Journal of Sports Sciences
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rjsp20

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Published online: 22 Jul 2011.

To cite this article: Pertti Huotari , Heimo Nupponen , Lasse Mikkelsson , Lauri Laakso & Urho Kujala (2011) Adolescent physical fitness and activity as predictors of adulthood activity, Journal of Sports Sciences, 29:11, 1135-1141, DOI: 10.1080/02640414.2011.585166

To link to this article: http://dx.doi.org/10.1080/02640414.2011.585166

Journal of Sports Sciences, August 2011; 29(11): 1135–1141

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Adolescent physical fitness and activity as predictors of adulthood activity

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(Accepted 28 April 2011)

Abstract

A 25-year population-based study was conducted to determine how physical fitness and participation in leisure-time physical activity in adolescence (age 12–18 years) predict leisure-time physical activity in adulthood (age 37–43 years). In 1976, five field tests were conducted to measure muscular fitness, agility and aerobic capacity, and self-report weekly frequencies of activity were obtained by questionnaire. A modified questionnaire was repeated in 2001, when participants were age 37–43 years ($N = 1525$). On the basis of the questionnaire, a physical activity index was calculated both in 1976 and 2001. The odds ratios (OR) for being inactive in adulthood among those who were physically very active in adolescence compared with those who were inactive in adolescence was 0.13 for males (95%CI: 0.06–0.31) and 0.28 for females (95%CI: 0.13–0.59). The odds ratio for adult inactivity among males in the highest versus lowest fitness group in adolescence was 0.24 (95%CI: 0.07–0.81). Activity in adolescence predicted activity in adulthood in both males and females. The risk for adult inactivity was significantly lower for those who were physically active in adolescence. In addition, high fitness predicted adult activity among males but not among females.

Keywords: *Health-related fitness, physical activity, longitudinal, adolescent*

Introduction

There is evidence that good physical fitness and regular participation in leisure-time physical activity are beneficial for health and well-being. Physical activity and physical fitness have been shown to reduce morbidity and mortality, including that related to metabolic diseases (type 2 diabetes) and fracture risk (Blair et al., 1996; Kujala, Kaprio, Sarna, & Koskenvuo, 1998; Sayer et al., 2005; Wijndaele et al., 2007).

For optimal benefit, physical activity in childhood should persist into adulthood. Despite physical activity and fitness tracking studies, there is a need to understand better how physical fitness and physical activity in adolescence predict physical activity in adulthood. Previous tracking studies have shown that physical activity in childhood and adolescence predicts physical activity in adulthood, and thus may influence population health (Barnekow-Bergkvist, Hedberg, Janlert, & Jansson, 1998; Tammelin, Näyhä, Hills, & Järvelin, 2003; Telama et al., 2005). Many long-term questionnaire-based studies have shown a statistically significant but rather low or only moderate association between adolescent and adult physical activity (Parsons, Power, & Manor 2006; Telama, 2009; Telama et al., 2005). Many studies that have focused on people aged 13–20 years have shown that stability seems to be lower from early childhood to adulthood than from adolescence to adulthood (Kemper, de Vente, van Mechelen, & Twisk, 2001). Also, tracking has been higher among men than women (Barnekow-Bergkvist et al., 1998; Tammelin et al., 2003; Telama et al., 2005). More short-term studies indicate that physical fitness during youth (10–18 years) may be predictive of physical activity in adulthood (Barnekow-Bergkvist et al., 1998; Dennison, Straus, Mellits, & Charney, 1988; Glenmark, Hedberg, & Jansson, 1994). Health-related fitness (strength, flexibility, and aerobic power) track significantly across childhood and adolescence, but tracking into adulthood is not well understood (Malina, 1996).

The purpose of this study was to investigate how physical fitness and leisure-time physical activity in

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ISSN 0264-0414 print/ISSN 1466-447X online
DOI: 10.1080/02640414.2011.585166

adolescence (age 12–18 years) predict leisure-time physical activity in adulthood (age 37–43 years).

Methods

Sample and assessment of physical fitness

In April and May 1976, trained teams measured physical fitness and recorded participation in leisure-time physical activity (later'' physical activity) among 2796 nine- to 21-year-old Finnish adolescents in their schools. Data were collected from 56 comprehensive and high schools. The sample was a four-phase stratified random sample and the schools represented Finland's different geographical provinces, including both urban and rural municipalities. In the first phase, 20 towns and rural communities were randomly selected from the four geographical areas (west, east, middle, and north) of Finland. A random sample of 56 schools matched for student numbers was taken from these towns and communities (so that sizes of the schools from towns and communities corresponded to each other). Classes were randomly selected and adolescents were chosen from either the beginning or the end of the alphabet, or, at the beginning of measurement, they were lined up and chosen at equal intervals (every second or third pupil, etc.).

