Changes in physical activity patterns in the United States, by sex and cross-sectional age

CARL J. CASPERSEN, MARK A. PEREIRA, and KATY M. CURRAN

Division of Diabetes Translation, Centers for Disease Control and Prevention, Atlanta, GA; Division of Endocrinology, Children’s Hospital, Boston, MA; and Office of Smoking and Health, Centers for Disease Control and Prevention, Atlanta, GA

ABSTRACT

CASPERSEN, C. J., M. A. PEREIRA, and K. M. CURRAN. Changes in physical activity patterns in the United States, by sex and cross-sectional age. Med. Sci. Sports Exerc., Vol. 32, No. 9, pp. 1601–1609, 2000. Purpose: To determine sex-specific, age-related changes in physical activity patterns. Methods: We examined cross-sectional data from the National Health Interview Survey, using the 1992 Youth Risk Behavior Survey supplement for adolescents and the 1991 Health Promotion/Disease Prevention supplement for adults. Physical activity patterns were modeled after Healthy People 2000 objectives. Results: Among adolescents, physical activity patterns generally eroded most from ages 15 through 18. The “regular, vigorous activity” and strengthening patterns declined consistently from ages 12 through 21. Young adulthood (18–29 yr) often marked continuing erosion of activity patterns, whereas middle adulthood (30–64 yr) often revealed relatively stable patterns. At retirement age (65 yr), there was a stabilizing, or even an improving, tendency in activity patterns, usually followed by further erosion through the final period of life. Strengthening behavior eroded dramatically with advancing age among adults, especially among men. Among adolescents, differences between female and male respondents were large for regular, vigorous activity (11.3 percentage points greater for male respondents). In comparison with female adolescents and adults, male respondents reported much higher rates of regular, sustained activity (5.5 and 5.9 percentage points, respectively), and strengthening (18.2 and 11.3 percentage points, respectively). Among adults, levels of physical inactivity among women were moderately greater (5.5 percentage points) than for men. Absolute rates of change per year were mostly large to very large (3.0–8.0 percentage points yr\(^{-1}\)) during ages 15–18 yr, but, for adults, they were small (<0.5 percentage points yr\(^{-1}\)) for 33 of 40 sex, age, and pattern groupings. Conclusion: These data suggest that early and continued intervention will be necessary to offset these declines in physical activity throughout adolescence and adulthood. Key Words: ADOLESCENTS, ADULTS, AGE, PHYSICAL ACTIVITY, SEX, SURVEYS

Risk factors for cardiovascular disease (CVD), a disorder that begins early in life (3,38), have been shown to track from childhood to adolescence and adulthood (2,23,25,31,32). Correspondingly, there is some evidence that physical activity, which is causally related to CVD among adults (34), tracks from childhood to adulthood (23,28–30,37).

Childhood is the most physically active time of life, after which levels of physical activity invariably decay during adolescence and early adulthood (1,35). At present, we do not know whether this decline is of similar proportions for various types of activity patterns, whether it continues throughout adulthood, and whether it affects both sexes equally.

METHODS

Healthy People 2000, which sets forth several objectives for leisure-time physical activity and for fitness (33), provides a useful framework for assessing the physical activity of adolescents and adults. For this study, we selected five activity patterns—1) leisure-time physical inactivity; 2) regular, sustained, light to moderate physical activity; 3) regular, vigorous physical activity; 4) strengthening activities; and 5) stretching activities—that are covered in Healthy People 2000 objectives and used their operational definitions (Table 1) to describe physical activity as reported in two national surveys. The first objective pertained to a risk factor for coronary heart disease (CHD), the second objective sought to reduce CHD risk and to promote weight control, the third objective sought to improve and maintain cardiorespiratory fitness, and the fourth objective pertained to two contributors to physical function (6). We estimated physical activity by age and sex, measured differences in prevalence of activity between the sexes, and calculated rates of change per year of increasing cross-sectional age for each sex. We also identified age periods during which annual rates of change were relatively large.
**Data sources.** We plotted physical activity levels using data from the 1992 National Health Interview Survey–Youth Risk Behavior Survey (NHIS-YRBS), of 10,645 male and female respondents ages 12–21 yr (15,20,21) and the 1991 National Health Interview Survey–Health Promotion/Disease Prevention (NHIS-HPDP) supplement (19), which covered 43,732 men and women aged ≥ 18 yr. The sociodemographic composition of these national probability samples (19–21) and other characteristics of both surveys have been detailed and presented elsewhere (9,12,22,34). Although more contemporary data were available for adolescents in grades 9–12 (16), the NHIS-YRBS provided the most recent data for adolescents as young as age 12. We used the NHIS-YRBS questions about walking or bicycling for >30 min, running, jogging, or swimming for exercise, exercise to strengthen or tone muscles, and stretching exercise to represent four of the five activity patterns of interest. For the other, physical inactivity, we considered adolescents who did not report any vigorous activity, walking, or bicycling as inactive. We did not use information from other activities listed as part of the 11 activity groups queried in the survey because there was no way to incorporate the extra information into indicators relevant to the year 2000 objectives.

