Letter to the Editor

Association between Physical Activity and Telomere Length in a North Chinese Population: A China Suboptimal Health Cohort Study*

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Several studies have demonstrated an association between physical activity and telomere length; however, the association remains inconsistent. A cross-sectional study consisting of 588 participants (375 females, median age of 33.8 years) was carried out to investigate the association between telomere length and physical activity in a general population from North China. The results show that relative telomere length is not significantly different in participants in the northern Chinese population with different levels of physical activity, either in the model only adjusted for age (*F* = 2.127, *P* = 0.120) or in the model adjusted for demographics and lifestyle (*F* = 1.227, *P* = 0.294). The gender-stratified analysis also produced insignificant results. Our study confirmed a non-significant association between physical activity and telomere length in the northern Chinese population, which adds to the inconsistent association between physical activity and telomere length across different ethnic populations.

Key words: Physical activity; Telomere length; Relative telomere length; Chinese

Physical activity refers to any body movement that works one's muscles and requires more energy than resting. There is a growing consensus that physical activity confers favorable health outcomes across the lifespan and is consistently associated with a reduction in obesity, weight gain, coronary heart diseases (CHD), type II diabetes mellitus and the age-related diseases of dementia and Alzheimer's disease; decreased all-cause mortality rates and higher probability of late survival; good health and functioning during older age; and higher cognitive performance[1]. Conversely, sedentary behavior is associated with an unfavorable biomarker profile in older age, all-cause mortality, cardiovascular disease (CVD) incidence and mortality, type II diabetes incidence and cancer[2]. Recently, we demonstrated that short relative telomere length (RTL) is associated with suboptimal health status (SHS), a physical state between health and disease that can be recognized as a subclinical and reversible stage of chronic health conditions[3].

Telomeres are the repetitive sequences that protect the ends of chromosomes, help to maintain genomic integrity and are of key importance to human health. Telomere length (TL) declines with age and varies in relation to factors such as smoking and obesity, as well as a number of common diseases, including cardiovascular disease and some cancers; however, its relationship with cancer appears complex, in that longer telomeres are associated with a higher risk of some cancers[4]. Conversely, longer TL is associated with better health and protection from age-related diseases[5]. Therefore, TL might be an indicator of healthy aging and serve as a candidate biomarker of chronic diseases.

Considering that physical activity contributes to healthy aging and that telomere length might be an indicator of healthy aging, physical activity might correlate with telomere length. A systematic review and meta-analysis including 37 original articles indicated that further research is needed to determine the existence of a significant association between physical activity and telomere length, with

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15 studies favoring a positive association, 2 studies indicating an inverted 'U' correlation, and 20 studies not showing statistically significant associations[6]. Recently, a cross-sectional analysis including 5,823 adults from the National Health and Nutrition Examination Survey (NHANES 1999-2002) showed that physical activity (PA) was significantly and meaningfully associated with telomere length in U.S. men and women[7]. Only one study was carried out to investigate the relationship between telomere length and physical activity in an elderly Chinese population of individuals 65 years and older, and the results showed that there was no significant association[8]. The present study was aimed at investigating the association between telomere length and physical activity in a general population from Northern China.

A cross-sectional analysis was performed as part of the baseline survey of the China Suboptimal Health Cohort Study (COACS), a prospective community-based cohort study, with participants aged 18-64 years at enrollment and free from any diseases at the baseline screening[9]. Participants currently suffering from diabetes (self-reported diabetes or FPG ≥ 7.0 mmol/L at the investigation), hypertension (self-reported hypertension, or SBP ≥ 140 mmHg, or DBP ≥ 90 mmHg at the investigation), hyperlipemia (self-reported), cardiovascular or cerebrovascular conditions (including self-reported atrial fibrillation, atrial flutter, heart failure, myocardial infarction, transient ischemic attack, and stroke), any type of cancer (self-reported) and gout (self-reported) were excluded in the present study. The Ethical Committees of the Staff Hospital of Jidong oil-field of Chinese National Petroleum, and Capital Medical University approved the study. The ethical guidelines of the Helsinki Declaration were also followed.

Descriptions of DNA extraction, quantification, dilution and the determination of relative telomere length measurement by qPCR can be referred to in our previous paper[3].

Physical activity was classified as ideal (≥ 150 min/week of moderate intensity or ≥ 75 min/week of vigorous intensity), intermediate (1-149 min/week of moderate intensity or 1-74 min/week of vigorous intensity), or poor (none). Covariates such as demographic variables (age, sex, marital status, education level, and family income), alcohol drinking, smoking history, and sleeping hours per night were included. In addition, body mass index (BMI), hip circumference, abdominal circumference, blood pressure and biochemistry measurements (FBG, TG, LDL, TC) were also included. Methods of collecting these data have been described previously[9].

Continuous variables with an underlying normal distribution were presented as a mean ± SD and analyzed by independent *t*-tests or analyses of variance (ANOVAs); otherwise, variables were presented as a median (interquartile range) and analyzed by nonparametric tests. The chi-square test was used to examine between-group differences in categorical variables. General linear models were used to compare the between-group differences of RTL after controlling for covariates. All statistical tests were 2-sided, and $P < 0.05$ was considered significant. All statistical analyses were carried out using IBM SPSS Statistics software (version 21.0 from Armonk, NY: IBM Corp, USA).

In total, 588 subjects (375 females, 63.8%) with a median age of 33.8 years (range 20-64 years) are included in the final analysis. The descriptive characteristics of the participants are listed in Table 1. The proportion of females, age, education, smoking and alcohol drinking are significantly different among participants with inactive, intermediate and active physical activity levels, while BMI is not significantly different. The results show that RTL is not significantly different among participants with different levels of physical activity in the northern Chinese, neither in the model only adjusted for age ($F = 2.127$, $P = 0.120$) nor in the model adjusted for demographics and lifestyle ($F = 1.227$, $P = 0.294$) (Table 2). Similarly, the stratified analysis shows that RTLs are not significantly different in participants with different levels of physical activity, either in males ($F = 1.016$, $P = 0.364$) or in females ($F = 0.350$, $P = 0.750$) (Table 3).

In the present study, we demonstrated that RTLs are not significantly associated with physical activity, either in males or in females. This is the first attempt to explore the association between telomere length and physical activity in a general population in mainland China. Our findings are consistent with the findings from an elderly Chinese population of individuals 65 years and older in Hong Kong, which showed no association between telomere length and physical activity[8]. However, our findings are contrary to the findings in NHANES 1999-2002, which demonstrated that telomere length does not differ among the sedentary and those engaged in low or moderate levels of physical activity; however,

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