Leisure Activities and the Risk of Dementia in the Elderly

Background

Participation in leisure activities has been associated with a lower risk of dementia. It is unclear whether increased participation in leisure activities lowers the risk of dementia or participation in leisure activities declines during the preclinical phase of dementia.

Methods

We examined the relation between leisure activities and the risk of dementia in a prospective cohort of 469 subjects older than 75 years of age who resided in the community and did not have dementia at base line. We examined the frequency of participation in leisure activities at enrollment and derived cognitive-activity and physical-activity scales in which the units of measure were activity-days per week. Cox proportional-hazards analysis was used to evaluate the risk of dementia according to the base-line level of participation in leisure activities, with adjustment for age, sex, educational level, presence or absence of chronic medical illnesses, and base-line cognitive status.

Results

Over a median follow-up period of 5.1 years, dementia developed in 124 subjects (Alzheimer's disease in 61 subjects, vascular dementia in 30, mixed dementia in 25, and other types of dementia in 8). Among leisure activities, reading, playing board games, playing musical instruments, and dancing were associated with a reduced risk of dementia. A one-point increment in the cognitive-activity score was significantly associated with a reduced risk of dementia (hazard ratio, 0.93 [95 percent confidence interval, 0.90 to 0.97]), but a one-point increment in the physical-activity score was not (hazard ratio, 1.00). The association with the cognitive-activity score persisted after the exclusion of the subjects with possible preclinical dementia at base line. Results were similar for Alzheimer's disease and vascular dementia. In linear mixed models, increased participation in cognitive activities at base line was associated with reduced rates of decline in memory.

Conclusions

Participation in leisure activities is associated with a reduced risk of dementia, even after adjustment for base-line cognitive status and after the exclusion of subjects with possible

preclinical dementia. Controlled trials are needed to assess the protective effect of cognitive leisure activities on the risk of dementia.

The incidence of dementia increases with increasing age. Although the prevention of dementia has emerged as a major public health priority, there is a paucity of potential preventive strategies. Identifying protective factors is essential to the formulation of effective interventions for dementia. Cross-sectional studies report associations between dementia and reduced participation in leisure activities in midlife, as well as between cognitive status and participation in leisure activities in old age. Katzman proposed that persons with higher educational levels are more resistant to the effects of dementia as a result of having greater cognitive reserve and increased complexity of neuronal synapses. Like education, participation in leisure activities may lower the risk of dementia by improving cognitive reserve.

In observational studies, elderly persons who had participated to a greater extent in leisure activities had a lower risk of dementia than those who had participated to a lesser extent. Although these results suggest that leisure activities have a protective role, an alternative explanation is possible. In most types of dementia, there is a long period of cognitive decline preceding diagnosis. Reduced participation in activities during this preclinical phase of dementia may be the consequence and not the cause of cognitive decline. Resolution of this issue requires a long period of observation before diagnosis to enable researchers to disentangle the potential effects of preclinical dementia. Base-line cognitive status, educational level, and level of depression may confound the relation between leisure activities and dementia. Moreover, most studies have not assessed the associations between leisure activities and particular types of dementia.

The Bronx Aging Study provided us with the opportunity to study the influence of leisure activities on the risk of dementia over a long period while accounting for previously identified confounders. This community-based study has followed a cohort of persons who did not have dementia at base line, with the use of detailed clinical and neuropsychological evaluations performed at intervals for up to 21 years. We examined the influence of individual and composite measures of cognitive and physical leisure activities on the risk of the development of dementia.

Methods

Study Population

The study design and recruitment methods of the Bronx Aging Study have been described previously. Briefly, the study enrolled English-speaking subjects between 75 and 85 years of age who resided in the community. Criteria for exclusion included severe visual or hearing impairment and a previous diagnosis of idiopathic Parkinson's disease, liver disease, alcoholism, or known terminal illness. Subjects were screened to rule out the presence of dementia at base line and were included if they made eight or fewer errors on the Blessed Information–Memory–Concentration test. This test has a high test–retest reliability (0.86), and its results correlate well with the stages of Alzheimer's disease. At the inception of the study, the cohort was middle-class, most subjects were white (91 percent), and the majority were female (64 percent). Written informed consent was obtained at enrollment. The local institutional review board approved the study protocol.

