the proportions of subjects with $CD4^+$ cell counts below 0.20×10^9/L (200/μL^3).

Finally, in the baseline asymptomatic group, work disability was not associated with psychiatric diagnosis. Depressive disorders were equally distributed between subjects who experienced work disability and those who did not (13.3% and 13.8%, respectively). Substance abuse diagnoses were higher in the group that remained employed.

COMMENT

This research has shown that baseline asymptomatic HIV+ status is associated with increased risk of work disability, relative to seronegative control subjects, over a 4.5-year follow-up period. This increased risk is largely the result of a much higher risk among a subset of asymptomatic HIV+ subjects who go on to develop severe neuropsychologic symptoms in the course of infection. These subjects are also at increased risk of mortality, for in this cohort half (four of eight) are known to have died by the 10th assessment. This confirms the findings of Mayeux et al,[10] who found that defective neuropsychologic performance in HIV infection was associated with increased risk of mortality.

At baseline, asymptomatic HIV+ subjects who went on to experience neuropsychologic deficit and work disability did not differ in obvious ways from other asymptomatic seropositive subjects. The two groups did not differ significantly in $CD4^+$ cell counts, in neurologic status, or in medical status. However, subjects who later experienced work disability already showed significantly poorer performance at baseline on a variety of neuropsychologic tests (data available on request), including raw score differences in verbal memory (selective reminding, delayed recall), language (controlled verbal fluency, animal recognition), motor function (Trails-A, Purdue pegboard), and attention (cancellations, digit span forward and backward). Thus, poor neuropsychologic performance during the phase of asymptomatic HIV infection may indicate increased risk of early functional morbidity.

The significance of defective neuropsychologic performance as a source of work disability in asymptomatic subjects is confirmed in proportional hazards models that adjust for competing sources of work disability, such as worsening symptom status and worsening $CD4^+$ cell status. Adjusting for these covariates showed that defective neuropsychologic performance in the course of HIV infection still significantly increased the risk of work disability, relative to seronegative, neuropsychologically normal control subjects.

These findings suggest that only a subset of asymptomatic HIV+ subjects develop severe neuropsychologic impairment and face an increased risk of incident work disability; in this cohort, 18.2% (8/44) of the subjects fell into this category. The prevalence of defective neuropsychologic performance among seronegative subjects (16.7% [12/72])was similar (ie, a similar proportion overall scored in the defective range at some point in the course of follow-up); but for these seronegative subjects, defective neuropsychologic performance was not sustained over subsequent assessments and was not a significant predictor of work disability.

While the sample size is small, requiring caution in the interpretation of results, it is notable that seropositivity increased the risk of work disability among the 20 subjects (12 of 72 seronegative, eight of 44 asymptomatic seropositive) who showed defective neuropsychologic performance at follow-up assessments. The cumulative incidence of work disability among seronegative subjects who developed neuropsychologic deficits was 25%; but among seropositive subjects in this category, the cumulative incidence was 75%.

Incident neuropsychologic deficit remains a signifi-

cant predictor of work disability, even with adjustment for progressive systemic disease (as indicated by the number of HIV-related symptoms and $CD4^+$ cell counts in the course of infection). This indicates that neuropsychologic impairment is not simply a surrogate for more advanced disease in predicting work disability. Examining the proportion of subjects still asymptomatic at the point of disability confirms this result. If more advanced disease were responsible for work disability (with no independent effect for defective neuropsychologic status), the neuropsychologically compromised group should show a lower proportion of subjects still asymptomatic at the time of disability. In fact, the proportion of asymptomatic subjects in the impaired and nonimpaired groups was not significantly different (two of six vs four of nine). The proportion remaining asymptomatic was actually somewhat lower in the group that did not experience neuropsychologic deficit and continued to work (6/27 [22%]).

In these analyses, a stringent definition of work disability was employed; subjects had to work 20 or less hours per week for 2 consecutive years (four follow-up visits) to be considered an incident case. We chose this duration to eliminate transient work reduction unrelated to HIV. Because this definition excludes short periods of work disability (which are clearly significant in the lives of people with HIV infection), analyses were also conducted with less stringent definitions of work disability, taking as an end point (1) less than 20 h/wk persisting for only 1 year and (2) first occurrence of less than 20 h/wk, whatever its duration over subsequent assessments. Proportional hazards regression models using these end points yielded similar results.

It should be stressed that the increased risk of work disability associated with asymptomatic HIV infection was evident only in the follow-up period. A baseline comparison of cohort subjects who were working and not working did not reveal significant differences in neuropsychologic performance. Heaton et al[19] reported such a baseline difference, even when limiting the analysis to asymptomatic subjects. Lack of such a difference in the Columbia cohort may be attributable to unemployment linked to economic trends (rather than HIV), onset of severe neuropsychologic impairment at a later point in the course of infection, and the generally high economic status of the cohort.

The finding of increased risk of work disability among asymptomatic HIV+ subjects, relative to that among seronegative control subjects, should be understood in the context of certain limitations in this study. First, we have assessed work disability with a single indicator, eg, whether subjects are working more or less than 20 hours a week. It is possible that more sensitive occupational measures, such as qualitative changes in work performance, would show greater rates of work disability early in the course of HIV infection. Second, while defective neuropsychologic performance is the best predictor of incident work disability in the initially asymptomatic subjects, we cannot assume that these defects cause work disability. That is, subjects may still be performing work duties adequately, but they may quit working because of other concerns, such as fear that they will soon be unable to perform such work duties. The actual motivations to stop working or remain employed in the face of HIV-related deficits require further research.

In summary, this research suggests that a subset of seropositive asymptomatic subjects, for reasons still unclear, is likely to develop neuropsychologic impairment severe enough to increase their risk of work disability. The relationship between neuropsychologic impairment and work disability remains even when adjustment is made for the $CD4^+$ cell count and symptom status at the time of disability. The prognosis for this pattern of HIV infection is poor, with increased risk of mortality. Neuropsychologic tests may, thus, be an important diagnostic tool for identifying this subset of early, asymptomatic HIV patients who need to be targeted for therapies designed to arrest the neurologic effects of HIV infection.

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Reprint requests to Gertrude H. Sergievsky Center, Columbia University, P & S Box 16, 630 W 168th St, New York, NY 10032 (Dr Albert).

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