



Physical Activity for Children: Current Patterns and Guidelines

Editor's Note

Since the President's Council on Physical Fitness and Sports Research Digest resumed publication in 1993, we have published ten issues devoted primarily to physical activity among children and adolescents. The papers have covered a wide variety of topics but two in particular have been devoted to physical activity patterns and guidelines for youth. In an early issue of the Digest, Corbin et al. (1994) outlined the need for specific physical activity guidelines for children and youth. In 1998, the National Association for Sport and Physical Education (NASPE, 1998) and Health Education Authority (HEA, 1998) independently developed physical activity guidelines for children. The recommendations of the two groups were quite similar. Pate (1998) described current activity patterns of children and reviewed the various physical activity guidelines for children. Since that time many studies describing the physical activity patterns of youth have been published and new guidelines developed. The editors felt it was time to revisit the topic. This issue of the Digest reviews current activity patterns of youth and current guidelines.

The Physical Activity Patterns of Youth

Rowland (1990) presented a graph of physical activity patterns of youth. Since there was no single study available describing the activity patterns of school-aged youth, Rowland included data from a variety of sources that used similar methodology (see Figure 1). This graphic description of the activity patterns of youth is based on estimated daily energy expenditure derived from heart rate data. Rowland's graph has been widely interpreted to illustrate the decrease in physical activity as youth grow older.

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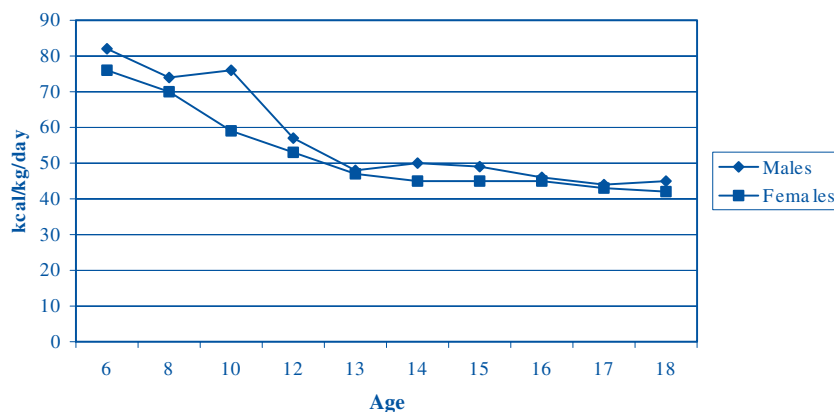


Figure 1.
Total Daily Energy Expenditure.
Adapted from Rowland, 1990.

Since 1990 new data have accumulated to depict the physical activity levels of youth. It is clear that, depending on the method of assessing physical activity, patterns of youth activity vary considerably. In the following sections of this paper, youth activity patterns are described based on self-reported questionnaire, pedometer, and accelerometer data.

Questionnaire Assessments of Physical Activity

The problems associated with the use of questionnaire assessments of physical activity among youth, particularly young children, have been well documented (Welk, 2002; Welk, Corbin, and Dale, 2000). Factors such as inaccurate recall and inability to estimate time are of concern. The Youth Media Campaign Longitudinal Study

(YMCLS) of the Centers for Disease Control and Prevention (CDC) (Duke et al., 2003) used parent and student responses in an attempt to gather accurate data. This study used random telephone interviews of a large population of youth and their parents. Questions were asked concerning participation in organized and free time physical activity. Results are displayed in Table 1. Slightly more than one third of all children 9-13 participate in organized sports, with similar rates of involvement for males and females and for different age groups. A large percentage of children reported performing free-time activity with a greater percentage of boys reporting involvement than girls. Participation was similar across ages. Unlike the curve depicted by Rowland, results of YMCLS show no decrease in physical activity from age 9-13. Figure 1 is based on energy expenditure estimated from heart rate data that includes frequency, intensity, and duration components of physical activity while the YMCLS information describes involvement in organized and free-time activity (level of participation only). The YMCLS data do little to help us understand the frequency, intensity or duration of the activities in which children are involved.