Details of validity and reliability are limited for the NHIS-YRBS. When compared with criteria from one of three 24-h recalls of physical activity of corresponding intensity levels, reported vigorous physical activity of 3 d from the YRBS had a sensitivity of 0.80, as did walking and bicycling of at least 5 d (Harvard School of Public Health and the Centers for Disease Control and Prevention. Validation of the YRBSS questions on dietary behaviors and physical activity among adolescents in grades 9–12, unpublished technical report, 1996). Although not directly comparable, Brener and colleagues (5) have noted that measures of test-retest reliability were quite good for self-reported physical education enrollment and time spent in vigorous exercise as part of such classes (91.1% and 74.9%, respectively).

We used the 1991 NHIS-HPDP supplement for adults to match the year for adolescents (1992) as closely as possible. In the NHIS-HPDP, interviewers first probed for 19 common leisure-time activities and two “other” activities, then probed for frequency and duration of these activities as well as associated increases in breathing or heart rate to try to characterize intensity of effort. Interviewers did not probe for duration of bowling, downhill or water skiing, or weight lifting, because respondents historically have reported uniformly high values for these activities.

Although formal tests of the reliability or validity of the physical activity patterns we created from the NHIS-HPDP questions have not been reported for adults, indexes of physical activity reflective of individual energy expenditure (kcal·kg⁻¹·d⁻¹) have been compared with responses to three single-item self-assessment questions revealing Spearman’s correlation coefficients of r = 0.14 to 0.41, suggesting weak validity between these alternate measures of physical activity (39).

As revealed in Table 1, in all cases the operational definitions for the five physical activity patterns used to address Healthy People 2000 objectives differed between adolescents and adults. For strengthening and stretching, the definitions for adults were less stringent in terms of frequency than they were for adolescents. Similarly, to avoid being deemed physically inactive, adolescents had to meet a higher standard than adults. For regular, sustained activity, the definitions were quite similar, except that adolescents had to do this activity in the form of walking or bicycling, whereas adults could engage in any activity. For regular, vigorous activity, adolescents had to engage in one of three specific activities (running, jogging, or swimming), but again adults could engage in any activity. In this instance, however, the definition for adults was quite extensive, having been formulated from a scoring procedure (Caspersen and Powell, A computerized scoring method for the physical activity questions of the Behavioral risk Factor Surveillance System, unpublished technical monograph, 1986) that used age- and sex-regression equations to adjust for individual maximal cardiorespiratory capacity. Despite the various differences in definitions, however, the data we present for each of these patterns should be useful in describing relative age-related changes for both sexes.

**Statistical analyses.** As this paper is primarily descriptive and makes numerous comparisons, we did not conduct multiple tests of statistical significance. We did, however, calculate nonoverlapping 95% confidence intervals to identify potential statistically significant differences. In addition, we computed the prevalence differences (in percentage points) between the sexes to estimate age-related differences by sex among adolescents and adults. In the absence of any specific guidance in the literature, we established a convention that a difference in prevalence of <5.0 percentage points was small and that all larger differences were noteworthy (subdivided by moderate, large, very large) (Table 2).