The study enrolled 488 subjects between 1980 and 1983. Subjects underwent detailed clinical and neuropsychological evaluations at enrollment and at follow-up visits every 12 to 18 months. The potential study period consisted of the 21-year period from 1980 to 2001. We excluded 2 subjects without documented leisure activities and 17 subjects who moved or declined to return for follow-up. After these subjects had been excluded, 469 subjects (96.1 percent) were eligible. In 1992, 73 surviving subjects were still having study visits in our current project, the Einstein Aging Study.

Clinical Evaluation

During the study, subjects were interviewed with the use of a structured medical-history questionnaire and were examined by study clinicians. Functional limitations on 10 basic and instrumental activities of daily living were rated on a 3-point scale for each activity (range of total scores, 10 to 30 points), with 1 point indicating "no limitation," 2 points indicating "does activity with difficulty," and 3 points indicating "unable." A spouse or family member accompanied most subjects or was contacted for confirmation of the history.

Neuropsychological Evaluation

An extensive battery of neuropsychological tests was administered at study visits. We examined performance on the Blessed Information–Memory–Concentration test (range of scores, 0 to 33), the verbal and performance IQ according to the Wechsler

Adult Intelligence Scale, the Fuld Object-Memory Evaluation (range of scores, 0 to 10), and the Zung depression scale (range of scores, 0 to 100). These tests were used to inform the diagnosis of dementia at case conferences.

Leisure Activities

At base line, subjects were interviewed regarding participation in 6 cognitive activities (reading books or newspapers, writing for pleasure, doing crossword puzzles, playing board games or cards, participating in organized group discussions, and playing musical instruments) and 11 physical activities (playing tennis or golf, swimming, bicycling, dancing, participating in group exercises, playing team games such as bowling, walking for exercise, climbing more than two flights of stairs, doing housework, and babysitting). Subjects reported the frequency of participation as "daily," "several days per week," "once weekly," "monthly," "occasionally," or "never." We recoded these responses to generate a scale with one point corresponding to participation in one activity for one day per week. The units of the scales are thus activity-days per week; the scales were designed to be intuitively meaningful to clinicians and elderly persons and to be useful in the design of intervention studies or public health recommendations. For each activity, subjects received seven points for daily participation; four points for participating several days per week; one point for participating once weekly; and zero points for participating monthly, occasionally, or never. We summed the activity-days for each activity to generate a cognitive-activity score, ranging from 0 to 42, and a physical-activity score, ranging from 0 to 77.

The estimates of the overall level of participation were consistent with good test–retest reliability for scores obtained on entry and at the next visit a year later on the cognitive-activity scale (Spearman $r = 0.518$, P=0.001) and the physical-activity scales (Spearman $r = 0.410$, P=0.001). There was no direct measurement of the time spent in activities, although participation was verified by family members or friends. The scores were not correlated with age. Scores on the cognitive-activity scale correlated with scores on the Blessed test (Spearman $r = −0.286$, P=0.001), but not functional status (Spearman $r = −0.042$, P=0.77). Scores on the physical-activity scale correlated with functional status (Spearman $r = −0.293$, P=0.001) but not with scores on the Blessed test (Spearman $r = −0.021$, P=0.65).

Diagnosis of Dementia

At study visits, subjects in whom dementia was suspected on the basis of the observations of members of the study staff, results of neuropsychological tests, or a worsening of the scores on the Blessed test by four points or a total of more than seven errors underwent a workup including computed tomographic scanning and blood tests. A diagnosis of dementia was assigned at case conferences attended by study neurologists, a neuropsychologist, and a geriatric nurse clinician, according to the criteria of the *Diagnostic and Statistical Manual of Mental Disorders,* third edition (DSM-III) or, after 1986, the revised third edition (DSM-III-R). Updated criteria for the diagnosis of dementia and particular types of dementia were introduced after the study had begun.

To ensure uniformity of diagnosis, all cases were discussed again at new diagnostic conferences held in 2001 and involving a neurologist and a neuropsychologist who had not participated in diagnostic conferences between 1980 and 1998. Dementia was diagnosed according to the DSM-III-R criteria. Reduced participation in leisure activities was used to assess functional decline, but the leisure-activity scales were not available to the raters assessing such decline. Disagreements between raters were resolved by consensus after the case was presented to a second neurologist, with blinding maintained. Cases of dementia were classified according to the criteria for probable or possible Alzheimer's disease published by the National Institutes of Neurological Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association and the criteria for probable, possible, or mixed vascular dementia published by the Alzheimer's Disease Research Centers of California.

