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ANTHROPOLOGY AND PHYSICAL ACTIVITY: A LIFESPAN PERSPECTIVE*

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ABSTRACT

The presently available evidence indicates significant, but generally moderate relationships between physical activity and health-related physical fitness in childhood and adolescence, and physical activity and health status in adulthood. This is not surprising given the variety of methods of estimating habitual physical activity and tests of health-related physical fitness. A major proportion of the variability in indicators of health-related and metabolic fitness is not accounted for by physical activity as assessed in the available studies. Nevertheless, the trends emphasize the importance of a lifestyle of regular physical activity during childhood and adolescence, which continues into and throughout adulthood, for the health and well-being of the individual and the population. The trends also emphasize the need for further study of the interactions among physical activity, physical fitness and health status in childhood, adolescence and adulthood.

Key words: activity, fitness, childhood, adolescence, adulthood, tracking

A goal of public health is to have individuals across the lifespan and in turn the population regularly involved in physical activity at a level that is believed to be conducive to the maintenance of good health and the prevention of disease. At the same time, the majority of individuals in many developed countries are not regularly active. In the mid-1990s, for example, almost one-half of American youth 12-21 years and 60% of American adults were not regularly active. Moreover, 25% of adults reported no regular physical activity (27). Calls for increasing daily physical activity in all segments of the population from early childhood through old age are, therefore, common in discussions of public health policy.

Evidence indicates that a lifestyle of regular physical activity contributes to more efficient functioning of various systems, weight maintenance, reduced risk of several degenerative diseases, reduced risk of mortality, and overall improvement of quality of life (6). This generalization is derived largely from data for adults. Nevertheless, it is commonly assumed that habits of physical activity and benefits of regular activity established during childhood and adolescence persist into adulthood.

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Hence, what is the relationship between physical activity in childhood or adolescence and activity in adulthood? And, what is the relationship between health and fitness in childhood or adolescence and health status in adulthood? Issues related to these questions and others are, needless to say, complex. They deal to a large extent with tracking, or stability, of characteristics and behaviors from childhood through adolescence into adulthood.

Pathways of potential relationships between physical activity and health status in childhood, and between physical activity and health status during childhood and activity and health status in adulthood are illustrated in Fig. 1. For the sake of this discussion, physical fitness, specifically health-related physical fitness, is viewed as a component of health status. The potential associations indicated in Fig. 1 are subsequenly evaluated.

Definitions

Physical activity is a behavior. It is generally defined in the context of energy expenditure, but physical activity has several other dimensions. These include, ground reaction forces and stresses and strains (biomechanical), physical fitness (strength and endurance), proficiency in motor skills, and context. Physical activity occurs in many forms and contexts (work, play, sport, leisure, among others), which are influenced by the culture in which the individual lives. Physical activity is biocultural - energy is expended or ground reaction forces are exerted (biological and mechanical) in movement behaviors that occur within a cultural context. There is a need to understand physical activity as a biocultural behavior, including determinants of activity and of an active lifestyle.

Health has many dimensions. For the sake of the present discussion, health is operationalized in the context of health-related physical fitness (see below) and selected indicators of health status, e.g., obesity and bone mineral.

Physical fitness is a state - a condition which permits the individual to carry out daily activities without undue fatigue and with sufficient reserve to enjoy active leisure. Indicators of physical fitness change with normal growth and maturation, and with aging during adulthood. The concept

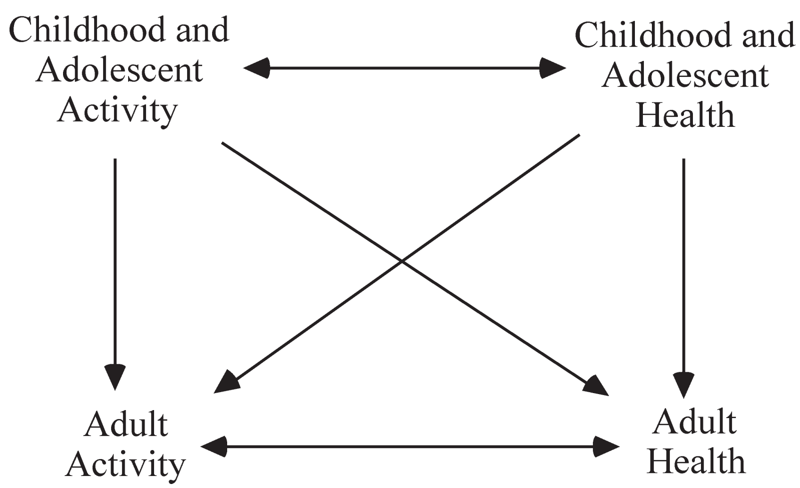

Fig. 1. *Potential relationships between physical activity and health in childhood and adolescence, and physical activity and health during childhood, adolescence and adulthood. Modified after Blair et al. (3).*

