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Leisure Activities and Risk of Vascular Cognitive Impairment in Older Adults

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Abstract

“Vascular cognitive impairment” refers to cognitive impairment caused or associated with vascular risk factors, and encompasses a cognitive spectrum ranging from mild cognitive impairment to dementia. We examined the association of leisure activity participation to risk of developing VCI in the Bronx aging study. Over 21 years, 71 of the 401 participants who were free of dementia or VCI at entry developed VCI (49 participants with VCI without dementia). We derived Cognitive and Physical Activity Scales based on frequency of leisure activity participation. A 1-point increase on the Cognitive, but not Physical Activity Scale, was associated with lower risk of VCI (hazard ratio 0.931, 95% confidence interval [CI] 0.895–0.970) in Cox analysis. Participation in cognitive but not physical leisure activities is associated with lower risk of VCI with or without dementia. Prospective studies and clinical trials are needed to define the causal role of cognitive leisure activities in influencing vascular risk for cognitive decline.

Keywords

leisure activities; cognition; elderly; stroke

Introduction

There is increasing evidence that cerebrovascular disease can cause significant cognitive and functional decline even in the absence of dementia.^{1–3} The term “vascular cognitive impairment” (VCI) has been proposed to indicate cognitive impairment that is caused by or associated with vascular risk factors.^{1–3} Clinically, the VCI syndrome encompasses a broad spectrum of cognitive and behavioral disturbances ranging from states of mild cognitive impairment (MCI) associated with strokes or cerebrovascular disease to vascular dementia and Alzheimer disease (AD) with a vascular component (mixed dementia).^{1–6} The concept and definitions of VCI are still evolving,¹ and little is known about risk factors that influence progression to VCI.

We have previously reported that increased participation in leisure activities by older adults in the Bronx Aging Study was associated with a lower risk of dementia, including vascular dementia and mixed dementia subtypes as well as the amnesic subtype of the MCI syndrome. Leisure activities may help reduce cognitive decline by building cognitive reserve, reducing

chronic stress, or promoting a healthy lifestyle.^{7,8} Based on our prior findings,^{7,8} we hypothesized that leisure activities, especially cognitive activities, would be associated with reduced risk of developing VCI in the same cohort. We define VCI based on cognitive dysfunction mainly in nonmemory domains associated with cerebrovascular disease, consistent with current conceptual definitions.^{1–3} Leisure activity participation represents a modifiable lifestyle choice that has been found to influence cognitive decline in older adults; the current investigation examines the impact of cognitive and physical activities on risk for VCI with and without dementia.

Methods

Study Population

The study design of the Bronx Aging Study has been described previously.^{7–9} Briefly, the study enrolled English-speaking community residing participants between 75 and 85 years of age. Exclusion criteria included severe visual or hearing loss, idiopathic Parkinson disease, liver disease, alcoholism, or known terminal illness. Participants were screened to rule out dementia using a cutscore of 8 or fewer errors on the Blessed Information–Memory–Concentration Test,¹⁰ which has high test-retest reliability (0.86), and correlates well with Alzheimer pathology.¹¹ The inception cohort was middle-class, predominantly Caucasian (91%), and mostly women (64%). Written informed consent was obtained after complete description of the study to the participants. Participants were assessed using study protocols that were approved by the local institutional review board. The study enrolled 488 nondemented participants between 1980 and 1983. The study period for this analysis consists of the 21-year span from 1980 to 2001.