We computed yearly rates of change in prevalence of physical activity patterns in two ways for both adolescents and adults. For adolescents, we computed the difference in

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Adolescents</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical inactivity</td>
<td>No participation in vigorous or moderate physical activity</td>
<td>No participation in any leisure-time physical activity</td>
</tr>
<tr>
<td>Regular, light</td>
<td>5 or more d·wk⁻¹ and 30 or more min-occasion⁻¹ of walking or bicycling</td>
<td>5 or more times·wk⁻¹ and 30 or more min-occasion⁻¹ of any activity</td>
</tr>
<tr>
<td>to moderate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regular, vigorous</td>
<td>3 or more d·wk⁻¹ of running, jogging, or swimming</td>
<td>3 or more times·wk⁻¹ and 20 or more min-occasion⁻¹ of any activity</td>
</tr>
<tr>
<td>Strengthening</td>
<td>3 or more d·wk⁻¹ of strengthening or toning exercises</td>
<td>1 or more times·wk⁻¹ of strengthening and other exercises to increase muscle strength</td>
</tr>
<tr>
<td>Stretching</td>
<td>3 or more d·wk⁻¹ of stretching exercises</td>
<td>1 or more times·wk⁻¹ of stretching exercises</td>
</tr>
</tbody>
</table>
prevalence between ages 12 and 21 and divided that result by 9. We also computed the annual rate of change for the 3-yr age groupings of 12–15, 15–18, and 18–21 yr to compare with data from Telama and Yang (30). For adults, we computed the difference in prevalence between the age groups of 18–29 and ≥ 75 yr and divided that result by 57, assuming that the interval midpoints were 24.5 yr and 81.5 yr, respectively. We also computed the rate of change in prevalence between successive interval midpoints for adults by dividing the prevalence difference by the number of years between the midpoints. We considered as important (moderate, large, or very large) absolute rates of change of ≥ 0.5 percentage points yr⁻¹ (Table 2) to be consistent with significant values noted by Caspersen and Merritt (8) in their trend analyses of physical activity in adults.

**RESULTS**

**Estimates of adolescent physical activity patterns by sex and age.** The prevalence of adolescent leisure-time physical inactivity increased from about 6% for male and female respondents aged 14 yr to a peak of about 24% at age 20 (Fig. 1A). Overall estimates between male and female respondents differed significantly by a small (<5 percentage points) amount (12% vs 15%, respectively); however, there were no statistically significant sex differences at any age (except at age 17).

The prevalence of adolescents reporting regular, sustained activity dropped 16 percentage points (40% to 24%) for male respondents and 10 percentage points (30% to 20%) for female respondents ages 12 to 17, then each essentially stabilized (Fig. 1C).

Regular, vigorous physical activity began to decline for male respondents at age 14, when it was 76%, and reached a nadir at age 21 (42%); for female respondents, a decline began at age 12 (66%) and reached bottom at age 20 (28%) (Fig. 1E).

Strengthening behavior was much more likely to be reported by male (55%) than female respondents (36%)—a very large difference (e.g., ≥ 15 percentage points) (Fig. 2A). Declines began at age 14 for female respondents (48%) and at age 15 for male respondents (67%) and reached 23% (female respondents) and 41% (male respondents) at age 21. The prevalence of stretching activity ranged from 62% for male respondents and 41% (male respondents) at age 21. The prevalence of stretching activity dropped 16 percentage points (40% to 24%) at age 15 for male respondents (67%) and reached 23% (female respondents) and 41% (male respondents) at age 21.

**Estimates of adult physical activity patterns by sex and age.** Across the five age groups, adult women (27%) had a significantly higher prevalence of physical inactivity than men (21%), with moderate or large divergences at the youngest and oldest age groups of 7 and 11 percentage points, respectively (Fig. 1B). Differences were remarkably stable (roughly 4 percentage points) between the two sexes in the three middle age groups. Both men and women generally reported more physical inactivity with greater age, with an increase between the 65–74 yr and the ≥ 75-yr age groups of 4 and 10 percentage points, respectively.

Men more often reported regular, sustained physical activity than did women (27% vs 21%), with moderate or large differences between the sexes at the youngest and oldest age groups of 9 and 11 percentage points, respectively (Fig. 1D). After being fairly close at ages 30–44 and 45–64, men and women had a widening gap between them in the first few retirement years, as the rate for men increased in the 65–74 group, whereas the rate for women was essentially unchanged. After age 74, the prevalence of regular, sustained activity began to decline substantially for both sexes, but the decline was more pronounced for women.