In 2001, a follow-up questionnaire on leisure-time physical activity was sent to 2396 adults aged 34–46 years who had taken part in the fitness tests or answered the questionnaire in 1976. Of these, 1820 responded to the questionnaire.

The final sample in this study consisted of the 722 men and 803 women who took part in both the baseline measurements at age 12–18 years in 1976 and returned the follow-up questionnaire at age 37–43 years in 2001 ($n = 1525$). However, not everyone participated in all tests. We had either fitness test or baseline questionnaire data for all those who responded to the questionnaire in 2001; complete baseline data (both fitness tests and questionnaire) were available for only 209 participants, 14% of the target group. The association between physical activity in adolescence and as an adult could be investigated in 1334 participants (616 males and 718 females), 87% of the target group. Analysis between fitness components and physical activity was possible for 824 participants for aerobic fitness (54% of the target group: 12–15 years, 278 males, 292 females; and 16–18 years, 147 males, 107 females), 1065 participants for muscular fitness (70% of the target group: 12–15 years, 351 males, 412 females; and 16–18 years, 91 males, 211 females), and 463 participants for the fitness index (30% of the target group: 219 males and 244 females). For the correlation analyses, we divided participants into two groups according to age at baseline. In the younger age group, the participants were followed from age 12–15 years to age 37–40 years, and in the older group from age 16–18 years to age 41–43 years. The follow-up questionnaire response rate was 66% of those who participated in baseline measurements.

The study received approval from the Ethics Committee of the Central Finland Health Region. Before all tests, parental consent was obtained and participants were allowed to refuse to participate in the tests.

The fitness tests were conducted by specially trained personnel in the children's own school during school hours using identical procedures. All children performed the same pre-test warm-up routine. The measurements, for both sexes, included height (cm), weight (kg), standing broad jump (cm), sit-ups (repetitions in 30 s), and 4×10-m shuttle run (s). In addition, upper-body strength was measured for girls by the flexed arm hang (s) and for boys by pull-ups (maximum repetitions) (Table I). The fitness test results were used to construct a gender-stratified muscular fitness index, which was formed by summing the age-adjusted z-scores. The internal consistency coefficient (α), used to indicate the reliability of the muscular fitness index, was 0.76 for males and 0.77 for females. An aerobic fitness index was calculated as the age-adjusted z-score for long-distance running, 2000 m for boys and 1500 m for girls. Previous research has shown theses tests to have good validity, satisfactory reliability, and conform to international standards for the assessment of physical fitness (Safrit, 1990). Previous researchers have reported the inter-rater reliability of the tests to vary between 0.57 and 0.98 (Simons, Beunen, Renson, & van Gerven, 1982). For the multinominal regression analyses, we the calculated gender-stratified fitness index by summing the z-scores for the all tests and dividing the participants into quartiles.

Assessment of physical activity

At both assessment points, physical activity and participation in sports were documented using a self-report questionnaire (Table I). In 1976, the questionnaire was administered individually in connection with the fitness tests and the questions concerned the frequency and intensity of leisure-time physical activity, participation in sport club training, and participation in competitive sport events. The frequency and intensity of leisure-time physical activity was ascertained by the question, ''How many times a week do you participate in leisure-time physical activity of at least 30 min duration so that you feel breathless?'' This question was coded on a 6-point response scale (0 = not at all, 1 = less than once a month, 2 = once a month, 3 = 2–3 times a month, 4 = once a week, 5 = 2–6 times a week, and

Table I. Characteristics of participants in 1976 (upper row of figures) and 2001 (lower row of figures).