Clinical Evaluation

Participants were evaluated at entry and at 12- to 18-month follow-up visits.^{7–9} They were interviewed by research assistants to obtain information about sociodemographic variables, medical illness, medication use, and depressive symptoms.^{7,8,12} They were examined by study neurologists, who also completed the Hachinski ischemic score as an index of cerebrovascular disease burden.¹³ A family member or caregiver accompanied most participants or was contacted to confirm the medical history. However, absence of informants was not used as an exclusion criterion. Medical records and primary care physicians were also consulted to obtain additional information. Functional limitations in 10 basic and instrumental activities of daily living were assessed.^{7–9} An extensive neuropsychological test battery was administered at each visit that included tests of general cognition (Blessed test),¹⁰ intelligence (Wechsler IQ Scales),¹⁴ memory (Fuld Object-memory Evaluation test),¹⁵ and semantic memory (Category Fluency test).¹⁶

Leisure Activities

Leisure activities may be defined as activities that individuals engage in for enjoyment or well-being, independent of work or activities of daily living.^{7,8} At baseline, participants were interviewed about participation in 6 cognitive (reading, writing, crossword puzzles, board or card games, group discussions, or playing music) and 10 physical activities (tennis, golf, swimming, bicycling, dancing, group exercises, team games, walking, climbing more than 2 flights of stairs, and babysitting). We coded self-reported frequency of participation to generate a scale with 1 point corresponding to participation in 1 activity for 1 day per week. For each activity, participants received 7 points for daily participation; 4 points for participating several days per week; 1 point for weekly participation; and 0 points for participating occasionally or never. We summed activity days for each individual activity to generate a Cognitive Activity Scale (CAS) and a Physical Activity Scale (PAS).⁷ Although a decline in participation may be expected with increasing age, good test-retest reliability for scores on the first and second

annual study visits on the CAS (Spearman $r = .518$, $P = .001$) and PAS (Spearman $r = .410$, $P = .001$) were seen.⁷ Moreover, these scales were not correlated with age.⁷

Dementia

At study visits, participants with suspected dementia received a diagnostic workup, including computed tomography scan and blood tests.^{7–9} Triggers included new cognitive complaints by participants or caregivers, study staffs' observations, Blessed test scores change of 4 points or more than 8 errors, and worsening neuropsychological test scores.^{7,8} Updated criteria for dementia and subtypes were introduced after the study launch. To ensure uniformity of diagnosis, all cases were reconferenced in 2001 by a neurologist and a neuropsychologist who did not participate in diagnostic conferences from 1980 to 1998, as previously described.^{7,8} Diagnosticians had access to all available information for each participant at the conference, including results of any investigations done at or following the study visit when dementia was diagnosed. Functional decline was ascertained independent of decline due to physical causes or in leisure activity participation. Dementia diagnosis was assigned using the *Diagnostic and Statistical Manual of Mental Disorders revised, third edition* criteria¹⁷ and subtyped using established criteria.^{7,18–20}

Vascular Cognitive Impairment

The concept and definitions of VCI evolved after our study launch.¹ Hence, we developed an operational definition of VCI, consistent with current definitions,^{1,3} as nonamnesic impairment, especially in executive function, along with cerebrovascular disease.¹ We retrospectively applied our definition to each participant at each follow-up visit using all available clinical, neuropsychological, and neuroimaging information irrespective of whether participants had triggers for the diagnostic workup. Participants were diagnosed with VCI if they met the following 2 criteria:

1. Nonamnesic impairment. We examined performance on the following 3 tests that were administered to all participants: Digit Symbol Substitution, Digit span (total span), and Category Fluency tests. These tests capture performance on executive function as well as a broad range of related processes such as attention, visuospatial skills, learning abilities, and working memory. Digit span forwards tests attention. Digit span backwards tests working memory, which refers to the structures and processes used for temporarily storing and manipulating information. The total digit span is calculated as the sum of the forward and backward digit spans. Raw scores on each of these tests administered at baseline in the entire cohort were converted to standardized z scores, which were averaged to form a composite score. Nonamnesic impairment was defined as performance at or below 1 standard deviation from the mean composite score in this cohort. Memory impairment is the hallmark of amnesic MCI⁸ and was not included in the definition. However, we conducted secondary analyses to account for memory impairment (see below).
2. Cerebrovascular disease defined as presence of any 1 of Hachinski ischemic score of 4 or higher,¹³ presence of hemiparesis on clinical evaluation, or history of strokes verified by medical records and imaging studies. Leukoaraiosis alone on imaging studies without other vascular lesions such as strokes was not used to define cerebrovascular disease, given its heterogeneous nature.²¹