The prevalence of regular, vigorous physical activity was marked by an almost U-shaped relationship with age (Fig. 1F). This phenomenon apparently resulted from comparing the intensity of activity participation to a relative percentage of maximal cardiorespiratory capacity, as adjusted for age and sex differences, rather than comparing it with an absolute intensity level (10). The difference between men and women was: small (almost 4 percentage points) at 18–29 yr, moderate (almost 9 percentage points) at 65–74 yr, and very large (almost 16 percentage points) at ≥ 75 yr. Across adulthood, the prevalence increased by almost 19 percentage points for men and by seven percentage points for women, but the rate for women increased 10 percentage points from ages 45–64 yr to ≥ 75 yr.

Among both men and women, the prevalence of strengthening exercise declined sharply through adulthood (34% to 5% for men, and 15% to 1% for women) (Fig. 2B). Unlike the case for strengthening, where men always had a significantly higher rate than women, for stretching, the sexes were statistically indistinguishable in all but the 65–74 yr age group, where women had a rate that was 6 percentage points higher (Fig. 2D). For both sexes overall, the prevalence of stretching dropped from 32% to about 17% at 75 yr and older.

**Prevalence differences between sexes.** Important prevalence differences (i.e., five or more percentage points) between male and female adolescents varied by age and by the particular activity pattern (Fig. 3). The qualitative sizes were the differences between sexes (male-female) varied by activity pattern and were moderate (+5.4%) for regular, sustained activity, large (+11.3%) for regular, vigorous activity, and very large (+18.2%) for strengthening activity. When compared with male respondents, female adolescents reported a moderately greater prevalence of physical inactivity only at age 17 (16.8% vs 10.5%, respectively) (Fig. 1A). Male adolescents reported significantly higher prevalence than female respondents of the regular, sustained pattern for ages 13 and 15, of the regular, vigorous pattern.

**TABLE 2.** Convention for gauging the size of cross-sectional differences in prevalence across levels of demographic groups and for cross-sectional trends.

<table>
<thead>
<tr>
<th>Size</th>
<th>Demographic Differences (Prevalence Difference)</th>
<th>Trends (Annual Difference)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>&lt;5.0%</td>
<td>&lt;0.5 yr⁻¹</td>
</tr>
<tr>
<td>Moderate</td>
<td>5.0–9.9%</td>
<td>0.5–2.9 yr⁻¹</td>
</tr>
<tr>
<td>Large</td>
<td>10.0–14.9%</td>
<td>3.0–4.9 yr⁻¹</td>
</tr>
<tr>
<td>Very large</td>
<td>≥15.0%</td>
<td>≥5.0 yr⁻¹</td>
</tr>
</tbody>
</table>

Values in percentage points.

ACTIVITY CHANGES BY SEX AND AGE IN U.S.
(with the exception of age 12), and of the strengthening pattern (regardless of age) (Figs. 1C, 1E, and 2A, respectively). There were no differences between sexes for the stretching pattern.

Among adults, the qualitative size of important prevalence differences between sexes were moderate for physical inactivity (−5.5%) and for regular, sustained activity (+5.9%), and large for strengthening activity (+11.2%) (Fig. 3). Statistically significant differences between sexes were consistent across age for patterns of physical inactivity (Fig. 1B), regular, sustained (Fig. 1D), and for strengthening (Fig. 2B). For the regular, vigorous pattern men had significantly higher levels than women for the two oldest age groups (Fig. 1F), while adult women had a higher prevalence than men for the stretching pattern only for ages 65–74 yr.

