Original Article

High Physical Activity is Associated with an Improved Lipid Profile and Resting Heart Rate among Healthy Middle-aged Chinese People

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Abstract

Objective To investigate the effects of physical activity (PA) on dyslipidemia and elevated resting heart rate (RHR) in a large-scale cross-sectional study in China.

Methods We recruited community-based individuals who were 40-60 years old using a cluster sampling method. The PA levels of the participants were classified as low, moderate, or high, using the International Physical Activity Questionnaire. Dyslipidemia was defined as the detection of abnormalities in lipid indicators, and 4 lipid parameters were evaluated using fasting blood samples. Multivariate logistic regression analyses were used to evaluate the associations of PA with dyslipidemia and RHR.

Results A total of 10,321 participants (38.88% men) were included in this study. The percentages of individuals with high, moderate, and low PA levels were 46.5%, 43.9%, and 9.6%, respectively. In both men and women, high PA provided odds ratios of 0.88 [95% confidence interval (CI): 0.83, 0.94] for dyslipidemia and 0.82 (95% CI: 0.73, 0.92) for elevated RHR, compared to participants with low PA.

Conclusion Our data suggested that substantial health benefits (related to dyslipidemia and elevated RHR) occurred at higher intensity PA, with greater energy consumption, in middle-aged Chinese people, and particularly in men.

Key words: Physical activity; Lipid profile; Dyslipidemia; Heart rate; Unconditional logistic regression

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INTRODUCTION

Elevated levels of lipids in the blood can lead to significant chronic health problems. For example, increased amounts of fat and cholesterol in the blood, which is known as dyslipidemia, are associated with an increased risk of coronary heart disease[1-2] and stroke[3-4]. In addition, the 2002 World Health Report[5] estimated that 7.6% of the disease burden in developed countries, and approximately 2% of the burden in developing countries, was caused by elevated blood cholesterol levels. Furthermore, 56% of ischemic heart disease cases and 32% of ischemic stroke cases in World

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Health Organization (WHO) regions are due to high blood cholesterol levels. Unfortunately, dyslipidemia may be caused by an unhealthy diet and lifestyle (80%) or by hereditary familial disorders (20%)[6]. Elevated serum levels of lipids also have a multifactorial etiology that is determined by a large number of environmental and genetic factors. In addition, diet, physical inactivity, and socioeconomic and cultural factors are associated with both obesity and dyslipidemia[7]. Furthermore, variations in the genes of enzymes, receptors, and apolipoproteins are partially involved in regulating serum levels of low-density lipoprotein cholesterol (LDL-C) and total cholesterol[8].

An elevation in resting heart rate (RHR) is also associated with cardiovascular disease. Epidemiological evidence suggests that an elevated RHR is associated with increased cardiovascular morbidity and mortality in the general population, independent of the conventional risk factors[9-10]. Hall and Palmer[11] have also determined that a 2% reduction in death was associated with each 1 beat/min reduction in heart rate. In addition, elevated RHR has been associated with a poorer prognosis within subgroups of patients with cardiovascular disease[12].

Physical activity (PA) is of major importance in regulating health, as it is strongly associated with obesity and a number of diseases, including metabolic disorders[13]. Several previous intervention trials had been performed to explore the associations between PA and serum lipid levels[14-16], and most of these trials have reported that high levels of PA were associated with low serum lipid levels. However, due to the use of various exercise interventions and the different characteristics of the studies' populations, the influence of PA on lipid profiles remains uncertain[6,14-15]. In addition, the type and intensity of PA that produces the most beneficial effects also remain unclear, and the effects of PA on serum lipid levels are inconsistent in different studies[15-16]. Moreover, the lipid profiles of men and women exhibit different responses to PA[17-18].

Similar to the association between PA and lipid profiles, previous studies have demonstrate that subjects with a higher PA had lower RHRs, compared to physically inactive subjects[19-20]. However, Black et al.[21] did not observe this trend in young female adults, after adjusting for covariates. In addition, to our best knowledge, PAs that were performed at work and in the home have rarely been considered together in the previous studies. Therefore, the goal of this study was to evaluate the influences of total PA on dyslipidemia and RHR, according to sex, in a middle-aged population of Chinese people.

METHODS

Sampling

We used a cluster sampling method to recruit subjects from urban and rural areas in Hebei, China between 2009 and 2011. First, due to feasibility considerations, 5 communities (urban) and 5 villages (rural) in three cities of Hebei province were initially screened. Next, after evaluating their representative nature, 4 communities and 3 villages were selected for inclusion in the study. Finally, 15,851 residents who were 40-60 years old and had lived in these communities and villages for >5 years were included in the study. The Ethics Committee of Hebei United University (Tangshan, China) approved the study's design, and all subjects gave their informed consent to participate.

Among the included individuals, 13,648 subjects completed the questionnaire and laboratory tests, providing a final response rate of 86.1%. Participants were excluded if they had a history of hypertension, diabetes, cardiovascular disease, or stroke (2973 subjects); regularly took anti-hypertensive, lipid-lowering, or hypoglycemic agents within 1 month (60 subjects); or had missing data regarding physical activity, lipid levels, and the main demographic variables (including age and sex) (294 subjects). Based on these exclusions, 10,321 subjects (4013 men and 6308 women) were included in the statistical analysis.

Data Collection

Data were collected in examination centers at the local health stations or at community clinics in the participants' residential areas. The quality of the data that were collected was maintained by using standardized protocols and centralized training. At each center, all data were entered into an electronic customized database that was programmed with the appropriate ranges, and were then re-checked for consistency using quality control measures.

Questionnaire Survey

Structured pre-test questionnaires were administered via face-to-face interviews. The first part of the survey was designed to collect basic