TABLE 1. Percentage of children aged 9–13 years who reported participation in organized and free-time physical activity during the preceding 7 days, by selected characteristics — Youth Media Campaign Longitudinal Survey, United States, 2002

Characteristic	Participated in organized physical activity during preceding 7 days		Participated in free-time physical activity during preceding 7 days	
	%	(95% CI)*	%	(95% CI)
Sex				
Female	38.6	(±2.5)	74.1†	(±2.0)
Male	38.3	(±2.9)	80.5†	(±1.7)
Age (yrs)				
9	36.1	(±4.0)	75.8	(±3.1)
10	37.5	(±4.0)	77.0	(±2.7)
11	43.1	(±3.6)	78.9	(±3.0)
12	37.7	(±4.1)	77.5	(±3.5)
13	38.1	(±4.2)	78.0	(±4.0)
Race/Ethnicity§				
Black, non-Hispanic	24.1†	(±3.8)	74.7	(±4.6)
Hispanic	25.9†	(±4.0)	74.6	(±3.9)
White, non-Hispanic	46.6†	(±3.0)	79.3	(±1.7)
Parental education				
<High school	19.4†	(±4.8)	75.3	(±5.7)
High school	28.3†	(±3.4)	75.4	(±2.9)
>High school	46.8†	(±2.5)	78.7	(±2.0)
Parental income				
≤\$25,000	23.5†	(±3.7)	74.1	(±3.1)
\$25,001–\$50,000	32.8†	(±3.4)	78.6	(±2.5)
>\$50,000	49.1†	(±2.6)	78.3	(±2.0)
Total	38.5	(±2.0)	77.4	(±1.2)

* Confidence interval.

† Statistically significant difference ($p < 0.05$).

§ Numbers for other racial/ethnic populations were too small for meaningful analysis.

From Duke et al., 2003.

Considerably more questionnaire data are available for older youth than for children. Adolescents have a greater ability to recall and understand activity questions. The Youth Risk Behavior Surveillance Survey (YRBSS) is a nationwide survey conducted by CDC to assess a wide variety of behaviors associated with health (Grunbaum et al., 2002). The survey asks about vigorous, moderate and strength exercise patterns. Those youth who report doing 30 minutes of moderate activity (activity equal to brisk walking) at least five days a week are considered to be moderately active,

those who report doing 20 minutes of activity that makes them breathe hard and sweat at least three days a week are considered to meet the vigorous activity standard, and those who report doing three days a week of training for strength meet the strength exercise standard. Youth who are considered to get “insufficient exercise” fail to meet either the moderate or the vigorous activity standard. Those considered sedentary reported doing no 30-minute bouts of moderate or 20-minute bouts of vigorous activity during a seven-day period. Results of the most recent YRBSS that relate to physical activity are presented in Figures 2-5.

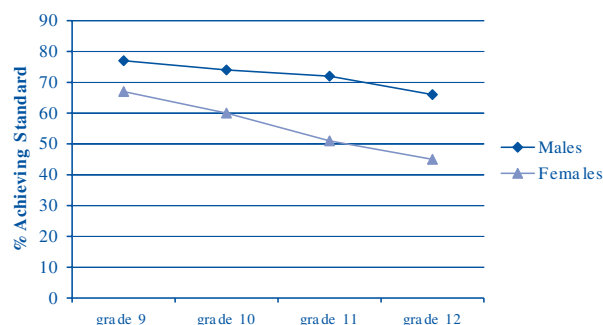


Figure 2.
Percent of students achieving vigorous exercise standard (YRBSS)

Data from Grunbaum et al., 2002.

Figure 2 illustrates a drop in percentage of students meeting vigorous activity standards from grades 9-12 that is not dissimilar to the drop in energy expenditure described by Rowland. A greater proportion of males as compared to females reported being active based on the YRBSS vigorous activity question. This difference between the sexes is more dramatic than portrayed in Figure 1 with a greater percentage of girls failing to meet the vigorous activity criterion in the upper grades.

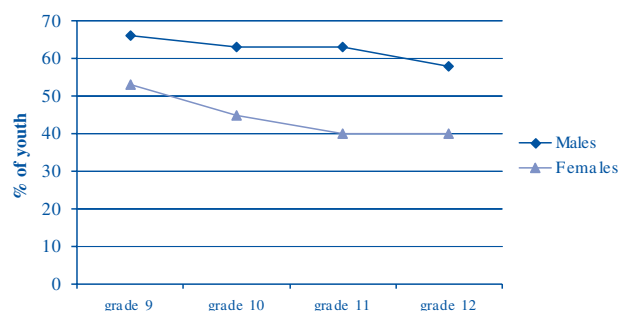


Figure 3.
Percent of high school youth meeting standards for strength exercise (YRBSS)

Data from Grunbaum et al., 2002.