Rate of change in prevalence per year. Across the ages of 12 yr to 21 yr, the overall changes in physical activity prevalence (male vs female) were: physical inactivity (+10.4% vs +11.2%), regular, sustained (−15.6% vs −10.1%), regular, vigorous (−28.6% vs −36.0%), strengthening (−18.9% vs −20.7%), and stretching (−16.9% vs −27.5%). Among adults, the overall changes in prevalence from age groups 18–29 yr to 75 yr and older were: physical inactivity (+9.5% vs +12.9%), regular, sustained (−7.4% vs −9.4%), regular, vigorous (+19.0% vs +6.6%), strengthening (−28.9% vs −13.4%), and stretching (−16.4% vs −14.6%). The changes for adolescents and adults appeared roughly similar; however, the age spans over which the prevalence changes were 9 yr for the adolescents and 57 yr or more for adults. To overcome this disparate comparison, we chose to compare rates of change per year.

As noted in Table 2, we deemed as important an annual rate of change of ±0.5 percentage points yr⁻¹ or greater (Table 2). Among adolescents, each pattern of physical activity revealed important changes (Fig. 4). In the 15–18-yr age group, values were large or very large in every case except the regular, sustained activity for female respondents, where there was a moderate decrease of −0.9 percentage points yr⁻¹. The only increases in this age group were for inactivity, which rose 4.2 percentage points yr⁻¹ for male respondents and 3.0 percentage points yr⁻¹ for female respondents. Male respondents aged 12–15 yr had
important increases (in percentage points) of 0.6 yr⁻¹ for regular, vigorous activity and 2.4 yr⁻¹ for strengthening, whereas young men aged 18–21 yr had an increase of 0.8 yr⁻¹ for stretching. Young women aged 18–21 yr had an increase of 0.7 yr⁻¹ for regular, sustained activity.

Relative to adolescents, annual rates of change among adults were generally far less pronounced. Rates (in percentage points) were moderate for men only for regular, vigorous activity in the two oldest age intervals (+0.8 yr⁻¹ and +0.9 yr⁻¹, respectively) and for strengthening in the two youngest groups (−1.0 yr⁻¹ and −0.5 yr⁻¹, respectively). Among women, a moderate rate of change was found in the oldest age group for both physical inactivity (+0.8 percentage points yr⁻¹) and regular, sustained activity (−0.8 percentage points yr⁻¹). All other rates had an absolute magnitude of less than 0.5 percentage points yr⁻¹ (data not shown).

**DISCUSSION**

In this study, we found that male adolescents generally had somewhat more favorable physical activity patterns overall than their female counterparts, most notably for regular, vigorous activity and for strengthening, and to a lesser degree for regular, sustained activity, where differences at ages 12 through 16 were largely significant. Each of the physical activity patterns became less satisfactory with increasing age. This finding is extremely disappointing, because schools and community centers should be relatively stable environments that support exercise and sports as well as the opportunity to be active with peers.

Our results place much greater emphasis on comparisons by age and sex than similar data reported in the Surgeon General’s Report on Physical Activity and Health (34). Our results are consistent with the recent findings of Cullen and colleagues (13) who used the same data of the 1992 NHIS-YRBS as in our study, but with a smaller subset of 5881 adolescents ages 14 through 21 and a different analytic strategy. As in our results, these authors reported declines in the number of reported days of vigorous activity participation during the prior week as cross-sectional age increased. They also noted that female respondents reported significantly fewer days of vigorous physical activity compared with male respondents, with male respondents reporting a significantly greater decline than female respondents. Finally, the authors reported that both male and female respondents reported smaller declines in days of reported vigorous activity participation after the transition from being in high school to out of high school, which can also be seen in Figure 1E.

Our results can also be compared with those of students participating in the 3-yr follow-up of the Child and Adolescent Trial for Cardiovascular Health (CATCH) (18). In that study, Nader and colleagues reported decreases of roughly 45% when total minutes of vigorous physical activity in grade 6 were compared with that for grade 8, irrespective of intervention or control group status. In comparing adolescents aged 12 with those of age 15, our study...
revealed that the prevalence of regular, vigorous physical activity pattern showed a nonsignificant difference of 70.8% to 72.6% among male respondents, whereas female respondents reported a significant difference of 66.2% to 56.6% (or an overall decrease of 14.5%). Comparisons between the two studies are limited because the CATCH study reported total minutes of activity participation and we reported the prevalence of a physical activity pattern.

