1.a. Full Title: Physical Activity and Cognitive Decline

b. Abbreviated Title (Length 26 characters): PA and Cognitive Decline

2. Writing Group (list individual with lead responsibility first):

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3. Timeline:
Manuscript proposal to Publication's Committee: June / 2004
Data analysis completed: August / 2004
Completed manuscript to Publication's Committee: December / 2004

4. Rationale:
Although some decline in physical and cognitive function with aging may be inevitable, there is increasing evidence that it may be possible to postpone or even prevent severe impairments in quality of life with advancing age through good medical care and healthy lifestyles (Fillit et al., 2002). Until recently, the evidence for benefits of physical activity on cognitive functioning was considered mixed or at best reliable, but small (Thomas, Landers, Salazar, & Etnier, 1994). New evidence is changing this perspective.

In longitudinal studies, physical activity has emerged as a predictor of preserved cognitive function. In a recent study of almost 6000 community dwelling women over age 65, those with greater physical activity were less likely to show cognitive decline. Almost identical results were obtained in analyses using estimated kilocalories expended and blocks walked as measures of physical activity (Yaffe, Barnes, Nevitt, Lui, & Covinsky, 2001). For every 10 blocks walked/day, odds of cognitive decline were reduced by 13%. Similar results were reported in a smaller sample of 70-75 year old women (Pignatti, Rozzini, & Trabucchi, 2002). In a cross-sectional study of the ARIC cohort using baseline data, Cerhan et al. (1998) found that a higher level of participation in sports was associated with better performance on measures of delayed
recall, information processing speed, and word fluency in women, and higher word fluency in men (Cerhan et al., 1998).

Other observational data suggest that mental but not many physical activities may reduce risk of dementia. Verghese et al. (2003) found that a variety of leisure activities involving mental effort (e.g., reading, playing board games, and playing musical instruments) were associated with reduced risk of dementia while physical activities such as walking, swimming, and group exercise were not.

Studies of physical activity and brain function thus far have not examined sedentary behaviors such as television watching. Television watching may compete for available leisure time both for physical activity and exercise and for the kinds of effortful mental activities (e.g., crossword puzzles, games, playing musical instruments) that have been associated with protection of cognitive function.

5. Main Hypothesis/Study Questions:
Analyses will examine exposure to physical activity and television watching as measured at Visits 1 and 3 in relation to changes in cognitive functioning between Visits 2 and 4.

Study Question 1. What is the relationship between physical activity and change in cognitive function? We hypothesize that ARIC participants with the highest levels of physical activity will have less decline in cognitive function than those with low levels of physical activity.

Study Question 2. What is the relationship between sedentary time, defined as time watching television, and change in cognitive function? We hypothesize that ARIC participants who reported watching television “often” or “very often” will have a greater decline in cognitive function than those who reported watching “seldom” or “never”.

6. Data (variables, time window, source, inclusions/exclusions):
The analyses will utilize data on physical activity and television watching measured at V1 and V3 to predict change in cognitive function between V2 and V4.

For Hypothesis 1, the primary outcome will be change in cognitive function from V2 to V4 for the 3 cognitive variables: delayed recall, information processing speed, and word fluency. We will examine both the change in scores and the incidence of “major cognitive decline” (defined a priori (Kanaya, Barrett-Connor, Gildengorin, & Yaffe, 2004)). The primary exposure variables will be physical activity indicated by the ARIC Baecke scores (Sport, Work, and Leisure indexes (Richardson, Ainsworth, Wu, Jacobs, & Leon, 1995)). Each index will be examined separately. The Work index will be examined with and without participants employed outside the home because the same value was assigned to all participants not employed outside the home. We will also use other classifications of participation in physical activity used by previous ARIC investigators as exposure measures, including “regular vigorous activity” (defined as participation in activities classified as high intensity for at least 1 hour per week for ≥ 10 months per year (Evenson et al., 1999)) and responses to the individual questions on frequency of walking during leisure time and leisure time activity compared to peers. The primary analyses for this hypothesis will use only the baseline V1 physical activity scores. In secondary analyses, we will utilize the additional information available from V3 physical activity measures by comparing maintenance of
cognitive function in groups of participants who maintained or increased their sport or leisure physical activity from V1 to V3 with those whose physical activity declined. Increase will be defined as an increase of $\geq 0.25$ units for sport or leisure scores; maintenance will be defined as scores within +/- 0.25 units; decrease will be defined as decrease of $\geq -0.25$ units from the baseline scores (Pereira et al., 1999).