For strength activities (see Figure 3) males are again more active than females and a higher percentage of grade 9 youth participate than grade 12 youth. The rate of decrease is not as dramatic as for vigorous activity, however.

Many more 12th graders than 9th graders reported doing insufficient physical activity (see Figure 4). There was a

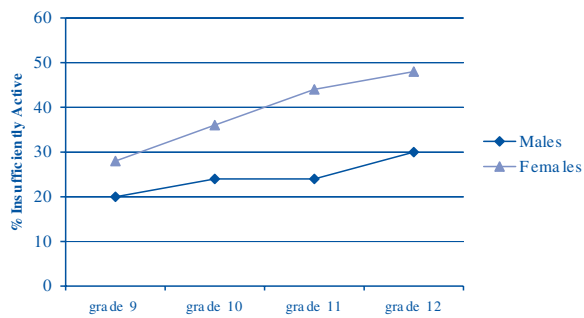


Figure 4.
Percent of students achieving insufficient exercise (YRBSS)
Data from Grunbaum et al., 2002.

greater difference in insufficient activity for girls than boys. Those who do insufficient activity (see Figure 5) do some moderate or vigorous activity, just not enough to meet either the moderate or vigorous activity standard. Those who are sedentary did not participate in any moderate or vigorous activity over a seven-day period. A greater proportion of females were sedentary (9 to 12%) than males (6 to 9%). The proportion of totally inactive teens is considerably less than the 24% reported for adults (USDHHS, 2000), however, the fact that so many teens are totally sedentary is of concern.

Questionnaire Assessments of Physical Education Involvement

Though not a direct measure of physical activity, the opportunity to be active in physical education classes is associated with out-of-school physical activity, and ultimately, overall physical activity participation. The percentage of high school youth enrolled in physical education (not necessarily daily), based on YRBSS data decreases even more markedly than vigorous activity showing considerably lower percentages of involvement in the upper grades than the lower grades. Enrollment at grade 12 is only half the enrollment of grade 9. Interestingly, girls are as likely to participate in physical education classes as boys at grade 9, but at grade 12 they are much less likely to be in physical education than boys (see Figure 6). Daily physical education enrollment is even lower, with less than 30% of boys and 20% of girls involved in the upper grades (see Figure 7). This decline in participation is a likely contributor to the lower physical activity accumulation of older teens compared to younger teens. This finding is supported by Dale et al. (2000) who showed that children who received physical education were more active than those who did not. The increase in total daily activity was due in part to more activity in the school day (in physical education) and also because children were more active outside of school on days when they had physical education. Results from the 1991, 1993, 1995, and 1997 YRBSS survey indicate a decrease in daily physical education among American adolescents (Lowry et al., 2001). From 1991 to 1997 reported daily physical education participation decreased 15.8% (45.6% to 29.8%) for males and 12.8% (37.4% to 24.6%) for females.

Pedometer Assessments of Physical Activity

In the past few years objective techniques for assessment of physical activity have been developed that make it possible

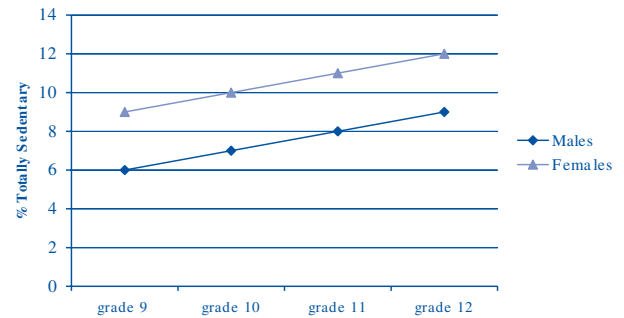


Figure 5.
Percent of students achieving no exercise (YRBSS)
Data from Grunbaum et al., 2002.

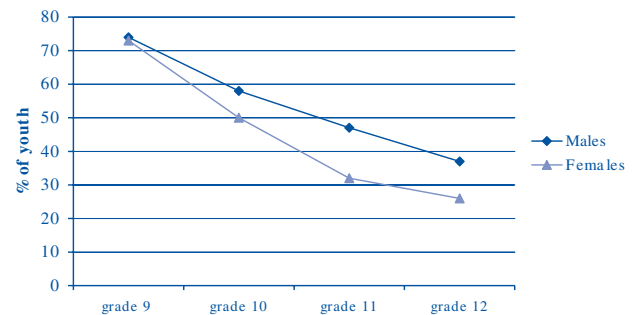


Figure 6.
Percent of high school youth enrolled in physical education (YRBSS)
Data from Grunbaum et al., 2002.

