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The health benefits of physical activity in children and adolescents: implications for chronic disease prevention

Abstract Clinical, epidemiological and basic research evidence clearly supports the inclusion of regular physical activity as a tool for the prevention of chronic disease and the enhancement of overall health. In children, activities of a moderate intensity may enhance overall health, and assist in preventing chronic disease in at-risk youth. The numerous health benefits of regular exercise are dependent on the type, intensity and volume of activity pursued by the individual. These benefits include reduction of low density lipoproteins while increasing high density lipoprotein; improvement of glucose metabolism in patients with type II diabetes; improved strength, self esteem and body image; and reduction in the occurrence of back injuries. In addition, a progressive, moderate-intensity exercise program will not adversely affect the immune system and may have a beneficial effect on the interleukin-2/natural killer cell system. Furthermore, by decreasing sedentary behaviors and, thus, increasing daily physical activity, individuals may experience many stress-reducing benefits, which may enhance the immune system.

Conclusion Moderate intensity exercise of a non-structured nature seems to facilitate most of the disease prevention goals and health promoting benefits. With new guidelines promoting a less intense and more time-efficient approach to regular physical activity, it is hoped that an upward trend in the physical activity patterns, and specifically children at risk for chronic disease, will develop in the near future.

Key words Exercise · Physical activity · Childhood

Abbreviation \( VO_2 \text{ max} \) aerobic capacity

Introduction Clinical, epidemiological and basic research evidence clearly supports the inclusion of regular physical activity as a tool for the prevention of chronic disease and the enhancement of overall health [12, 22]. Specific recommendations as to the intensity, duration and frequency of exercise have formerly concentrated on the improvement of cardio-respiratory or aerobic health [12]. It was not until recently that the additional health benefits of regular moderate physical activity have been identified. In children, the replacement of sedentary behaviors, such as television viewing and computer games, by activities of a moderate intensity may enhance overall health, and assist in preventing chronic disease in at-risk youth [9, 25].
Physical activity and the prevention of chronic disease in children

The numerous health benefits of regular exercise are dependent on the type, intensity and volume of activity pursued by the individual. Aerobic exercise reduces mental stress and depression, improves the oxygen transport system and endocrine function and reduces low density blood lipoproteins while increasing high density blood lipoproteins, thereby improving cholesterol ratio [30]. Dynamic resistive training at a moderate intensity with short rest intervals (circuit training) has been shown to promote similar health benefits in adults [30]. Similar positive results in blood lipid profiles have been observed in studies using non-weight bearing, single segment resistance training regimens [15]. Also, the impaired oxidative capacity of skeletal muscle associated with heart failure was shown to improve with localized muscle training [29].

The positive effect of regular exercise training on individuals with type II diabetes is now widely accepted [4]. A single bout of exercise increases blood flow and glucose delivery, thus adding to the effect of maximal insulin concentrations in human skeletal muscle. The effect is increased by regular exercise training, a phenomenon that is still under investigation [10]. Recent evidence suggests that resistance training also improves glucose metabolism in adults [28]. Durak and colleagues [8] observed positive alterations in glucose metabolism in type I diabetic men engaged in resistance training. In addition, resistance-type exercise training is shown to improve muscle function, thereby promoting independence, especially in the later years [30].

Exercise is recommended as a preventive measure for increasing bone density and, thus, discouraging osteoporosis before menopause in women [5]. Two forms of exercise will promote the desired effect, high impact endurance-type training and resistive training. Lean body mass is better correlated with bone mass than aerobic fitness [5].

Children in the U.S. are participating in sports at an earlier age and at a higher level of intensity [18, 21]. This contributes to an increased occurrence of injury and is enhanced by rapid bone development in the prepubertal years. The prepubescent child is at an increased risk of injury due to a reduction in joint flexibility caused by rapid growth in the long bones [21]. The benefits of strength gains may also add an additional resistance to sports injury in the prepubescent child and reduce the incidence of overuse injury [19, 20, 31]. As early as 1983, the American Academy of Pediatrics concluded that strength is a vital component of health-related fitness and physiological function in children [1].

One of the primary concerns of participation in exercise in childhood is the risk of damage to the developing musculoskeletal system and, in particular, the epiphyseal or growth plate. The growing bones of children are believed to be less resistant to physical stress than mature adult bones. Damage to the epiphysis may result in a disruption of normal bone development and the impairment of normal growth [3]. The American Physical Therapy Association concluded that the primary cause of sports injury was poor physical conditioning [20]. There is evidence that physical fitness and experience may play a role in reducing the risk of injury.

The health benefits of resistance training in children are similar to those of adults and include: improved strength, power, muscular endurance, bone density, tendon-bone interface strength, improved motor performance, self-satisfaction, self-esteem and body image [23, 24, 32]. Recent research indicates that there is an increase in spinal pain among elementary school aged youths similar to that reported in adults [2]. A strong and balanced musculature will promote healthy posture and reduce the occurrence of back injuries. In addition, Loucks suggested that young girls should participate in resistance or strength exercise along with other physical activities to prevent osteoporosis in later life [17].

Physical activity and the immune system

An additional area of research is the effect of exercise training on the immune system. A progressive, moderate-intensity exercise program will not adversely affect the immune system and may have a beneficial effect on the interleukin-2/natural killer cell system. Interleukins stimulate immune cell growth and work in conjunction with natural killer cells which destroy tumor cells, viral-infected cells and eliminate injured tissue [13]. Short bouts of exercise will not affect immune function; however, more intense and more stressful exercise has an adverse effect on the immune system. As little as 90–120 min of exercise at 60% of aerobic capacity (VO2 max) lowers national killer cell counts, possibly increasing susceptibility to viral infections and tumorigenesis. Excessive training contributes to a cumulative disturbance of immune function. Adverse immune reactions associated with challenging exercise may be reduced by using a more progressive approach and/or reducing the intensity to a moderate level [27].

By decreasing sedentary behaviors and, thus, increasing daily physical activity, individuals may experience many stress-reducing benefits, which may enhance the immune system. Regular physical activity has been shown to improve energy levels, concentration, mental performance and mood [16]. It is also attributed with reduced tension, anxiety, depression and hostility [16].

The short-term mood-enhancing benefits of physical activity are well established in the literature [14]. Short-term decreases in psychological stress indices such as anxiety, tension, depression and anger are promoted by exercise. Specifically, exercise of > 30 min at 70% of VO2 max acutely reduces resting blood pressure, especially in hypertensive individuals [14]. In addition, moderate to vigorous activity with a duration of 40 min was shown to promote a decrease in cardiac reactivity (heart rate and mean arterial blood pressure) to