Measuring Physical Activity Among Adolescents

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PHYSICAL ACTIVITY is defined as any bodily movement produced by skeletal muscles that results in energy expenditure. Physical activity includes work-related, recreational, and leisure-time activity (1). Regular physical activity is an essential component of personal and public health programs and is associated with reduced risk for specific health problems and lower all-cause mortality (2,3).

This paper describes the development of questions related to physical activity for the Youth Risk Behavior Surveillance System (YRBSS) questionnaire. The YRBSS Panel participants (see Appendix I, page 56) first identified major health outcomes associated with physical activity during adolescence and adulthood. Guided by national health objectives for the year 2000 (4), we developed questions that would elicit information on priority physical activity behaviors among adolescents.

Health Outcomes During Adolescence

Although few children suffer from the chronic diseases that physical activity prevents, between 36 percent and 60 percent of children in the United States exhibit by age 12 at least one modifiable risk factor for coronary heart disease (CHD) (5). Some risk factors associated with CHD are known to be traceable from childhood and adolescence into adulthood (5). In studies examining CHD risk factors such as hypertension, high levels of blood lipids, obesity, and cigarette smoking, children with the highest levels of physical activity demonstrated the lowest risk factor profiles for CHD (6). Adolescents who perform regular physical activity consistently have a healthier cardiorespiratory fitness profile and greater functional capacity than their more sedentary peers (7). Among adolescents diagnosed with hypertension, initiation of a program of regular moderate physical activity consistently lowers diastolic and systolic blood pressure (8).

Regular physical activity in children also is associated with the maintenance of good mental health and self-esteem (9). These outcomes of physical activity are associated with improved psychological and emotional functioning that may be carried into adulthood (10).

Physical activity may result in adverse health outcomes including injuries, myocardial infarction, and sudden cardiac death (11). Risk of injury is related to the intensity, frequency, and duration of exercise. The exercise setting also is important. Some types of physical activity — such as walking, jogging, and bicycling — that may be performed near motor vehicles are more likely than other types of exercise to be associated with serious injury. Previous injury is the most important determinant of subsequent injury. Injuries occurring during youth can have serious implications for functional health status in adulthood (12).

Risk of myocardial infarction and sudden cardiac death during physical activity is small (13), is inversely related to usual levels of vigorous habitual activity (14), and typically is accompanied by standard coronary risk factors (13,15,16). These types of events are relatively rare in youth (17). Congenital cardiovascular disease accounts for most sudden deaths in exercising youth (18).

Health Outcomes During Adulthood

Lack of physical activity is an independent risk factor for several long-term negative health outcomes among adults, including CHD, obesity, non-insulin-dependent diabetes mellitus (NIDDM), hypertension, colon cancer, and depression (2). Physical activity increases bone mineral content and reduces risk of osteoporotic fractures (19).

A composite review of studies that examined risk of CHD according to patterns of physical activity among adults, found that the median relative risk for the least

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active compared with the most active persons was 1.9 (20). The magnitude of this effect was similar to the relative risks associated with other documented risk factors for CHD, such as hypertension, cigarette smoking, and high serum cholesterol (21). No study reported a detrimental effect of physical activity on risk for CHD (20).

Although not controlled for self-selection bias, studies examining the relationship between level of occupational activity and incidence or prevalence of CHD reveal that workers in occupations requiring physical activity have less risk of both total and fatal CHD events than workers in sedentary occupations (22). Studies of the relationship between leisure-time activities and risk of CHD show that the more active persons have about one-third to one-half the risk of the least active persons (22).

Regular physical activity can help prevent and manage obesity (23). Approximately 34 million adults ages 20-74 in the United States are obese. Obesity is an independent risk factor for hypertension, NIDDM, and CHD (24). Physically active people generally weigh less than those who are sedentary. Further, habitual activity is inversely associated with body fatness and body mass index. One meta-analysis of 16 intervention studies concluded that exercise produces a reliable and measurable effect on weight loss (25). The studies tended to focus on short-term weight loss, however, rather than long-term weight control.