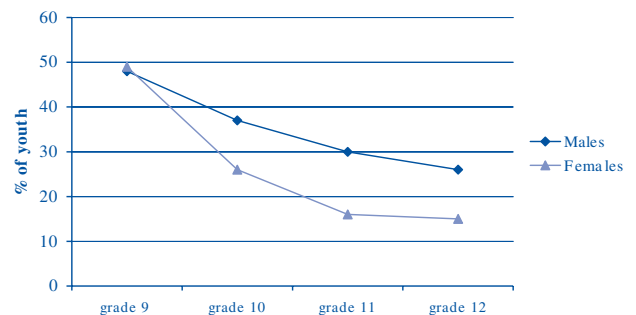
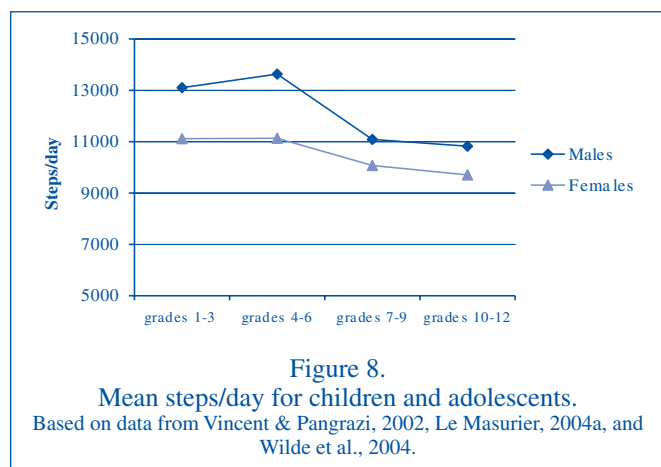


Figure 7.
Percent of high school youth enrolled in daily physical education (YRBSS)
Data from Grunbaum et al., 2002.

to assess large samples of youth. Welk (2002) describes many of these techniques in detail. In this paper, data from two types of objective assessment devices, the pedometer and the accelerometer, are described. Pedometers are small digital devices that detect steps by responding to vertical accelerations. They are popular for the objective measurement of physical activity (Le Masurier, 2004b; Le Masurier & Tudor-Locke, 2003; Le Masurier et al., 2004; Tudor-Locke & Myers, 2001) because they are relatively inexpensive (\$10-30) and unobtrusive in addition to being relatively accurate (Le Masurier & Tudor-Locke, 2003;

Schneider et al., 2003), and valid (Bassett et al., 1996; Crouter et al., 2003). Their limitations are that they measure only ambulatory movements and do not accurately detect some modes of physical activity common to children and adolescents (e.g., bicycling, climbing, and swimming) and do not assess the intensity of activity.

Pedometer data have now been gathered from youth of all ages and levels in school including elementary school children (Vincent & Pangrazi, 2002) and middle and high school adolescents (Le Masurier, 2004a; Wilde et al., 2004). The data are not from a national sample, as is the case for YRBSS, but they do provide basic information on relatively large convenience samples from the southwest United States. Figure 8 was created using data from the studies cited above. Consistent with YMCLS and YRBSS findings for questionnaires, males take more steps than females at all ages. Steps accumulated by elementary school children do not differ by age/grade (Vincent & Pangrazi, 2002). Also there were no differences in steps taken between 7th and 8th grade middle school students (Le Masurier, 2004a). Wilde et al. (2004) did find differences in activity from grade 10 to grade 12. The general trend toward less activity involvement in the higher grades is apparent, though not as dramatic as for energy expenditure and questionnaire assessments. The number of steps accumulated (average steps per day) by school age youth is higher than reported in the literature for adults, as male youth accumulate 11 to 13 thousand and female youth accumulate 10 to 11 thousand steps per day while sedentary adults range from 5 to 8 thousand steps per day and more active adults range from 7 to 10 thousand or more steps per day (Tudor-Locke, 2002).