of physical fitness has evolved from a primary focus on proficiency in strength and motor tasks (performance-related fitness) to more emphasis on health. Thus, the concept of health-related physical fitness has evolved. It is often viewed in three components: cardiovascular fitness, musculoskeletal function of the lower trunk - abdominal strength and lower back flexibility, and body composition - specifically fatness.

The definition of fitness has been further expanded to include both physical and physiological fitness in the context of morphological, muscular, motor, cardiovascular, and metabolic components (5). Hence, the term metabolic fitness, which includes measures of serum lipids, blood pressures, blood glucose, and so on, is increasingly used.

Pathway I - What is the relationship between activity in childhood and adolescence and activity in adulthoodc?

The potential relationship between childhood and adolescent activity and adult activity assumes that physical activity is a stable aspect of behavior from childhood through adolescence into adulthood. The literature on the tracking of physical activity has been recently summarized (18). Studies which span three or more years during childhood, the transition from childhood into adolescence, and adolescence indicate a low to moderate level of stability for physical activity. The same is true for data which span the transition from adolescence into young adulthood, although interage correlations decrease with increasing intervals between observations. Presently available studies, however, do not control for changes which accompany normal growth and maturation, covariates of physical activity, and methodological variation. Allowing for limitations of our measures of physical activity and lack of control of important covariates, habits of physical activity (and also inactivity) track at moderate levels during childhood and adolescence and into adulthood, i.e., the active are likely to stay active and the inactive are likely to stay inactive. A challenge for the physical activity sciences is to motivate the inactive to become active and the active to remain active.

Pathway II - What is the relationship between activity in childhood and adolescence and health in childhood and adolescence?

The relationship between habitual physical activity and the health-related and metabolic fitness of children and adolescents, though statistically significant, is not strong (16). A large part of the variability (80% to 90%) is not accounted for by physical activity as measured in the studies, which suggests that factors other than physical activity exert an important influence on the health-related fitness of children and adolescents. These factors are probably rooted in the interaction of biological and behavioral changes that occur with normal growth, maturation and development from childhood through adolescence (15). When viewed in a multivariate context incorporating indicators of physical activity, health-related fitness, and metabolic fitness, data for youth 9-18 years of age suggest that an ***activity profile*** of greater energy expenditure and energy expenditure in moderate-to-vigorous physical activity and less time being inactive, and a ***fitness profile*** of low fatness and high aerobic fitness (PWC 150) are *associated* with a more favorable ***metabolic risk profile*** - lower blood pressure, serum triglycerides, LDL-C and plasma glucose, and higher HDL-C (13).

A related question deals with variation in physical activity among children and adolescents who are physically fit and unfit.

Are physically fit children and adolescents more active than those who are not fit? Data addressing this issue are not extensive. This question was addressed among Taiwanese adolescents of both sexes who were classified as fit and unfit on the basis of indicators of health-related physical fitness (12). Adolescents classified as more fit in the one mile run (about 1500 km, cardiovascular endurance) and the sit and reach (lower back flexibility) had significantly higher estimated daily energy expenditure per unit of body weight than those classified as not fit. On the other hand, adolescents classified as fit and unfit on the basis of skinfolds and sit-ups did not differ in estimated daily energy expenditure.

Pathway III - What is the relationship between health and fitness in childhood and adolescence, and health and fitness in adulthood?

Longitudinal data indicate that measures of health-related physical fitness track at higher levels, i.e., are more stable, than indicators of physical activity. Muscular strength and endurance, flexibility and cardiovascular fitness track reasonably well during childhood and adolescence (17). As males progress through adolescence (data are limited for females), correlations between adolescent measures of muscular strength and endurance and corresponding measures at 30 years of age tend to increase with age, especially between 15 and 18 years (1). Thus, measures taken in later adolescence indicate a stronger relationship with adult values compared to measures taken at earlier adolescent ages.