	Males			Females		
Age group	12–15 37–40 mean (*s*)	16–18 41–43 mean (*s*)	Total mean (*s*)	12–15 37–40 mean (*s*)	16–18 41–43 mean (*s*)	Total mean (*s*)
Age (years)	13.7 (1.0)	16.6 (0.7)	14.7 (1.6)	13.8 (1.1)	16.6 (0.7)	14.7 (1.6)
	38.7 (1.0)	41.6 (0.7)	39.7 (1.6)	38.8 (1.1)	41.6 (0.7)	39.7 (1.6)
Height (cm)	164.0 (10.8)	177.0 (6.6)	168.1 (11.4)	161.0 (6.3)	165.0 (5.8)	162.1 (6.4)
	179.0 (6.5)	179.8 (6.4)	179.8 (6.4)	165.8 (5.8)	165.8 (5.4)	165.8 (5.7)
Weight (kg)	51.0 (10.7)	65.0 (8.3)	55.6 (11.8)	51.0 (8.4)	55.5 (6.3)	52.2 (8.1)
	83.3 (12.1)	83.1 (11.9)	83.2 (8.1)	66.5 (12.1)	65.7 (9.3)	66.2 (11.2)
BMI ($kg \cdot m^{-2}$)	18.8 (2.2)	20.6 (2.1)	19.4 (2.3)	19.5 (2.6)	20.5 (2.1)	19.8 (2.5)
	25.8 (3.4)	25.7 (3.3)	25.8 (3.3)	24.1 (4.0)	23.9 (3.4)	24.1 (3.8)
Fitness tests 1976						
Running test (s)	578 (110.1)	537 (104.6)	564 (110.0)	492 (80.2)	473 (59.3)	487 (75.5)
Sit-up (reps.)	19.7 (4.2)	21.7 (3.3)	20.4 (4.0)	16.6 (3.6)	16.9 (4.0)	16.7 (3.8)
4 × 10-m shuttle run (s)	12.0 (8.7)	11.3 (8.3)	11.8 (9.0)	12.8 (9.3)	12.5 (8.8)	12.7 (9.2)
Pull-ups (reps.)/flexed arm hang (s)*	4.7 (3.6)	7.7 (4.0)	5.7 (4.0)	14.0 (10.0)	15.4 (9.9)	14.5 (10.0)
Standing broad jump (cm)	201.0 (25.9)	235.0 (21.5)	213.5 (29.3)	173.0 (21.5)	180.0 (21.1)	175.1 (21.6)
Participation in leisure-time physical activity (%)						
Less than once a week	13.5	14.1	13.7	10.7	10.3	10.6
	31.8	20.1	27.7	18.8	15.8	17.8
1–6 times a week	54.5	68.6	59.4	57.5	66.0	60.3
	64.1	77.1	68.7	75.1	74.0	74.7
Daily	32.0	17.3	26.9	31.8	23.7	29.1
	4.1	2.8	3.6	6.1	10.2	7.5
Participation in organized sport	38.8	36.4	38.0	22.2	14.5	19.7
	18.6	24.8	20.8	37.2	39.5	38.0

*Pull-ups for males, flexed arm hang for females.

6 = every day). The answers concerning participation in sport club training and in competitive sport were coded from 1 to 3, where 1 represents inactivity or very low activity, 2 represents moderately intense or frequent activity, and 3 represents frequent or vigorous activity. Participation in a school sport club was coded as 1 (no) or 2 (yes). After coding, an index of physical activity was calculated by summing the variables. This index comprised four variables with a total score ranging from 3 to 14.

In 2001, the physical activity questionnaire consisted of questions concerning the frequency of physical activity, which was ascertained by the question, "How often do you participate in leisure-time physical activity". A 7-point response scale was used, which was subsequently recoded from 1 to 3, where 1 represents leisure-time physical activity at most 3 times a month, 2 represents 1–4 times a week, and 3 represents 5–7 times a week. Other questions concerned the average duration of a leisure-time physical activity session (0 = not at all, 1 = at most 20 min, 2 = 20–60 min, and 3 = 60 min or more), participation in competitive sport events (0 = not at all, 1 = up to club level, and 2 = regional, national or international), participation in organized leisure-time physical activity (0 = not at all, 1 = at most 3 times a month, 2 = 1–2 times a week, and 3 = 3–7 times a week) and intensity of participation (1 = not quite breathless, 2 = somewhat breathless, and 3 = very breathless). In 2001, the physical activity index comprised five variables with a total score ranging from 1 to 14.

The validity of the physical activity measurements was investigated in adolescence by correlating the physical activity index with the aerobic and muscular fitness indices (Table II). The internal consistency coefficients (α), used as an indicator of the reliability of the physical activity index, was 0.68 in 1976 and 0.76 in 2001 for males, and 0.58 in 1976 and 0.68 in 2001 for females.

To analyse the effect of high, average, and low physical activity and fitness categories in adolescence on adult physical inactivity, participants were divided into three categories according to their physical activity and fitness in 1976, and their physical activity in 2001. Among males, the lowest physical activity and fitness categories in 1976 comprised 21% of participants compared with 26% in 2001. The highest physical activity and fitness categories comprised 26% of participants in 1976 compared with 21% in 2001. Among females, 24% belonged to the lowest and 24% to the highest physical activity and fitness categories in 1976, compared with 16% and 21% in 2001.