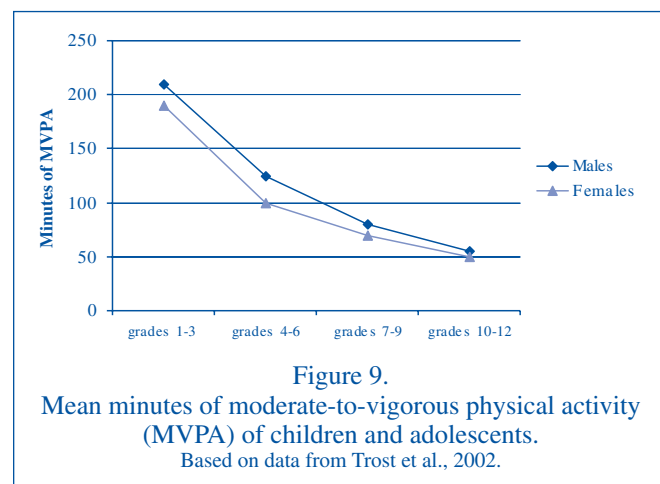


Accelerometer Assessments of Physical Activity

Accelerometers detect movement in one or more directions, up and down, side to side, and/or forward and backward. The Tritrac accelerometer detects movements in all three directions, but it is relatively large and expensive. Unidimensional accelerometers, such as the CSA accelerometer (CSA; MTI Health Services, Fort Walton Beach, FL), are smaller (about the size of a pedometer) and therefore less obtrusive than the Tritrac. They record only vertical (up and down) accelerations that can be recorded as activity counts or steps, but have been shown to provide data similar to the more expensive multidimensional monitors. The CSA has the ability to collect activity counts over user specified (e.g., 1-minute, 30-second, etc.) intervals for

several days. Accelerometer outputs are associated with MET levels and allow the estimation of physical activity intensity (Freedson et al., 1998). However, the accurate conversion from activity counts to METs is dependent on the type of activity performed (Hendelman et al., 2000). Unidimensional accelerometers do not accurately capture upper body movements, load carriage, or terrain changes such as grade. Though the activity count to MET conversions were developed in the laboratory rather than free living conditions (Nichols et al., 2000) they do provide accurate assessments of activity patterns and conservative estimations of activity intensity that can be used for surveillance of physical activity, validating self-report measures of physical activity, and measuring changes in physical activity behavior during interventions.

Data are available from one large study using the CSA accelerometer (Trost et al., 2002). The researchers monitored the physical activities of approximately 400 school-aged children (grades 1-12) for seven consecutive days. Because the accelerometer allows estimates of activity intensity it was possible to estimate the minutes of involvement in a combination of moderate to vigorous physical activity (MVPA). As illustrated in Figure 9, MVPA decreased as grade level increased. At every grade level males accumulated more activity than females. This was particularly true of vigorous activity (not illustrated in Figure 9). The curve in Figure 9 looks quite similar to Rowland's curve in Figure 1, perhaps because they both depict activity assessments that include the dimension of frequency, intensity and duration.



Current Physical Activity Guidelines for Youth

Physical Activity Guidelines for Adolescents

Prior to the 1990s, adult standards were often used to determine if youth activity levels were adequate. For adults there are multiple guidelines including those for health (USDHHS, 1996), vigorous physical activity, muscle fitness, and flexibility (ACSM, 2000), and for weight loss (IOM, 2002). For more information concerning these recommendations, see Corbin, Le Masurier and Franks (2002).

In 1993 Corbin, Pangrazi, & Welk proposed the development of guidelines specifically for youth, particularly children. In

1994, an international consensus conference developed physical activity guidelines (Sallis et al., 1994) specifically for adolescents (see Table 2). The consensus panel recommended moderate activity in amounts similar to those outlined for adults in the Surgeon General’s report (USDHHS, 1996). These guidelines also called for three days of vigorous activity per week consistent with American College of Sports Medicine guidelines for adults (ACSM, 2000). Thus, the recommendations for adolescents included amounts of both moderate and vigorous physical activity. The YRBSS questions relating to moderate and vigorous activity are based on these guidelines.

Physical Activity Guidelines for Children

In 1998, physical activity guidelines for children (ages 5-12) were developed by both the National Association for Sport

Table 2. Physical Activity Guidelines for Adolescents 1. All adolescents should be physically active daily, or nearly every day, for at least 30 minutes as part of play, games, sports, work, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities. 2. Adolescents should engage in three or more sessions per week of activities that last 20 minutes or more and that require moderate to vigorous levels of exertion. From Sallis et al., 1994.
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and Physical Education (NASPE, 1998) and the Health Education Authority (1998) in the United Kingdom. In 2004 the NASPE physical activity guidelines for children (NASPE, 2004) were revised (see Table 3). A complete description of the guidelines, suggestions for implementation, the rationale for guideline development, and references are available in the NASPE (2004) document.