Flexibility of the lower back (sit and reach) tracks at the same low to moderate range as muscular strength during childhood and adolescence, but it tracks somewhat better from adolescence into adulthood (1, 17). Interage correlations for $\dot{V}O_2$ max per unit body mass ($ml \cdot kg^{-1} \cdot min^{-1}$), an indicator of cardiovascular fitness, are generally moderate during childhood and adolescence and from adolescence into adulthood (17).

Body composition is a component of health-related fitness, and the focus is almost exclusively on fatness. The body mass index (BMI, kg/m^2) and skinfolds are routinely used in fitness surveys as indicators of fatness. Correlations between the BMI at various ages during childhood and adolescence and the BMI in adulthood are moderate during childhood, but increase with age during adolescence (11, 21). Correlations between the sum of four skinfolds during childhood and in young adulthood are lower than corresponding correlations for the BMI, but the pattern of change in correlations across age is reasonably similar for skinfolds and the BMI. Unfortunately, stability at the extremes of fatness, i.e., overweight and obesity, is greater. A high BMI during childhood and adolescence (>85th percentile) places the individual at greater risk for overweight/obesity in adulthood (11).

Pathway IV - What is the relationship between health and fitness in childhood and adolescence, and activity in adulthood?

Are those who are more physically fit as children and adolescents more likely to be physically active as adults? Some evidence suggests that physical fitness during childhood and adolescence may be predictive of adult physical activity, but the presently available data do not control for the relationship between childhood/adolescent and adult fitness.

Physically active young adult males, 23-25 years, had better motor fitness scores as children (10-11 years) and adolescents (15-18 years) than inactive young adults (8). As children and adolescents, active adults performed, on average, significantly better than inactive adults in the 600 yard (about 550 m) run, sit-ups, 50 yard (about 46 m) dash and shuttle run. Thus, performance-related fitness during childhood and adolescence may be predictive of activity levels in early adulthood.

In Swedish adults at 27 years of age, aerobic potential ($\dot{V}O_2$ max and percentage type I muscle fibers) at 16 years of age alone accounted for about 31% and 24% of the variation in leisure time physical activity at 27 years of age in women and men, respectively. In the complete model, aerobic potential, strength, physical activity and grades in physical education at 16 years of age explained 82% of the variance in physical activity at 27 years of age in women, but only 47% of the variance in men (10). The results suggest two issues that merit further study. First, there appear to be sex differences in predicting adult activity level from activity, performance and physiological variables during adolescence. And second, there is some degree of coupling between muscle physiology and physical activity pursuits.

Pathway V - What is the relationship between activity in childhood and adolescence and health in adulthood?

Evidence dealing with the relationship between physical activity during childhood and adolescence and health in adulthood is limited with the exception of data for skeletal health. Regular physical activity during childhood and adolescence is associated with increased bone mineral content in boys and girls (22, 23). The osteogenic influence of activity is generally specific to the skeletal sites at which the mechanical strains occur. Beneficial effects are more apparent in weight bearing than non-weight bearing activities. Of particular importance for activity during childhood and adolescence is the observation that bone mineral established during childhood and adolescence is a determinant of adult bone mineral status (19). Observations based on records of historical physical activity indicate that adults, particularly females, who were active during childhood and adolescence had better skeletal health (24, 26).

Pathway VI - What is the relationship between activity in adulthood and health in adulthood?

Relationships between adult activity and adult health can be viewed in two contexts. First, how well do indicators of activity and fitness track during adulthood? Second, what is the relationship between adult habits of physical activity and adult health?

Interage correlations for measures of physical activity in adulthood are generally similar in magnitude to those during adolescence, i.e., moderate, but with increasing age and as the interval between observations increases (e.g., 11 to 26 years, interage correlations for indicators of physical activity decline (18). In contrast, indicators of fatness show moderate to strong stability in aduthood, and stability of fatness tends to increase with age (7, 9).

Relationships between habitual physical activity and indicators of physical fitness in adults are also generally of the same magnitude as in adolescence. Some data also suggest a graded effect, i.e., a stronger relationship between aerobic fitness and high intensity leisure activity than between aerobic fitness and low intensity leisure activity (25).

Further, a habitually active lifestyle in adults is associated with reduced cardiovascular morbidity and mortality, and reduced risk for several cancers. Physical inactivity and low levels of cardiorespiratory fitness during adulthood are independent risk factors in all cause mortality and specifically in cardiovascular disease mortality (2, 3, 14, 20, 28).

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