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Original Study

# Intensity and Types of Physical Exercise in Relation to Dementia Risk Reduction in Community-Living Older Adults

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A B S T R A C T

*Objective:* To systematically examine the amount and type of physical exercise that might reduce the future risk of dementia in community-living older people.
*Design:* Six-year observational study.
*Setting:* All the Elderly Health Centers (EHCs) of the Department of Health in Hong Kong.
*Participants:* A total of 15,589 community-living Chinese aged 65 years and older with no history of stroke, clinical dementia, or Parkinson disease when they completed health assessment at the EHCs in the first 6 months of 2005.
*Measurements:* Self-reported habitual physical exercise patterns, including the frequency, duration, and type of exercise, at baseline and Year 3 were analyzed. The study outcome was incident dementia in 6 years. Dementia was defined by presence of clinical dementia in accordance with the 10th revision of the International Statistical Classification of Diseases and Related Health Problems or Clinical Dementia Rating of 1 to 3.
*Results:* Both the cognitively stable and incident groups reported exercising a median of 7 days per week and 45 minutes per day at baseline and Year 3. The former practiced aerobic and mind-body exercises more at baseline and Year 3, whereas the latter practiced stretching and toning exercises more. The odds ratio for dementia remained significant for aerobic (0.81; 95% confidence interval 0.68–0.95; $P = .01$) and mind-body exercises (0.76; 0.63–0.92; $P = .004$) after excluding participants who developed dementia within 3 years after baseline and adjusting for important potential confounders, such as age, gender, educational level, and physical and psychiatric comorbidities.
*Conclusion:* Although physical exercise is widely promoted as a nonpharmacological intervention for dementia prevention, not all types of exercise appear to be useful in reducing risk of dementia in older people. Our findings suggest that daily participation in aerobic and mind-body but not stretching and toning exercises might protect community-living older adults from developing dementia.


Dementia is now a major health concern worldwide.[1] Given the lack of disease-modifying treatment, finding interventions that can prevent or slow the onset of dementia is of great clinical and public health importance.[2–4] One nonpharmacological intervention that can potentially reduce dementia risk is physical exercise. Earlier longitudinal epidemiological findings suggest that older people with habitual physical exercise have a lower risk of dementia.[5,6] However, subsequent randomized controlled trials (RCTs) of exercise intervention show mixed results, with the intervention groups having mild improvement in selected cognitive domains rather than a significant

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reduction of dementia risk.[7,8] In some RCTs, the improvement was not even significantly different between the intervention and control groups.[9,10] In addition to typical RCTs often poorly reflecting real-life exposures, the limited understanding of the amount and type of exercise that might help preserve cognitive function in older adults could potentially explain the observed difference between epidemiological studies and RCTs. At present, it remains inconclusive which type of physical exercise is more effective in lowering risk of dementia in older people, whether aerobic training is an essential component in exercise intervention for dementia prevention, and whether a dose-response relationship exists between the amount of exercise and dementia risk reduction.[11,12] Moreover, the underlying mechanisms of how physical exercise improves cognition appear to be multifold.[13] Further studies that examine the relationship between physical exercise and dementia prevention are of urgent need in view of a growing older population worldwide.

To better understand how physical exercise protects against dementia in older people, we conducted a longitudinal observational study of a large well-characterized cohort of community-living dementia-free older adults and examined whether habitual exercise pattern might be different between those who maintained cognitive stability and those who developed dementia in 6 years. The objective of this study was to identify the amount and type of physical exercise that might reduce the future risk of dementia in community-living older people. We hypothesized that those who remained dementia-free exercised more frequently and longer than those who developed dementia. Regarding the type of exercise, we hypothesized that those who maintained cognitive stability practiced aerobic and mind-body exercises more, whereas those with incident dementia practiced stretching and toning exercises more. The results may add to the current understanding of physical exercise for dementia prevention, and may provide insight for the design of an exercise intervention program that is effective in lowering dementia risk in the older population.