Statistical Analysis

Continuous variables were compared with use of either an independent-samples t-test or the Mann–Whitney U test, and categorical variables were compared with use of the Pearson chi-square test. In primary analyses, we studied the association between cognitive and physical activities and the risk of dementia and specific types of dementia using Cox proportional-hazards regression analysis to estimate hazard ratios, with 95 percent confidence intervals. The time to an event was defined as the time from enrollment to the date of a diagnosis of dementia or to the final contact or visit for subjects without dementia. All multivariate models reported include the following covariates unless otherwise specified: age at enrollment, sex, educational level (high school or less vs. college-level education), presence or absence of chronic medical illnesses, and base-line scores on the Blessed test. Presence of the following

self-reported chronic medical illnesses was individually entered in the models: cardiac disease (angina, previous myocardial infarction, or cardiac failure), hypertension, diabetes mellitus, stroke, depression, and hypothyroidism. We also divided the study cohort into thirds on the basis of their scores on the two activity scales and determined the risk of dementia according to these groups. We examined the role of individual leisure activities by comparing subjects who participated in an activity several days or more per week (frequent participation) with subjects who participated weekly or less frequently (rare participation) and, in the full models, adjusted for participation in other leisure activities.

In secondary analyses, we examined the influence of base-line cognitive status and possible preclinical dementia. First, we sequentially excluded from the full models subjects in whom dementia developed during the first two, four, seven, and nine years of follow-up in order to avoid confounding by a possible influence of preclinical dementia on participation in leisure activities. Second, we used linear mixed models controlled for age, sex, and educational level to assess the relation between cognitive activities and base-line cognitive status and the annual rate of change in cognitive status. We analyzed verbal IQ as well as specific cognitive domains, including episodic memory (with the Buschke Selective Reminding test [range of scores, 0 to 72, with lower scores indicating worse memory] and the Fuld Object-Memory Evaluation) and executive function (with the Digit–Symbol Substitution subtest of the Wechsler Adult Intelligence Scale [range of scores, 0 to 90, with lower scores indicating worse cognition]). Each model included terms for the cognitive-activity score, time, and the interaction between the two. The assumptions of the models were examined analytically and graphically and were adequately met.

Results

Demographic Characteristics

During 2702 person-years of follow-up (median follow-up, 5.1 years), dementia developed in 124 subjects (Alzheimer's disease in 61, vascular dementia in 30, mixed dementia in 25, and other types of dementia in 8). By the end of the study period, 361 subjects had died, 88 subjects had dropped out (mean [±SD] follow-up, 6.6±4.9 years), and 20 subjects were still active. When the cohort was divided into thirds according to the cognitive-activity score or the physical-activity score, no significant differences in the length of follow-up were found among these subgroups.

On average, subjects in whom dementia developed were older, had lower levels of education, and had significantly lower scores on the cognitive-activity scale, but not on the physical-activity scale, than subjects in whom dementia did not develop (Table 1). Although their scores on neuropsychological tests were in the normal range (Table 1), subjects in whom dementia later developed had poorer cognition on the Blessed test (P=0.001) and a lower base-line performance IQ (P=0.07). The frequency of chronic medical illnesses did not differ significantly between subjects in whom dementia developed and those in whom it did not. Nineteen subjects were receiving antidepressants at enrollment. Cognitive-activity scores were inversely correlated with the Zung depression scale (Spearman r = −0.215, P<0.001), as were physical-activity scores (Spearman r = −0.254, P<0.001), indicating that lower levels of participation were associated with increasing levels of depression.

A smaller proportion of the 361 subjects with a high-school education or less than of the 108 subjects who had attended college participated in reading (90 percent vs. 96 percent, P=0.05), writing (67 percent vs. 80 percent, P=0.01), doing crossword puzzles (21 percent vs. 36 percent, P=0.001), and playing musical instruments (7 percent vs. 15 percent, P=0.02). There was no difference according to educational level in the proportion of subjects who played board games or participated in group discussions.

Leisure Activities

Among cognitive activities, reading, playing board games, and playing musical instruments were associated with a lower risk of dementia (Table 2). Dancing was the only physical activity associated with a lower risk of dementia. Fewer than 10 subjects played golf or tennis, so the relation between these activities and dementia was not assessed.