Our use of rates of change in prevalence for three adolescent age groups facilitates the making of inferences about which time periods are critical for the decay of physical activity habits among adolescents. Our study clearly indicates that children aged 15–18 yr are at greater risk of declining physical activity than are young men and women (ages 18–21) or very young adolescents (12–14). Indeed, we found annual decreases of >5.0 percentage points for 5 of 10 sex-specific activity patterns among 15- to 18-yr-olds. In an accompanying paper in this symposium, Telama and Yang (30), who studied 3-yr rates of change in physical activity patterns using longitudinal data for children and adolescents in northeastern Finland, reported the greatest rates of decline in the 12- to 15-yr, or 15- to 18 yr age groups. The overall annual rate of change in percentage points among adolescents for regular, vigorous activity (Fig. 1E) was roughly −3.2 ((70.8% − 42.2%) / 9) for male respondents and −4.0 ((66.2% − 30.2%) / 9) for female respondents. These rates were more than eight-fold greater in absolute terms than those reported for adults in this paper (−0.4 and −0.1 percentage points yr⁻¹, respectively) and those previously reported as trends by Caspersen and Merritt (+0.4 to +0.5 percentage points yr⁻¹, respectively) (8). The smaller rates of change among adults may be explained by the relative stability of adulthood with the amount of hours devoted to work, household, and family responsibilities varying modestly over time.

The dramatic changes in adolescent physical activity patterns we found could have been discerned through simple observation rather than formal surveys. For example, one is much more likely to find younger adolescents at playgrounds, playing soccer or basketball, than older adolescents or young adults. Certainly, these precipitous decreases in physical activity patterns during adolescence, followed by slower decreases in young adulthood, contribute substantially to the obesity epidemic in the United States (17). The present data suggest that ages 15–18 yr present a particularly critical period that begs for earlier and more continuous intervention.

The erosion of physical activity during young adulthood (ages 18–29), represents the period of increasing assimilation into adult work and family roles. In the Coronary Artery Risk Development in Young Adults Study (CARDIA), Anderssen and coworkers (1) reported 7-yr declines in total physical activity over the previous 12 months of almost 30% across all groupings of black and white men and women who were examined four times between 1985–1986 (ages 18–30 yr) and 1992–1993 (ages 25–37 yr). These authors attributed the declines to population-wide temporal trends rather than to aging factors alone.

Paralleling our findings with adolescents, adult men had somewhat more favorable physical activity patterns than adult women. All patterns, except regular, vigorous physical activity failed to improve with age, and strengthening behavior fell dramatically with increasing age for both men and women. In a comparison of international data, Stephens and Caspersen (26) have shown that physical activity levels

---

**Figure 3**—Prevalence difference (male − female) between sexes among adolescents and adults reporting five physical activity patterns (see Table 1 for definitions), U.S. National Health Interview Survey, 1991 and 1992.
generally decrease with increasing age although tending to be higher among men than women.

We also noted that although regular, sustained activity and regular, vigorous activity patterns appeared to stabilize from ages 30 to 64 yr, the prevalence of strengthening and stretching continued to decline through middle and older adulthood. At retirement age, some patterns started to improve, including increases in regular, vigorous physical activity for all adults and very slight increases in regular, sustained activity and stretching among adult men. How best to interpret the increase in regular, vigorous physical activity remained unclear, because rates were developed from a scoring procedure that uses age- and sex-regression equations to adjust for individual maximal capacity. As formulated, the number of activities that satisfy the definition of vigorous physical activity increases with age (7,8,10). We also noted a relatively greater yearly increase in regular, vigorous activity among men (vs women) upon reaching retirement age, which might be explained by men exercising ≥ three times weekly in what would qualify as vigorous activity. This notion gains some support from the increase in the prevalence of regular, sustained activity for men beginning with the age group of 65–74 yr. Similar increases in prevalence with increasing age have been noted previously for this activity pattern (7,8,10,26), and Folsom and coworkers (14), using cross-sectional data, found an increase in total estimated energy output among men reaching retirement age.

In this study, we noted dramatic, progressive declines in strengthening and stretching with increasing age. For strengthening, young men (18–29 yr) had a much higher prevalence than their female peers (34% vs 14%), but at ages 65–74 and ≥ 75, both sexes had dismal reports. The severe declines we noted for strengthening and stretching with increasing age are quite disturbing as we try to keep older adults functionally sound and out of nursing homes.