Statistical Analysis

Continuous measures were compared with either independent samples t test or Mann-Whitney U test, and categorical variables with Pearson chi-square test or Fisher exact test.²² We studied the association of baseline cognitive and physical activity scores with risk of VCI using Cox

proportional-hazards regression analysis to estimate hazard ratios (HR) with 95% CI.²³ All models included sex, education (high school or less versus college), medical illnesses score, and baseline cognitive status (Blessed test) as covariates. Medical illnesses were coded as a summary score (range 0–6) based on the presence or absence of the following illnesses: hypertension, diabetes, myocardial infarctions, seizures, hypothyroidism, and strokes. Entering the medical illnesses individually did not materially change the results. The CAS and PAS scores were examined continuously as well as dichotomized at the median score. Using age as the time-scale in Cox models is considered more appropriate than years of follow-up in cohort studies.²⁴ Time to event was from chronological age at assessment, which accounts for the left truncation occurring at study inclusion, to chronological age at VCI or to final study contact.

We examined the effect of individual leisure activities on risk of VCI by comparing participants who participated several days or more per week in an activity (frequent) with participants who participated weekly or less (rare) in the full models, also adjusting for participation in other leisure activities.⁷ To study the complete VCI cognitive spectrum, we included 22 participants who met clinical criteria for both VCI and dementia at the same visit. However, we also studied incident “VCI without dementia” as an outcome after excluding participants who met dementia criteria at or before the visit that they met VCI criteria. Proportional hazards assumptions of Cox models were examined analytically and graphically and were adequately met.

To support our study definition of VCI, we repeated our analyses using 2 alternate definitions for VCI. First, we considered a 1.5 SD cutscore (instead of 1 SD) on the composite score to define nonamnesic impairment. Single timed executive function tests, especially the Digit Symbol Substitution test, were recommended as screening tests for future VCI clinical trials at a recent international workshop organized to develop clinical and research standards for VCI.¹ Hence, we defined executive impairment using a cutscore (16) on the Digit symbol Substitution test (independent of the cerebrovascular disease criterion), which corresponds to performance at or below 1 SD from the mean (29 ± 13) at baseline in this age-restricted sample.

To account for the possibility that the association between cognitive leisure activities and VCI may be due to its effect on reducing risk of strokes, we examined the association of cognitive activities with incident strokes using Cox models.²³ We also examined the association of cognitive activities with VCI excluding incident strokes.

Study Population

At enrollment, 55 participants met the study criteria for VCI at baseline and were excluded. We also excluded 4 participants with visual loss, 3 who refused testing, 6 who were not tested due to tester unavailability, and 19 without follow-up (2 died before first follow-up visit). Hence, 401 participants (82.2%) were eligible for the survival analyses.

Results

Demographics

Of the 401 initially non-VCI and nondemented participants, 71 developed incident VCI (49 VCI without dementia and 22 VCI with dementia) over 1604 person-years (mean follow-up 4.0 ± 2.4 years). By the end of the study period (2001), 304 of the 401 participants had died (mean follow-up, 4.1 years) and 74 dropped out (mean follow-up, 3.5 years). Mean interval from entry to incident VCI was 3.4 ± 2.1 years. Of the 71 VCI, 60 had Hachinski ischemic scores of 4 or higher, and 12 had hemiparesis on clinical examination.

Unlike MCI definitions,²⁵ presence of cognitive complaints was not a requirement for VCI.^{1,3} However, cognitive complaints were present in 60 (84.5%) incident VCI. Reports of imaging studies done at or about the visit that they met VCI criteria were available in 42

participants. Findings included strokes (14), lacunar infarctions (18), moderate-to-severe cortical atrophy (9), moderate-to-severe leukoariosis (9), communicating hydrocephalus (3), and no abnormalities (3).