Cognitive Activities

When the cognitive-activity score was modeled as a continuous variable (Table 3), the hazard ratio for dementia for a one-point increment in this score was 0.93 (95 percent confidence interval, 0.89 to 0.96). Adjustment for the base-line score on the Blessed

test in a second model (Table 3) did not attenuate the association. Participation in cognitive activities was associated with a reduced risk of Alzheimer's disease (hazard ratio, 0.93 [95 percent confidence interval, 0.88 to 0.98]), vascular dementia (hazard ratio, 0.92 [95 percent confidence interval, 0.86 to 0.99]), and mixed dementia (hazard ratio, 0.87 [95 percent confidence interval, 0.78 to 0.93]). The frequency of participation in cognitive activities was related to the risk of dementia. According to the model in which we adjusted for the base-line score on the Blessed test, the hazard ratio for subjects with scores in the highest third on the cognitive-activity scale, as compared with those with scores in the lowest third, was 0.37 (95 percent confidence interval, 0.23 to 0.61) (Table 3).

Risk of Dementia According to the Base-Line Scores on the Cognitive-Activity Scale and the Physical-Activity Scale.

In additional analyses, adjustment for intellectual status with the use of the verbal IQ did not alter the association between participation in cognitive activities and the risk of dementia (hazard ratio, 0.92 [95 percent confidence interval, 0.87 to 0.97]). Participation in cognitive activities was also associated with a reduced risk of dementia among the 361 subjects with a high-school education or less (hazard ratio, 0.94 [95 percent confidence interval, 0.91 to 0.98]). The association of cognitive activities with dementia was not affected by adjustment for functional status, the restriction of the analyses to subjects with scores of less than 5 on the Blessed test, or the exclusion of subjects who died during the first year after enrollment.

Physical Activities

The physical-activity score was not significantly associated with dementia, either when analyzed as a continuous variable or when the study cohort was divided into thirds according to this score (Table 3).

Influence of Preclinical Dementia

The presence of preclinical dementia might reduce participation in leisure activities, leading to the overestimation of its protective influence. The association between the base-line cognitive-activity score and dementia was significant even after the exclusion of 94 subjects in whom dementia was diagnosed during the first seven years after enrollment (hazard ratio, 0.94 [95 percent confidence interval, 0.88 to

0.99]) (Table 4). The association was no longer significant after the exclusion of the 105 subjects in whom dementia was diagnosed during the first nine years after enrollment. However, only 19 subjects were given a diagnosis of dementia after this point.

We used linear mixed models to examine the influence of participation in cognitive activities on the annual rate of change in cognitive function. In these models (Table 5), the term for the cognitive-activity score represents the cross-sectional association between the cognitive activities and the scores on the selected tests administered at enrollment. These results indicate that subjects with increased participation in cognitive activities at entry had better overall cognitive status. Analysis with use of the term for time indicates that cognitive performance declines linearly as a function of follow-up time. The term for the interaction between the cognitive-activity score and time represents the longitudinal effect of the base-line measure of participation in cognitive activities on the annual rate of decline in performance on the selected tests; this effect was significant only for the tests of episodic memory. The estimates show that for a one-point increment in the cognitive-activity score, the annual rate of decline in scores on the Buschke Selective Reminding test is reduced by 0.043 point (P=0.02), and the annual rate of decline on the Fuld Object-Memory Evaluation is reduced by 0.006 point (P=0.04).

Risk of Dementia per 1-Point Increment in the Base-Line Cognitive-Activity Score, with the Sequential Exclusion of Subjects in Whom Dementia Developed during the First Nine Years of Follow-up.

Table 5

Association of Participation in Cognitive Leisure Activities with Base-Line Cognitive Function and Rate of Change in Cognitive Function.

Discussion

This prospective, 21-year study demonstrates a significant association between a higher level of participation in leisure activities at base line and a decreased risk of dementia — both for Alzheimer's disease and for vascular dementia. A one-point increment in the cognitive-activity score, which corresponds to participation in an activity for one day per week, was associated with a reduction of 7 percent in the risk of dementia. The association between cognitive activities and the risk of dementia remained robust even after adjustment for potential confounding variables such as age, sex, educational level, presence or absence of chronic medical illnesses, and base-line cognitive status. Increased participation in leisure activities was associated

with a lower risk of dementia. Subjects with scores in the highest third on the cognitive-activity scale (more than 11 activity-days) had a risk of dementia that was 63 percent lower than that among subjects with scores in the lowest third.

