Is maintaining or improving fitness key for dementia prevention?

Physical activity is associated with reduced risk of vascular and non-vascular outcomes and all-cause mortality.[1] Objectively measured cardiorespiratory fitness, an index of physical activity, is an important marker of functional ability and cardiovascular health. Although cardiorespiratory fitness can be potentially comparable with smoking, hypertension, type 2 diabetes, and high cholesterol in predicting vascular disease and all-cause mortality outcomes,[2] it is a risk factor that is not routinely measured in clinical settings.[3] Accumulating evidence suggests that baseline levels of cardiorespiratory fitness are linked to a reduced risk of dementia. We present in the appendix studies showing association between cardiorespiratory fitness and risk of dementia. Owing to errors in measurements, lifestyle changes, chronic disease, and ageing, assessments using baseline measurements of an exposure could underestimate the true strength of an association between an exposure and disease outcome due to regression dilution bias. Our reproducibility substudies of cardiorespiratory fitness measurements within the Kuopio Ischemic Heart Disease prospective cohort study showed a within-person variability in cardiorespiratory fitness levels measured many years apart (regression dilution ratio 0·58).[4] This finding suggests that analyses using only single baseline measurements of cardiorespiratory fitness will underestimate associations with disease outcomes.

Despite mounting evidence on the association between baseline levels of cardiorespiratory fitness and dementia risk, whether changes in cardiorespiratory fitness affect dementia risk is uncertain. In *The Lancet Public Health*, Atefe R Tari and colleagues[5] report new evidence on temporal changes in estimated cardiorespiratory fitness and its association with dementia incidence and mortality, time of onset of dementia, and longevity after diagnosis in apparently healthy men and women at baseline. By use of the large-scale Norwegian Nord-Trøndelag Health Study (HUNT) cohort of 30 695 participants with repeat assessments of estimated cardiorespiratory fitness done 10 years after the baseline measurements, the authors show that participants who maintained or improved their estimated cardiorespiratory fitness values over time had substantially reduced risk of dementia incidence or mortality than did persistently unfit participants. Furthermore, participants who increased their estimated cardiorespiratory fitness over time gained 2·2 dementia-free years and 2·7 years of life. We applaud the authors for this new study which accounts for changes in estimated cardiorespiratory fitness over time, given its high within-person variability and robust study methods, and large sample size.

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A drawback of their study was their assessment of cardiorespiratory fitness, which was not based on the gold standard measure; ie, cardiopulmonary exercise testing with maximal oxygen uptake (VO_{2max}) measured by ventilatory expired gas analysis.[6] The authors used a non-exercise algorithm for estimating cardiorespiratory fitness, based on readily available clinical variables. Several of these non-exercise-based algorithms exist and can conveniently estimate cardiorespiratory fitness in a rapid, inexpensive, and reasonably accurate way when used for large population settings.[3] The limitations of these non-exercise-based equations include underestimation and overestimation of cardiorespiratory fitness at the top and bottom ends of the distribution, respectively.[3] and variability in assessment methodologies of the variables (eg, heart rate and physical activity) used to estimate cardiorespiratory fitness. Hence, not all equations are suitable for particular populations. A uniform definition of estimated cardiorespiratory fitness needs to be developed and validated so that results between studies are comparable. Although the use of cardiopulmonary exercise testing for defining cardiorespiratory fitness involves skills, equipment, and high costs (especially for large-scale settings), this method allows for the most accurate and standardised quantification of cardiorespiratory fitness.[3] Finally, the authors' conclusions on the importance of assessing cardiorespiratory fitness in health risk assessment need to be interpreted with caution because no formal risk assessment analyses were done.

See **Online** for appendix

The findings reported by Tari and colleagues[5] are important and timely because they show that dementia risk could be decreased by maintaining or achieving a

high age-relative estimated cardiorespiratory fitness, even after midlife. Dementia is a major public health burden especially with an ageing population.[7] Although its pathogenesis is not fully understood, lifestyle factors, such as physical inactivity, smoking, unhealthy diet, and excessive alcohol, seem to play a part in its development. A physically active lifestyle promotes good cardiorespiratory fitness levels. However, most populations do not achieve levels recommended by established guidelines, which are 150–300 min per week of moderate intensity or 75–150 min per week of vigorous intensity aerobic physical activity or exercise for adults.[8] Various strategies for promoting physical activity have been recommended, such as individual level-interventions, community-wide and school-based physical activity programmes, policy and environmental changes that improve access to physical activity, and information and communication technology,, but levels are still low. Physical activity, exercise, or sports that are attractive to and feasible for the wider population, need to be identified to promote regular physical activity. Health professionals should use all opportunities to encourage their patients to be physically active.

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We declare no competing interests.

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