The 71 incident VCI cases were older ($P = .002$) and had worse functional status ($P = .009$) than the 330 normal controls at study entry (Table 1). Frequency of various medical illnesses was not different between VCI and controls except for hypothyroidism ($P = .01$), which was more common in controls. The 71 incident VCI cases had lower CAS but not PAS scores at entry. Although the neuropsychological test scores were in the normal range, participants who subsequently developed VCI had worse scores in these tests.

A similar pattern of differences on leisure activity scales, neuropsychological test scores, and medical illness were seen when comparing incident “VCI without dementia” to normal controls (Table 1) though the differences were not significant for functional status and cognitive activities.

Individual Leisure Activities

Only doing crossword puzzles frequently was associated with reduced risk of VCI (vs. never or rare HR 0.324, 95% CI 0.116–0.905, $P = .032$) but not VCI without dementia (HR 0.415, 95% CI 0.145–1.191, $P = .102$) adjusted for age, sex, education, cognitive status, and participation in other leisure activities. None of the other individual cognitive and physical activities were significantly associated with lower risk of VCI or VCI without dementia.

Cognitive Activities and VCI

The adjusted HR of VCI for a 1-point increase on the CAS was 0.931 (95% CI 0.895–0.970; Table 2). Additional adjustment for baseline functional status, which was worse at baseline in participants who developed VCI compared with controls, did not materially influence results (HR for 1-point increase on CAS 0.944, 95% CI 0.904–0.986). The adjusted HR of VCI for participants with CAS scores at or above the median score of 8 was 0.445 (95% CI 0.272–0.726) compared to those with scores in the lower half (Table 2 and Figure 1A).

Alternate Definitions

The adjusted HR of VCI for a 1-point increase on the CAS was 0.930 (95% CI 0.894–0.967) using the Digit Symbol Substitution test performance and presence of cerebrovascular disease to identify VCI (70 incident VCI). The 65 participants scoring below the Digit Symbol Substitution test cutscore at baseline in this initially nondemented cohort had a higher risk of developing vascular dementia ($n = 27$) in the first 5 study years (HR 3.80, 95% CI 1.58–9.14), corroborating the validity of this cutscore to identify high-risk participants.

Cognitive activities were still associated with VCI (1-point increase on CAS: HR 0.925, 95% CI 0.882–0.971) when nonamnesic impairment was defined using a cutscore at or below 1.5 SD from the mean composite Digit Symbol Substitution test score (independent of etiology), though the number of events were lower (50 incident VCI).

Cognitive Activities and VCI Without Dementia

Table 2 shows that a 1-point increase on the CAS was not associated with reduced risk of VCI without dementia (HR 0.955, 95% CI 0.909–1.002, $P = .062$). However, the adjusted HR of VCI without dementia for participants with CAS scores at or above the median score was 0.537 (95% CI 0.295–0.976, $P = .041$) compared to those with scores in the lower half (Table 2).

Reduced leisure activity participation may be the cause or consequence of cognitive decline. For instance, older adults may reduce leisure activity participation in the period leading up to

VCI as the consequence of early stages of cognitive dysfunction.⁷ However, even when we restricted our outcomes to the 17 cases who developed incident VCI 5 or more years after study entry, CAS scores was associated with reduced risk of VCI (HR 0.871, 95% CI 0.793–0.957).