Lack of physical activity increases risk for NIDDM (26,27). About 90 percent of the approximately 11 million Americans with diabetes have NIDDM. Of this group, approximately 80 percent were above their desirable body weight at the time of diagnosis (28). Because physical inactivity contributes to overweight, it also contributes indirectly to NIDDM. Physical inactivity also contributes independently to hyperinsulinemia, glucose intolerance (29), and cell insulin sensitivity (30).

Physical activity is associated with reduced risk for hypertension in adults. However, whether physical activity is related to hypertension independent of body weight is unclear. Risk of hypertension increases with relative weight, which is inversely related to physical activity (23).

Physical activity is associated with reduced risk for colon cancer (31). In seven studies using occupational activity as a measure of physical activity levels, less active persons were from 0.8 to 2.0 times more likely than more active persons to develop colon cancer. A dose-response relationship also has been noted between each decrement in activity level and increased incidence of colon cancer (31).

Physical activity appears to alleviate symptoms associated with mild to moderate depression in adults (32). It is less clear if physical activity benefits persons with severe depression. Alleviation of depression through physical activity has been attributed to diversion, social reinforcement, improved self-efficacy, and increased neurotransmission of catecholamines or endogenous opiates (32).

National Health Objectives

The national health objectives measured by the YRBSS are listed in Appendix III, page 67. Eight of the objectives for the year 2000 presented in Healthy People 2000 (4) are relevant to physical activity among adolescents. These objectives helped guide our selection of priority health outcomes and behaviors.

One health status objective that concerns physical activity calls for reducing overweight among adolescents ages 12-19 (Objective 1.2).

Among the risk reduction objectives that concern physical activity, Objectives 1.3, 15.11, and 17.13 call for increasing the proportion of people ages 6 and older who engage in light to moderate physical activity for at least 30 minutes per day. Objective 1.4 calls for increasing the proportion of people ages 6-17 who engage in vigorous physical activity three or more days per week for 20 or more minutes per occasion. Objective 1.5 calls for decreasing the proportion of people ages 6 and older who engage in no leisure time physical activity.

Additional risk reduction objectives call for increasing the proportion of people ages 6 and older who regularly perform physical activities that enhance and maintain muscular strength, muscular endurance, and flexibility (Objective 1.6) and increasing the proportion of overweight people ages 12 and older who adopt sound dietary practices combined with regular physical activity to attain appropriate body weight (Objective 1.7).

Two services and protection objectives in Healthy People 2000 call for increasing the proportion of students in 1st through 12th grade who participate in daily school physical education (Objective 1.8) and increasing the proportion of physical education class time that students spend being physically active (Objective 1.9).

Priority Behaviors

To focus our development of questions related to physical activity for the YRBSS, we selected, by priority, the following six behaviors: participation in light to moderate physical activity, participation in vigorous physical activity, participation in physical activity as a weight control strategy, participation in physical activity to promote strength and flexibility, participation on sports teams, and participation in school physical education classes. We chose these behaviors because of their contribution to beneficial health outcomes and their relevance to national health objectives (4).

Light to moderate physical activities include walking, gardening, and other activities that do not elevate the heart rate above 60 percent of the maximum rate (220 beats per minute minus age). Regular participation in moderate physical activity provides many of the health benefits that accrue from more vigorous physical activity (4). Moderate physical activities also are more likely to be adopted and maintained than vigorous physical activities and, presumably, are less likely to cause injuries (33). Adolescents who participate in moderate physical activity may be more likely to develop lifetime physical activity patterns conducive to health than those who do not (34).

Vigorous physical activities are rhythmic, repetitive, and use large muscle groups at 60 percent or more of the maximum heart rate for age. Regular participation in vigorous physical activities helps people achieve and maintain higher levels of cardiorespiratory fitness and enables people to perform daily tasks more easily than less vigorous physical activities (4).

Among overweight persons, insufficient exercise is more common than overeating (24). Physical activity burns calories, increases the proportion of lean to fat body mass, and raises metabolic rate. Weight-loss programs focused only on dietary restrictions have not produced encouraging results. A combination of both caloric restriction and increased physical activity is important for attaining and maintaining desirable body weight (23).