We identified three possible explanations for the association between greater participation in leisure activities and a decreased risk of dementia. First, the presence of preclinical dementia may decrease participation in leisure activities. Second, unmeasured confounding may influence the results. Third, there may be a true causal effect of cognitive activities. We used several strategies to test the hypothesis that reduced participation in leisure activities appears to be a risk factor for, but is in fact a consequence of, preclinical dementia. Adjustment for base-line scores on cognitive tests, which predict dementia, did not alter the association between participation in cognitive activities and dementia. We have reported that an accelerated decline in memory begins seven years before dementia is diagnosed. The exclusion of subjects in whom dementia was diagnosed during the first seven years after enrollment should eliminate most subjects who had preclinical dementia at enrollment. However, participation in cognitive activities predicted dementia even among those in whom it developed more than seven years after enrollment. Results from the linear mixed models that analyzed cognitive function over time corroborate the findings of previous studies and show that increased participation in cognitive activities is associated with slower rates of cognitive decline, especially in terms of episodic memory.

Because of the observational nature of our study, there is a possibility of residual or unmeasured confounding. The observed association appears to be independent of educational level and intellectual level, which may influence the choice of leisure activities. Perhaps reduced participation in leisure activities is an early marker of dementia that precedes the declines on cognitive tests. Alternatively, participation in leisure activities may be a marker of behavior that promotes health. But the specificity of our findings for cognitive activities and not physical activities argues against this hypothesis. We did not study the effect of apolipoprotein E genotype, which may influence the rates of cognitive decline. Hence, despite the magnitude and consistency of the associations, our findings do not establish a causal relation between participation in leisure activities and dementia, and controlled trials are therefore needed.

If there is a causal role, participation in leisure activities may increase cognitive

reserve, delaying the clinical or pathological onset of dementia. Alternatively, participation in cognitive activities might slow the pathological processes of disease during the preclinical phase of dementia. Our findings do not imply that subjects who were less active cognitively increased their risk of dementia.

The role of individual leisure activities is not well known, since most studies have used composite measures. In a French cohort, knitting, doing odd jobs, gardening, and traveling reduced the risk of dementia. In the Nun Study, low density of ideas and low levels of grammatical complexity in autobiographies written in early life were associated with low cognitive test scores in later life. Reading, playing board games, playing musical instruments, and dancing were associated with a lower risk of dementia in our cohort. There was no association between physical activity and the risk of dementia. Exercise is said to have beneficial effects on the brain by promoting plasticity, increasing the levels of neurotrophic factors in the brain, and enhancing resistance to insults. Cognitive and physical activities overlap, and therefore it is not surprising that previous studies have disagreed on the role of physical activities. Although physical activities are clearly important in promoting overall health, their protective effect against dementia remains uncertain.

Our study has several limitations. Ours was a cohort of volunteers who resided in the community; whites and subjects older than 75 years of age were overrepresented, as compared with the general population of those over 65 years of age, thus potentially limiting the generalizability of our results. Although standard criteria and well-established procedures were used to make diagnoses, some misclassification is inevitable. Time spent in each activity was not directly measured, although the history was verified by family members or other informants. Duration and cognitive demand are both important in the assessment of an activity. It is difficult to assign weights to the cognitive demands of leisure activities, since such demands vary among activities and among the persons who engage in each activity. Leisure activities were arbitrarily classified as cognitive or physical. For instance, doing housework requires not only a certain functional status but also the ability to plan, prepare, and adapt to changes in circumstances and the environment. The leisure activities we studied reflect the interests of our cohort, and it is quite likely that activities other than the ones we studied are also protective.

Participation in leisure activities is associated with a reduced risk of development of dementia, both Alzheimer's disease and vascular dementia. The reduction in risk is

related to the frequency of participation. According to our models, for example, elderly persons who did crossword puzzles four days a week (four activity-days) had a risk of dementia that was 47 percent lower than that among subjects who did puzzles once a week (one activity-day). Clinical trials are needed to define the causal role of participation in leisure activities. A recent study reported reduced cognitive declines after cognitive training in elderly persons without dementia. If confirmed, our results may support recommendations for participation in cognitive activities to lower the risk of dementia that parallel current recommendations for participation in physical activities to reduce the risk of cardiovascular diseases.

Source Information

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