Stroke

A total of 20 incident strokes during the study follow-up were reported by participants or identified on medical records review. Cognitive (HR 0.989, 95% CI 0.925–1.057) and physical (HR 1.019, 95% CI 0.957–1.086) leisure activities were not associated with reduced risk of incident strokes. Strokes were not significantly associated with VCI (HR 1.25, CI 0.575–2.721). In a model looking at stroke status and CAS simultaneously, we find that stroke is still not significantly associated with VCI (HR 1.192, CI 0.549–2.589), whereas the effect of CAS (HR 0.944, CI 0.905–0.986) remained significant. Cognitive activities were still associated with risk of VCI after excluding the incident strokes (HR 0.926, 95% CI 0.886–0.967).

Amnestic MCI

We have reported that increased participation in cognitive activities was associated with reduced risk of amnestic MCI²⁵ in this cohort (see reference⁸ for criteria and discussion). To test whether our observations could be explained by the association between leisure activities and amnestic MCI, we repeated the analysis excluding 27 of the 71 incident VCI participants who also met amnestic MCI criteria. The association of CAS with incident VCI remained (HR 0.949, 95% CI 0.902–0.998).

Physical Leisure Activities

The PAS, examined as either continuous or dichotomized at the median, was not associated with risk of VCI or VCI without dementia (Table 2 and Figure 1B).

Discussion

This prospective study demonstrates that high levels of participation in cognitive leisure activities are strongly associated with reduced risk of VCI in community-residing older adults, initially free of either VCI or dementia. A 1-point increase in the CAS score, which corresponds to increasing participation in any 1 activity for 1 day per week, was associated with a 7% reduced risk of VCI. Participants with high levels of cognitive leisure activity participation had a 55% reduced risk of developing VCI and a 46% reduced risk of VCI without dementia compared to those with low levels of cognitive activities. The observed association remained robust even after accounting for potential confounders such as age, sex, education, chronic illnesses, strokes, and preclinical dementia. This result builds on associations reported between cognitive leisure activity participation and reduced risk of dementia and subtypes of vascular and mixed dementias in the same cohort.⁷

Unlike amnestic MCI, the diagnosis of which is primarily based on neuropsychological criteria in nondemented participants, VCI is conceptualized as a vascular risk state that encompasses a wider spectrum of amnestic and nonamnestic deficits than MCI. Hence, the VCI definition encompasses dementia, which was accounted for in our analyses. We have reported that participation in cognitive activities in the same cohort was associated with reduced risk of amnestic MCI,⁸ where memory impairment is the primary cognitive deficit. Due to possible overlap between amnestic MCI and VCI,^{25,26} we excluded participants who met criteria for both syndromes. The results were still significant suggesting that cognitive activities may influence decline on nonmemory domains, which are primarily involved in VCI.

We defined a set of operational criteria for VCI and necessarily applied those retrospectively using available tests, given that the study launch predated the VCI concept.^{1,3} There is no

perfect solution when retrofitting diagnostic criteria. The confidence in our findings is increased by the consistency of our main results using 3 alternate definitions of VCI. Executive dysfunction is reported to be present out of proportion to memory impairment in non-Alzheimer's dementias.^{1,5,6} Given the emerging evidence of vascular diseases as risk factors for both Alzheimer's and non-Alzheimer's dementia,^{1,27} it is possible that some VCI cases may evolve into Alzheimer's or mixed dementias. Neuroimaging was not obtained on all participants. Hence, we could not rely solely on neuroimaging to define VCI. Nonetheless, abnormal findings were seen in 92% (82% vascular lesions) of participants in whom imaging studies were available.

Possible explanations for the association of cognitive activities with reduced VCI risk include building cognitive reserve, reducing chronic stress, or promoting a healthy lifestyle.^{7,8,28–30} Enhanced cognitive reserve resulting from leisure activities may help mask the earliest clinical changes of AD^{28–30} and vascular dementia.³¹ Many leisure activities involve social interactions, which are associated with reduced risk of dementia,²⁹ perhaps by reducing chronic stress. Reverse causation may reduce leisure activity participation in the period leading up to diagnosis of cognitive impairment. We attempted to account for reverse causation by excluding participants who developed incident VCI in the first 5 study years, who may have reduced their participation in leisure activities during this period. The remaining participants at baseline were less likely to have early cognitive impairment. However, even after excluding these incident VCI cases, CAS scores were associated with reduced risk of incident VCI developing more than 5 years from study entry. Although leisure activity participation may reflect health-related behavior such as exercise, our findings were limited to cognitive activities and remained significant after adjusting for chronic illnesses. Mixed vascular and neurodegenerative pathology is common in elderly brains.³² Benefits of cognitive activities on VCI may in part be mediated by its effect on Alzheimer pathology as suggested by enriched environment experiments in rodent models.^{33,34}

