

Title of proposed program: Mechanisms of Physical Activity-Induced Health Benefits

Submitting Source: NIH

What is the major obstacle/challenge/opportunity that the Common Fund should address? What would the goals of the program be?

Moderate to vigorous activity is related to less adiposity, a less atherogenic lipid profile, greater insulin sensitivity, lower arterial stiffness and blood pressure, better endothelial function, higher bone density, muscular strength and endurance, and aerobic fitness, and improved mental health (anxiety, depression, self-concept). It is important to point out that although physical activity is associated with lower rates of obesity, even obese individuals can enjoy the positive effects of physical activity independent of its effect on weight. According to the Centers for Disease Control and Prevention, less than 50% of people living in the United States get the recommended amount of physical activity¹. A study of the United Kingdom National Health Service found that 1/3 of all deaths are caused by diseases that could be attenuated by physical activity and that 3% of all morbidity and mortality is directly attributable to inactivity². Blue Cross Blue Shield published a study that showed that members who were sedentary had a mean per-member-per-year cost of \$5684, compared with \$4442 for persons who exercised 1 to 4 days and \$3594 for those members who engaged in physical activity on 5 or 6 days/week. Every-day exercisers had an average per-member-per-year cost of \$3453³. Another economic study, using the Canadian Community Health Survey, found that inactive individuals spend 38% more days in the hospital than active people and use more outpatient medical services⁴. Thus, the negative health and economic consequences of inactivity are undeniable.

Increased physical activity benefits the human body in a multifactorial manner, reducing the burden of many widely prevalent chronic diseases, including cardiovascular disease, several cancers, obesity, type 2 diabetes, osteoporosis, sarcopenia, and depression. Physical activity declines progressively after the first decade of life. Establishment of healthy patterns of physical activity during childhood and adolescence is important because physical activity tracks from childhood to adolescence and from adolescence to adulthood. Additional research leading to a more complete understanding of the mechanisms linking regular exercise to disease prevention and improved health can contribute to decreased burden of common diseases and a significant increase in quality-adjusted life years for many people. The mechanisms linking physical activity and disease prevention/amelioration may also contribute to the efficacy of physical activity as a treatment for these diseases. A more integrated approach is needed to study the effects of physical activity on the sum total of disease outcomes. For example, physical activity may reduce inflammation, which may in turn reduce risk of cancer, cardiovascular disease, depression, etc.

Goals include:

- creating, optimizing, and validating endpoints and outcome measures for both human and animal exercise studies
- developing optimal protocols, techniques, and tools for evaluating the biological effects of physical activity and exercise training
- studying the interactions between cells, tissues and organ systems during physical activity
- determining the common mechanisms by which exercise improves overall health and the exercise thresholds required for these benefits to occur
- studying the cognitive and psychological effects of physical activity and exercise training and their impact on other health behaviors

- creating a centralized community committed to transdisciplinary physical activity research

Why is a trans-NIH strategy needed to achieve these goals? What initiatives might form the strategic plan for this topic?

Currently, physical activity studies are funded across the NIH (NCI, NHLBI, NIA, NIAID, NIAMS, NICHD, NIDDK, NINDS, etc), and the investigators are organized not as exercise scientists, but as disease, organ, or tissue specialists. Such compartmentalization clearly limits the scope and impact of physical activity research projects. This initiative would invite applications addressing both general and disease-specific mechanisms of physical activity, with emphasis on transdisciplinary research and tool development.

If a Common Fund program on this topic achieved its objectives, what would be the impact?

There is a potential to develop exercise prescriptions that take into account an individual's motivations and health state and that give the maximum benefit for multiple comorbid conditions in the minimal amount of time. Ultimately, it is in the country's best interest for all citizens to engage in physical activity. Understanding the pathways through which physical activity influences disease outcomes would simultaneously allow for the development of targeted interventions (e.g., by intensity, type of activity) for people with varying characteristics (e.g., genetic variants) while also allowing for more targeted physical activity prescriptions for all Americans. This initiative would provide a much needed framework to promote integrated biological/physiological/psychological systems with the goal of optimizing the management of personal physical activity as well as general exercise programming. In addition, there is a potential to identify molecular targets that can be manipulated to mimic the effects of exercise in persons unable to do so. The transdisciplinary nature of this initiative (and the subsequent involvement of multiple ICs) would be important in developing appropriate physical activity recommendations and managing the health of individuals who have comorbidities. At present, such integrative management is only loosely achieved.

1. <http://apps.nccd.cdc.gov/PASurveillance/StateSumResultV.asp> (2007 data)
2. Allender S, Foster C, Scarborough P, Rayner M. [The burden of physical activity-related ill health in the UK.](#) *J Epidemiol Community Health.* 2007 Apr;61(4):344-8.
3. Bland PC, An L, Foldes SS, Garrett N, Alesci NL. [Modifiable health behaviors and short-term medical costs among health plan members.](#) *Am J Health Promot.* 2009 Mar-Apr; 23(4):265-73.
4. Sari N. [Physical inactivity and its impact on healthcare utilization.](#) *Health Econ.* 2009 Aug;18(8):885-901.