Strength and endurance increase ability to perform daily tasks without undue stress and fatigue. Lack of strength can be a limiting factor in performing daily activities or participating in active sports. Although weight training is the most obvious strengthening behavior, regular participation in home maintenance, yardwork, gardening, and active childhood pursuits also may contribute to gaining or maintaining strength (4).

Flexibility is the range of motion about a joint. Greater flexibility may lower risk for back injury during adulthood (35). Lack of flexibility can result in impaired movement and increased susceptibility to injury. Specific stretching and calisthenic exercises are the most obvious means of obtaining flexibility. Various sports and leisure-time activities also can contribute to increased flexibility (4).

Participation on sports teams is common during adolescence. Most of these teams are part of organized sports sponsored by schools. Participation on sports teams typically reflects participation in moderate to vigorous physical activity. Participation on sports teams does not appear, however, to contribute substantially to the development of lifelong physical activity patterns (34). Sports participation also places people at increased risk of injury (36).

Physical education classes provide an opportunity to ensure that all students have a minimal, regular amount of physical activity. Such classes also help establish lifelong physical activity patterns. Daily physical education, however, is not always offered to all students, often is not required for graduation, and may include only light physical activity (37).

YRBSS Questions

We developed eight questions to measure physical activity (see Appendix II, Youth Risk Behavior Surveillance System questionnaire for specific questions, page 60). One question (No. 71) addresses walking and bicycling, which are two of the most common types of light to moderate physical activity among adolescents (38). A 7-day recall period was selected. This question can be used to measure Objectives 1.3, 15.11, and 17.13 (4).

One question (No. 68) was developed to measure participation in vigorous physical activities. Laboratory and field tests conducted by the National Center for Health Statistics, Center for Disease Control and Prevention, indicated that adolescents may not recognize the term "vigorous exercise." Consequently, vigorous activities are described as "activities that made you sweat and breathe hard." Examples of vigorous activities are provided. Seven days was selected as the recall period. This question can be used to measure Objective 1.4 (4).

Participation in physical activity as a weight control strategy is measured with one question (No. 59). "Measuring Dietary Behaviors among Adolescents" by Trowbridge and Collins on page 37 describes this question.

Participation in physical activity to promote strength and flexibility is measured with two questions. One question (No. 69) asks about "stretching exercises" and the other question (No. 70) asks about "exercises to strengthen or tone your muscles." Examples of each type of exercise are provided. A 7-day recall period was

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selected. These questions can be used to measure Objective 1.6 (4).

Two questions were developed to measure participation on sports teams. In question No. 74 students are asked to report the number of school-sponsored sports teams on which they play. The other question (No. 75) addresses sports teams sponsored by organizations other than school. A 12-month recall period was selected for both questions in recognition of the seasonality of most sports.

Participation in school physical education class is measured with two questions. The first question (No. 72) addresses the number of days per week the respondent usually attends physical education class. This question can be used to measure Objective 1.8 (4). The second question (No. 73) addresses the number of minutes the respondent usually spends being physically active in physical education class. This question can be used to measure Objective 1.9 (4).

Since only a limited number of questions on physical activity could be included in the YRBSS questionnaire, we could not measure other important behaviors such as participating in leisure-time physical activity, watching television or playing video games, participating in physical activity at community sites, participating on specific types of sports teams, and participating in specific types of physical activity.

Discussion

In the past, the 1984 National Children and Youth Fitness Studies provided national estimates of physical activity levels among youth (38). The YRBSS is the only source of current and continuing information about physical activity among adolescents. National, State, and local education and health professionals can use the YRBSS data to measure differences in physical activity among subgroups, monitor how physical activity changes over time, and develop effective programs and policies to improve physical activity levels among adolescents.

As evidence of the multiple health benefits of physical activity continues to grow, the need to develop policies and programs that effectively promote physical activity among adolescents will increase. Governmental and professional organizations, including the World Health Organization, the Public Health Service, the American Public Health Association, and the American Heart Association, have officially recommended physical activity as part of any strategy to improve the health of the nation (34).

School physical education programs, sports teams, and community recreation centers can play critical roles in improving levels of physical activity. Educators, families, physicians, and public health officials need to work together to ensure that these programs are available and accessible to all adolescents.

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