Interestingly, exposure to enriched environments improves functional outcomes after experimental brain infarctions in animal models.³⁵ Cognitive activities did not predict strokes in our secondary analyses, and excluding incident strokes did not materially change our results. However, incidence of strokes was low, reflecting ascertainment bias and the very old age group with possible healthy survivor effects. Given these limitations and findings from animal studies, an association between cognitive activities and strokes cannot be excluded and merits further study.

Physical activities were not associated with reduced risk of VCI. These results are consistent with the lack of association between physical activities and reduced risk of dementia and amnesic MCI in our and other cohorts.^{7,8,29,36} Previous studies in mostly younger participants have shown cognitive benefits of aerobic exercise.^{37,38} The physical leisure activities reflect the interests of our elderly participants and intensity and frequency of participation may be lower. It is possible that activities other than the ones we studied may have beneficial cognitive effects.³⁸

The Bronx Aging study has several limitations, as previously acknowledged.⁷ This was a community-residing volunteer cohort; Caucasians and participants more than age 75 were overrepresented. Although participants were evaluated and diagnosed using well-established procedures, some misclassification is inevitable. Our pathological studies support the accuracy of clinical diagnoses.^{7,32,39} This set of analyses was not planned at study launch. Hence, new data collection was not possible. We did not study correlated changes in leisure activities and cognition. Leisure activities were divided into groups based on cognitive and physical content. There was no direct measurement of the time spent in leisure activities, although participation was verified with informants though no formal reliability study was done. Presence of dementia

was an exclusion criterion and analyses were adjusted for baseline cognitive status. The leisure activities studied were limited to those ascertained at baseline. Although we reported association of individual activities, intensity may not be comparable across activities. For instance, 1 hour of playing chess and reading may not be comparable. In ongoing studies, we are exploring the intensity, frequency, and type of activities. In another study, leisure activities were grouped into novelty seeking, social, exchange of ideas, and passive based on factor analysis.⁴⁰ Most of our cognitive activities include novelty seeking and social components.

Despite limitations of our sample and leisure activity measurements, our current and previous results are consistent with other studies that have examined the relationship of leisure activities with various cognitive outcomes.²⁹ We conducted a number of sensitivity analyses to account for diagnostic misclassification and preclinical dementia, which support our main findings. In recently established cohorts, lack of detailed leisure activity information or shorter follow-up may preclude similar analyses. Like any other observational study, our results do not establish causal relationships.

Our observations show that cognitive leisure activities are associated with lower risk of developing VCI with or without dementia in older adults. We have reported similar effects in other cognitive impairment and dementia states.^{7,8} Our results suggest even a modest increase in leisure activity levels is associated with reduced risk of VCI. According to our models, elderly participants who participated in any cognitive leisure activity 4 days per week (4-activity days) had a risk of VCI that was 21% lower than among participants who only did 1 cognitive activity for 1 day per week (1-activity day). Prospective studies and clinical trials are needed to define the causal role of cognitive leisure activities in influencing vascular risk for cognitive decline.

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Figure 1.

Kaplan-Meier curves with age as the time-scale for the cumulative risk of developing vascular cognitive impairment (VCI) according to baseline scores on the Cognitive Activity Scale (CAS; A) and the physical activity scale (PAS; B) dichotomized at the median and adjusted for sex, education, chronic illnesses, and baseline cognitive status. *P* values are for log-rank test comparison of survival curves.