We should note a variety of limitations for our analyses. Our data are restricted to leisure-time physical activity, and any inferences pertain only to this form of activity. Still, these data may have considerable practical value, because leisure-time activity is particularly amenable to individual modification or community intervention. For these reasons, Healthy People 2000 objectives focus on leisure-time physical activity (6). In addition, these data are self-reported and thus are potentially different from objective assessment, which has its own limitations. Furthermore, we were unable to obtain rates of change per year in the prevalence of five physical activity patterns (see Table 1 for definitions) reported by adolescents, U.S. National Health Interview Survey, 1992.
to provide a clear idea of how cross-sectional changes occur in activity patterns from ages 15 to 30 yr because we had to use two different data systems. We noted, however, a considerable amount of stabilization in the cross-sectional data among adolescents aged 18–21 yr, suggesting that this incongruence in data sources may not have been very limiting.

A major issue about our study concerns its reliance on cross-sectional data, which may not accurately reflect individual change in physical activity over time. Other authors in this symposium have provided longitudinal data analyses for adolescents of other countries (30,36), and a recent paper has reported longitudinal analyses for older adult Dutch men (4). Differences that occur due to aging can be studied by either longitudinal (1) or cross-sectional analyses (24), and each method has its disadvantages. Cross-sectional data of large population samples may be biased or suffer from cohort effects, but data from large samples with marked age ranges can be collected in a relatively short period of time and are especially useful when longitudinal trends are known to be small. Such is the case because trends reported in the Surgeon General’s Report suggest that changes in physical activity patterns are virtually nonexistent over a 15-yr period among adolescents or adults. Alternatively, longitudinal studies require arduous tracking of the same persons using constant methods over many years and are thus very labor intensive and expensive, and may suffer from cohort emigration or other sources of attrition. In addition, persons followed over time may alter their behavior because the act of repeated monitoring may serve, inadvertently, as a stimulus to make changes. Despite these limitations, several longitudinal studies of physical activity have been successfully conducted in adolescents and young adults (1,30,36) and, when coupled with our own cross-sectional results, should permit inferences to be drawn with increased confidence.

**SUMMARY AND RECOMMENDATIONS**

Overall, these data highlight widespread erosion of physical activity patterns with increasing age among adolescents and adults. In general, male respondents had somewhat better patterns of physical activity, although their decay with increasing age was greater than noted for the female respondents. Clearly, efforts must be undertaken to promote more aggressively the goals of Healthy People 2000 and to offset the cross-sectional declines noted with increasing age.

The Centers for Disease Control and Prevention has recently released Guidelines for School and Community Health Programs to Promote Lifelong Physical Activity among Youth (11,27), whose programmatic recommendations include the expansion of intramural and extramural offerings and the encouragement of community-based programs, facilities, and sports participation. Marketing of existing programs may be necessary to enhance levels of participation. For adults, physical activity facilities and programs within work sites should be increased, and preretirement counseling about exercise should be provided. The management of shopping malls and other indoor or protected locations should be encouraged to provide safe places for walking in any weather. Finally, health care providers should routinely counsel patients about incorporating physical activity into their daily lives.

Future research should identify predictors of age and sex differences for all ethnic and racial groups (e.g., white non-Hispanic, black non-Hispanic, Hispanic, Native American, and Asian American). Such studies may be particularly insightful in furthering our understanding of how rates of regular, vigorous activity and of strengthening exercises change across the lifespan and, ideally, would help guide the conduct of successful interventions.

This paper was derived from data used in a presentation to the 44th annual meeting of the American College of Sports Medicine, May 28–31, 1997, in Denver, CO. We would like to acknowledge those persons who generated the statistics available for physical activity estimates in the Surgeon General’s Report on Physical Activity and Health, as well as Michael Ruffin, who was instrumental in preparing the figures for publication, and Dr. Janet Fulton who offered her review of a later draft of this manuscript.

**Address for correspondence:** Carl J. Caspersen, Ph.D., M.P.H., Division of Diabetes Translation, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, K-10, 4770 Buford Highway, NE, Atlanta, GA 30341-3724.

**REFERENCES**