## Methods

### *Study Setting and Participants*

The study sample was drawn from all the older people who attended the Elderly Health Centers (EHCs) in the first 6 months of 2005. The 18 district-based EHCs are run by the Elderly Health Service of the Department of Health of the Government of Hong Kong, providing primary care services, such as regular physical health assessment and dementia screening for local elderly residents. All participants of this study were aged 65 years and older, ethnic Chinese, and living in the community. Exclusion criteria were living in care homes; having history of stroke, Parkinson disease, or clinical dementia; scoring below the education-specific cutoff on the Cantonese version of the Mini-Mental State Examination (C-MMSE) at baseline[14]; or not providing a full description of their habitual exercise pattern.

### *Study Design*

This 6-year observational study had 2 components. First, participants' records from 2005 to 2011 were retrieved anonymously from the database of the Elderly Health Service. Second, participants who had fewer than 2 annual reassessments since 2006 or no reassessment since 2008 and were not identified in the Deaths Registry were invited for a follow-up cognitive examination by geriatric psychiatrists either at the EHCs, at their homes, or by phone from October 2011 to December 2012. Informed consent was obtained from the participants, or from their relatives if they were mentally incapable to give consent, before a follow-up assessment was conducted.

### *Assessment and Classification of Physical Exercise Pattern*

At the time of health assessment, participants were asked by the EHC nursing staff to describe the duration, frequency, and type of habitual physical exercise that they practiced in the past 1 month. The type of physical exercise was then classified in accordance with a local classification system of leisure activities that had previously been validated: aerobic (such as jogging, running, swimming, hiking, ball games, and cycling), mind-body (Tai Chi and yoga), stretching and toning (strolling and shaking limbs), and others.[15] Frequency and duration of exercise were reported as number of days of exercise per week and minutes per day, respectively. No benefit was received by the participants regardless of their answers to the physical exercise pattern.

### *Other Variables*

Participants' demographics (age, sex, and education), medical and psychiatric history (hypertension, type 2 diabetes mellitus, hypercholesterolemia, heart diseases, depression, stroke, Parkinson disease, and dementia), and lifestyle patterns (smoking and drinking) were included in the data provided by the Elderly Health Service. All medical illnesses were verified and classified by primary care physicians at the EHCs in accordance with the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10).[16] Various physical parameters were also measured in the EHC health assessment. Obesity was defined as body mass index (BMI) equal to or greater than 25 $kg/m^2$ in accordance with local references. Hearing impairment was defined as 1 and 2 kHz loss of more than 40 dB in the better ear during audiometric testing (Audioscope, Welch Allyn 23300, Skaneateles Falls, NY). Visual impairment was defined as visual acuity of 20/100 or less in both eyes despite best correction. Poor mobility was defined as needing to walk with aid or being chairbound.

### *Identification of Dementia Cases*

Cognitive examinations were performed in 2 tiers at the EHCs. Nurse interview and a 3-object delayed recall test were first used to screen for any significant memory problem. The C-MMSE and clinical examination by physicians were then conducted for those who were suspected to have memory problems or failed to score full marks in the delayed recall test. Dementia was diagnosed by physicians based on ICD-10 criteria.

Participants who did not undergo reassessment at the EHCs but agreed to a follow-up cognitive examination in 2011–2012 were interviewed at the EHCs or at home, whereas those who declined face-to-face interview were interviewed by phone. The assessment comprised a clinical examination by a geriatric psychiatrist, the C-MMSE, and/or the Clinical Dementia Rating (CDR) depending on the nature of the interview. Dementia was diagnosed based on ICD-10 criteria or a CDR of 1 to 3.[17]

In this study, the outcome was incident dementia in 6 years. Dementia was defined by the presence of clinical dementia in accordance with the ICD-10 or CDR.

### *Sample Size Estimation*

Sample size estimation was performed using the Power and Precision software version 3.0 (Biostat, Englewood, NJ) and based on estimates of conversion rate of dementia and major risks for dementia in previous studies. As the participants of this study were living actively in the community without apparent cognitive impairment, we estimated the 6-year incidence rate of dementia to be 6%. For sample size estimates from computation of significant predictors, 48%