Research Theme
Metabolic Disorders

Research Project Title
The Modification of Age-associated Degeneration in Cardio-metabolic Health with Habitual Exercise

Principal Investigator
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Collaborator(s)
To be confirmed

Background
The clustering of poor glucose regulation, obesity, dyslipidemia, and hypertension is classified as metabolic syndrome (MS), which not only increases all-cause morbidity and mortality, but also the risks of cardiovascular disease (CVD) and diabetes mellitus (DM) by two- to five-fold. Ageing is the primary independent risk factor for metabolic disease, and the disease is projected to increase exponentially in the 2–3 decade. The burden of metabolic disease in the world is also projected to shift to the Asian continent, especially in developed countries with an ageing population, such as Singapore.

The current evidence supports habitual exercise as a potent modality for preventing and treating metabolic disease. For example, the lifespan of 9777 individuals tracked over 18 years was significantly longer for those who went from being “unfit” to “fit” compared with those who remained as “unfit” (Blair et. al., 1995). The risk of having metabolic disease was 60% higher in those who engaged in < 60 min of weekly physical activity compared with those who were active for > 3 h weekly (Lakka et. al., 2003), and 10 weeks of moderate-intensity swim training significantly decreased systolic blood pressure in hypertensive patients (Tanaka et. al., 1997). In addition, the risk of having MS was about 7 times higher in men with a maximal oxygen uptake (VO2max) < 29.1 mL/kg/min compared with VO2max > 35.5 mL/kg/min (Lakka et. al., 2007).

Aim and Hypothesis
Despite the emergence of evidence in the last 40 years, the health-benefits of habitual exercise have been underutilized in the care for patients with metabolic disease. Such evidence is also lacking in the Asian population despite a rapidly increasing ageing population and prevalence of the disease. This study will investigate the modification of age-associated degeneration in cardio-metabolic health with habitual exercise in the Asian population. We hypothesize that habitual exercise of > 5 years can inhibit or reverse the indicators of age-associated degeneration of cardio-metabolic in middle to older-aged individuals. The data generated from this study will help to steer
the direction of longer-term research investments for metabolic disease prevention and treatment. The evidence accumulated in the longer term may also influence the shift from a clinic-centric model to a holistic-model for metabolic disease care that includes exercise, nutrition, and design of living and community space to promote active lifestyle.

Approach
The effects of habitual exercise on age-associated cardio-metabolic health will be investigated using a cross-sectional design in up to 240 healthy male and female subjects assigned to 6 equal groups, comprising Young Active (YA) and Sedentary (YS); < 40 years old, Middle-aged Active (MA) and Sedentary (MS); 40 – 59 years old, and Older-aged Active (OA) and Sedentary (OS); > 60 years old. Sedentary individuals would have participated in < 2 X < 30 min sessions of exercise weekly in the 5 years and active individuals would have participated in > 3 sessions of > 45 min vigorous exercise weekly for > 5 years. The cross-sectional design permits the testing of the main (independent) and interaction effects of ageing and habitual exercise on the biomarkers of metabolic disease.

The study will employ the following biomarkers for metabolic disease, which will be measured over 3 separate trials on the same subjects:


b. Bioassays of blood lipids i.e., total cholesterol, and high and low-density lipoproteins, and triglycerides.

c. Bioassay of interleukin-6 (IL-6) and C-reactive proteins (CRP) to shed light on the roles of the inflammatory pathway in metabolic disease

d. Non-invasive measurement of arterial augmentation index (AiX) and pulse wave velocity (PWV) to indicate stiffness of the major arteries. Central arterial and brachial blood pressures will also be measured.

e. Arterial endothelium functions will be measured using flow mediate dilation (FMD) with ultrasound analysis of occlusion-induced brachial artery hyperemic response.

f. Body composition will be measured non-invasively using the bio-impedance or dual X-ray absorptiometry (DEXA).

g. Saliva and stool samples will be used to measure microbiota in the respiratory airway and the
intestines and to analyse the roles of microbes in the mechanisms of metabolic disease.

h. Submaximal (SXT) and maximal (MXT) exercise tests on the treadmill tests will be conducted with continuous measurement of expired air to measure oxygen uptake (VO₂), minute ventilation, respiratory rate, tidal volume responses as indicators of cardio-metabolic health.

This project is designed to be broad in scope, which provides the PhD candidate with sufficient intellectual space to carve out the hypotheses and focus of the thesis with habitual exercise, ageing and metabolic health as the underlying themes. Students may also propose to add to the study design to strengthen the scientific rigor of thesis, if additional resources are available to support the additional studies e.g. nutrition or exercise interventions or to focus on a sub-population.

Contact Us

If you have questions regarding this project, please email the Principal Investigator.

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