The recent NASPE guidelines for children (see Table 3) are more general in nature than guidelines for adolescents and adults. The guidelines indicate that children should do moderate to vigorous physical activity for at least 60 minutes and up to several hours a day. Consistent with developmental needs the activity expected for children is characterized as intermittent rather than continuous in nature (Bailey et al., 1995). It is **not** expected that children will perform non-stop continuous activity but they will alternate bursts of moderate to vigorous activity with frequent short rest periods. Because most children are unlikely to participate in highly specialized training, multiple recommendations are not made for children. Rather than recommending separate guidelines for each type of activity (e.g., moderate, vigorous, strength) the children’s guidelines are general in nature calling for participation in a wide variety of activities from the physical activity pyramid (see NASPE, 2004). Accordingly, the 60-minute standard is a minimum and for children to achieve the multiple benefits requires physical activity exceeding this minimum; thus the stated need for up to several hours of activity per day. Further, the guidelines call for several daily bouts of activity of 15 minutes or more. Research among adults suggests that several 10-minute bouts of moderate activity can be accumulated to meet moderate activity requirement for achieving good health (Murphy et al., 2002).

Based on patterns of activity for youth, it is apparent that without bouts of activity such as physical education, recess or sports, children are unlikely to meet activity guidelines. Further, the guidelines note that long periods of inactivity are discouraged. This guideline supports the Healthy People 2010 goal of achieving more physical education in schools since long school days without activity lead to long periods of inactivity.

Table 3. Physical Activity Guidelines for Children 5-12 1. Children should accumulate at least 60 minutes, and up to several hours, of age-appropriate physical activity on most if not all days of the week. This daily accumulation should include moderate and vigorous physical activity with the majority of the time being spent in activity that is intermittent in nature. 2. Children should participate in several bouts of physical activity lasting 15 minutes or more each day. 3. Children should participate each day in a variety of age-appropriate physical activities designed to achieve optimal health, wellness, fitness, and performance benefits. 4. Extended periods of inactivity (periods of two or more hours) are discouraged for children, especially during the daytime hours. From NASPE, 2004, see references.

Other Physical Activity Standards for Youth

Although not an official guidelines statement, the activity requirements for awards in the President’s Challenge, a program of the President’s Council on Physical Fitness and Sports, constitute a set of standards for youth (and adults) to achieve (PCPFS, 2003). To receive the President’s Active Lifestyle Award (PALA) youth (ages 6-17) must participate in 60 minutes of physical activity a day for at least 5 days per week, for a total of 6 weeks. This is consistent with the minimum 60-minute standard for children.

The program also allows youth to achieve the award by accumulating at least 13,000 (males) or 11,000 (females) steps/day for six consecutive weeks (PCPFS, 2003). These initial pedometer guidelines were established using the mean steps/day data from available research (Vincent & Pangrazi, 2002). A co-creator of the guidelines acknowledged (Pangrazi, personal communication, March 25, 2004) that these guidelines are based on limited data and will require revising as more data are generated.

A recent study by Tudor-Locke et al., (in press) used an empirical approach to establishing steps/day guidelines for elementary school children related to body mass index (BMI). These BMI-referenced standards suggest that females accumulate >12,000 steps/day and males accumulate >15,000 steps/day if the goal is maintenance of a healthy BMI. Children who failed to meet these standards were more likely to be classified as having a high BMI compared with those below these standards. These standards require more steps (males 3,000 steps/day and females 1,000 steps/day) than are required to meet the PALA standards. Because the

authors used secondary pedometer data from American, Australian, and Swedish children, these guidelines may be high for American children. Studies on Australian and European children found that these children accumulate more steps/day than their American counterparts (Vincent et al., 2003). These standards are preliminary and need to be cross-validated and evaluated. No similar standards are currently available for adolescents.

Do Most American Youth Meet Physical Activity Guidelines?