Table 1
Baseline Characteristics as a Function of Cognitive Outcomes

Variable	No VCI (n = 330)	Incident VCI (n = 71)	Incident VCI Without Dementia (n = 49)
Age, years	78.7 ± 3.0	79.9 ± 3.0 ^a	80.0 ± 2.9 ^a
Women, %	62	65	61
Caucasian, %	92	92	94
High school or less education, %	72	77	80
Functional rating (range,10–30)	10.9 ± 1.7	11.9 ± 3.2 ^a	11.8 ± 3.5
Physical Activity Scale (0–77)	11.1 ± 7.7	10.6 ± 6.6	11.3 ± 7.0
Cognitive Activity Scale (0–42)	11.8 ± 6.5	8.7 ± 6.6 ^a	10.2 ± 6.9
Zung Depression Scale	46.2 ± 9.6	45.8 ± 10.2	45.5 ± 10.6
Neuropsychological tests			
Blessed test	2.1 ± 1.9	3.0 ± 2.2 ^a	2.8 ± 2.0 ^b
DSST	32.7 ± 11.1	24.4 ± 9.8 ^a	24.1 ± 9.5 ^a
Fuld test	7.5 ± 1.2	6.6 ± 1.6 ^a	6.6 ± 1.5 ^a
Digit span	10.1 ± 2.0	9.2 ± 1.2 ^a	8.8 ± 1.1 ^a
Block design	20.6 ± 7.9	14.7 ± 7.5 ^a	14.4 ± 6.9 ^a
Category fluency	35.5 ± 7.5	29.3 ± 6.6 ^a	29.0 ± 6.7 ^a
Performance IQ	107.5 ± 11.6	97.6 ± 10.4 ^a	97.2 ± 10.9 ^a
Verbal IQ	112.8 ± 15.3	105.1 ± 12.0 ^a	104.3 ± 11.4 ^a
Medical illnesses (%)			
Hypertension	51	51	53
Myocardial infarction	14	10	6
Seizure	3	1	2
Hypothyroidism	14	3 ^a	4
Diabetes	12	8	10
Strokes	7	4	6

NOTE: The incident “VCI without dementia” excludes participants who met dementia criteria at or before the follow-up visit where they met VCI criteria. Values are means with standard deviations unless otherwise specified. The *P* values refer to comparisons with normal controls. VCI = vascular cognitive impairment; DSST = Digit Symbol Substitution test.

^a*P* < .01.

^b*P* < .05.

Table 2

Risk of VCI According to the Baseline Scores on the Cognitive Activity and the Physical Activity Scales, Examined for Overall Group as well as Dichotomized by Median

Activity	VCI		VCI Without Dementia	
	Incident Cases (Total Cases)	Hazard Ratio (95% CI)	Incident Cases (Total Cases)	Hazard Ratio (95% CI)
Cognitive Activity Score				
One-point increment	71 (401)	0.931 (0.895–0.970) ^a	49 (365)	0.955 (0.909–1.002)
<8 points	35 (132)	1 (reference)	20 (109)	1 (reference)
≥8 points	36 (269)	0.445 (0.272–0.726) ^a	29 (256)	0.537 (0.295–0.976) ^b
Physical Activity Score				
One-point increment	71 (401)	0.993 (0.961–1.027)	49 (365)	1.006 (0.968–1.045)
<8 points	32 (177)	1 (reference)	20 (159)	1 (reference)
≥8 points	39 (224)	1.022 (0.635–1.642)	29 (206)	1.224 (0.696–2.224)

NOTE: Hazard ratio adjusted for sex, education, medical illnesses, and Blessed test scores. Age is the time scale (see “methods”). CI = confidence interval; VCI = vascular cognitive impairment.

^a $P < .001$

^b $P < .05$