For Hypothesis 2, the primary outcomes will be the same as for Hypothesis 1, but the exposure variable will be time spent watching television from the Baeckee instrument (i.e., During leisure time do you watch television never, seldom, sometimes, often, or very often?). In the primary analyses, we will compare participants who responded at V1 they watched television often or very often with those who reported watching seldom or never. In secondary analyses, we will utilize the information from V3 as well, creating a group of participants whose television watching decreased or stayed the same (responses within 1 unit of V1) to compare with the group whose television watching increased (responses greater than 1 unit different from V1 in the direction of greater time watching).

Exclusions:
1. Missing cognitive function at V2 (cnfa01, cnfa02, cnfa04).
2. History of stroke or TIA at baseline (tiab01 = Y or hom 10d ne N).
3. Incident stroke prior to V4 (in00dp = 1 and ed00dp < v4date41).
4. Missing cognitive function at V4 (cnfc01, cnfc02, cnfc04)
5. Missing physical activity scores at V1 for hypothesis 1.
6. Missing physical activity scores at V3 for hypothesis 1.
7. Missing television at V1 for hypothesis 2.
9. Race not black or white, or blacks from Minn. or Washington

Other variables:
Visit 2: CV risk factor data: fasting blood sugar (glusiu21), history of diabetes(diaabts22, diaabts23), history of CHD (prvchd05 or (in_00sp=1 and .Z < dateisp < v2date21), smoking status (cursmk21, forsmk21, evrsmk21, cigt21), hypertension status including antihypertensive medication use (hypert24-26).
Medications with CNS effects
Cognitive test data from Visits 2 and 4: cnfa01, cnfa02, cnfa04, cnfc01, cnfc02, cnfc04
Functional status (ability to walk)

Analysis: The primary outcome will be “change” in cognition from V2 to V4 (for 3 semi continuous cognitive variables) and the primary exposure variables will be baseline physical activity (SPRT_I02 - Sport During Leisure Time; LISR_I02 - Physical Activity During Leisure Time Excluding Sport; WORK_I) and an indicator variable for frequent TV viewing (RPAA67 = Often or Very often). In secondary analyses, the exposure variable will be change (defined above) in physical activity and TV viewing from V1 to V3.

A series of linear models will be fit. Model 1 will control for age, race/center, and education level. Subsequent models will adjust for potential confounders measured at Visit 2 (see above list).
Although the proposed study design cannot rule out reverse causality, this limitation is true for other observational studies of physical activity and cognitive function. This limitation will be discussed, along with others, in the manuscript discussion. We will exclude participants with a history of stroke or TIA at baseline and adjust for baseline cognitive function.

7.a. Will the data be used for non-CVD analysis in this manuscript?  _XX_ Yes  ___ No

   b. If Yes, is the author aware that the file ICTDER02 must be used to exclude persons with a value RES_OTH = “CVD Research” for non-DNA analysis, and for DNA analysis RES_DNA = “CVD Research” would be used?  _XX_ Yes  ____ No
   (This file ICTDER02 has been distributed to ARIC PIs, and contains the responses to consent updates related to stored sample use for research.)

8.a. Will the DNA data be used in this manuscript?  ___ Yes  _XX__ No

8.b. If yes, is the author aware that either DNA data distributed by the Coordinating Center must be used, or the file ICTDER02 must be used to exclude those with value RES_DNA = “No use/storage DNA”?  ___ Yes  ____ No

9. The lead author of this manuscript proposal has reviewed the list of existing ARIC Study manuscript proposals and has found no overlap between this proposal and previously approved manuscript proposals either published or still in active status. ARIC Investigators have access to the publications lists under the Study Members Area of the web site at: http://bios.unc.edu/units/cscc/ARIC/study/studymem.html
   __XX____  Yes     ____ No

10. What are the most related manuscript proposals in ARIC (authors are encouraged to contact lead authors of these proposals for comments on the new proposal or collaboration)?

   Cerhan et al. (1998). "Correlates of cognitive function in middle-aged adults." Reported a positive association between sports participation and cognitive function in cross-sectional analyses.

   Knopman et al. (2000). "Cardiovascular risk factors and cognitive decline." Did not include physical activity in the analyses.

   Evenson (MS #615) proposes to examine the relationship between physical activity and TIA. Cognitive variables are not included.

11. Manuscript preparation is expected to be completed in one to three years. If a manuscript is not submitted for ARIC review at the end of the 3-years from the date of the approval, the manuscript proposal will expire.

References