The perception of the activity levels of American youth depends, to a great extent, on how physical activity is assessed. Using questionnaire techniques it is apparent that most children are involved in free-time activity and more than a third are involved in organized sport (YMCLS). The nature of the questionnaire does not allow an assessment of the extent to which children meet the current NASPE (2004) activity standards. Accelerometer data (Trost et al., 2002) that take intensity of activity into account indicate that, on average, young children exceed the minimum activity standard of 60 minutes of accumulated MVPA per day. Furthermore, the data indicate that most children participate in several bouts of MVPA lasting 15 minutes or more each day. However, these data are not from a national sample and are only indicative of the participants in one study. It would be premature, based on the evidence, to draw conclusions about children and activity guidelines based on these limited data.

More data are available for teens than for children. YRBSS questionnaire data indicate that except for grade 12 girls, most teens meet the adolescent guidelines for vigorous physical activity. It is doubtful, however, that the Healthy People 2010 goal of increasing the proportion of teens meeting this standard to 85% will be met based on decreases in physical education in schools and the lower amounts of activity reported by older teens compared to younger teens. The rates of involvement in muscle fitness activity are above 40% on average and as high as 70% but there is no current adolescent guideline for this type of activity. Fewer adolescents meet the moderate standard than meet the vigorous standard as assessed by questionnaire methods. Accelerometer data (Trost et al., 2002) indicate that many males and females in grades 7-12 fail to meet adolescent guidelines. Similarly, Riddoch et al., (2004) found that a majority of European children are active 60 minutes a day but many fewer adolescents meet both moderate and vigorous activity standards outlined by the international consensus conference (Sallis et al., 1994).

Of particular concern is the fact that as many as 20 to 50% of adolescents (YRBSS data) get insufficient activity and 6 to 12% get no moderate or vigorous activity. This indicates that many teens are not meeting the adolescent guidelines and supports Rowland's contention that adolescence is a "risk factor" for adult sedentary living (Rowland, 1999).

Regardless of how physical activity data are collected on youth, the majority of existing data are cross-sectional. The few longitudinal studies that do exist (Janz et al., 2000; Kimm et al., 2000; Pate et al., 1999) indicated that physical

activity levels decline as children move into adolescence. These studies demonstrate that physical **inactivity** tracks over time. That is, children who are inactive tend to remain inactive as they grow older. This finding supports the views of others including Malina (1999) and Corbin (2001), who posits that public health professionals must work to "untrack" sedentary living among children and youth. Inactivity tracks much better than activity so identifying inactive youth early and getting them "untracked" should be a priority for teachers, researchers and policy makers.

Summary

The type of physical activity assessment and the type of activity studied are important to the way we characterize activity patterns of youth. Regardless of the type of assessment and the type of activity studied, at all ages and grade levels males are more active than females. The magnitude of the difference is much more apparent for questionnaire data among teens. Also the data show that younger children are more active than teens. There is little variation in activity among grades in elementary school when pedometers were used but differences in activity among grades at the elementary level are apparent when other measures are used.

It is clear that young children are more likely to meet activity guidelines than adolescents. Though many adolescents meet the vigorous activity standard, many fewer meet the moderate standard. Questionnaire data indicate that as many as 20 to 50% of teens get insufficient physical activity and 6 to 12% **do not perform any moderate or vigorous activity**. While the proportion of inactive adolescents is lower than the proportion of adults who are sedentary, the fact that inactivity "tracks" into adulthood suggests a need to "untrack" or target sedentary youth early in life.

The documented decrease in school physical education, especially in secondary schools, is problematic inasmuch as it is during adolescence that activity patterns decline most dramatically. It would seem that the Healthy People 2010 (Spain & Franks, 2001) goal of increasing physical education in schools should be a high national priority, especially if we are to accommodate the need for multiple bouts of activity each day and to help youth avoid long periods of inactivity.

If physical activity guidelines for youth are to be met it is important for all people interested in promoting physical activity (including teachers, coaches, parents, and others who work with children) to be aware of the unique guidelines for children (NASPE, 2004) and adolescents (Sallis et al., 1994) and take steps necessary to encourage youth to meet these guidelines.

Finally, national longitudinal studies that assess physical activity patterns of youth using a variety of assessment techniques are necessary. The use of objective, as well as subjective, techniques seems warranted, especially with young children. It is only through such long-term studies that we will be able to accurately determine changes in patterns over time and accurately determine if youth meet activity guidelines on a regular basis.

Children should accumulate 60 minutes and up to several hours of physical activity each day and teens should do at least 20 minutes of vigorous activity 3 days a week and 30 minutes of moderate activity 5 days a week. Youth who are inactive as children and teens are more likely to grow up to be sedentary adults than youth who are active. Being active early in life is important to your health, fitness and wellness.

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