Table II. Correlation coefficients between the aerobic fitness index (AFI), muscular fitness index (MFI), and physical activity index (PAI 76 and PAI 01) in adolescence and from adolescence to adulthood in two age groups (12–15 and 16–18 years) (correlation coefficients on the upper line for males, on the lower line for females).

	12–15 years			16–18 years		
	AFI 76	PAI 76	PAI 01	AFI 76	PAI 76	PAI 01
MFI 76	0.48***	0.25**	0.10	0.28**	0.40***	0.14
	0.48***	0.37***	0.04	0.36**	0.20**	0.10
AFI 76		0.31***	0.11		0.44***	0.19*
		0.43***	0.06		0.32***	0.01
PAI 76			0.14*			0.31***
			0.05			0.17*

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

Statistical analyses

The association between fitness and physical activity in adolescence and adult levels of physical activity was examined by Spearman's rank order correlation and partial correlation controlling for age. The effect of different categories of physical activity and fitness in adolescence on adult physical inactivity were analysed using multinominal logistic regression. Odds ratios (OR) with 95% confidence intervals (95%CIs) were calculated. In the regression analysis, the results were adjusted for age and education. The estimates of statistical power in our data for the observed statistically significant results ($P < 0.05$) ranged from 0.74 to 1.00 (R Development Core Team, 2008). Males and females were always analysed separately. All statistical tests were performed using SPSS v.15.0 (SPSS, Chicago, IL, USA).

Results

Among males at age 12–18 years, the percentages of those who participated in leisure-time physical activity on a daily basis, 1–6 times a week, and less than once a week were 27%, 59%, and 14% respectively; among females the corresponding figures were 29%, 60%, and 11% respectively. At age 37–43 years, the percentage of males who participated in leisure-time physical activity on a daily basis, 1–6 times a week, and less than once a week were 4%, 68%, and 28% respectively; among females the corresponding figures were 8%, 74%, and 18% respectively. At age 12–18 years, the percentage of males and females who attended a sports club was 38% and 20% respectively. Twenty-five years later, the percentage of males and females regularly attending a sport club was 21% and 38% respectively (Table I).

Table II shows Spearman's correlation coefficients between the fitness indices and physical activity in adolescence and the correlation coefficients from adolescence to adulthood for two age groups (12–15 years and 16–18 years). There was a significant correlation between the aerobic fitness index, muscular fitness index, and physical activity in adolescence. The correlation coefficients were low or moderate and ranged from 0.20 to 0.48. A statistically significant association between fitness indices in adolescence (at age 12–18) and adult physical activity (at age 37–43) was observed for males. In the older age group, the correlation coefficient between the aerobic fitness index in adolescence and adult physical activity was 0.19 ($P < 0.05$) but non-significant between the muscular fitness index and adult physical activity. Among females there was no significant correlation between the baseline fitness indices and adult activity. The age-adjusted correlation coefficient for the longitudinal association of physical activity was 0.22 ($P < 0.001$) for males and 0.09 ($P = 0.021$) for females. For males, there was a small but significant correlation between age-adjusted physical activity and adult physical activity in both the younger ($r = 0.14$, $p < 0.05$) and older age groups ($r = 0.31$, $P < 0.001$), whereas among females there was a small but significant association of physical activity from age 16–18 to age 41–43 ($r = 0.17$, $P < 0.05$). In general, the longitudinal correlation coefficients were higher in the older age group and the associations from adolescence to adulthood were stronger for the physical activity index than for the fitness indices.

Table III shows the results of the regression analyses for adult inactivity at age 37–43 years. The results show that for both sexes, a high level of physical activity in adolescence predicted less of a risk for adult inactivity. The odds ratio for being inactive as an adult for those who were physically very active in adolescence compared with those who were inactive in adolescence was 0.13 (95%CI: 0.06–0.31) for males and 0.28 (95%CI: 0.13–0.59) for females. In addition, the odds ratio for adult inactivity was 0.24 (95%CI: 0.07–0.81) for males in the highest fitness group compared with

Table III. Risk (odds ratios) for physical inactivity in adulthood according to physical activity (PAI) and physical fitness (FI) categories in adolescence (adjusted for age and education).

	Males at age 37–43 years ($n=616$)			Females at age 37–43 years ($n=718$)		
	OR*	95%CI	*P*-value	OR*	95%CI	*P*-value
PAI at age 12–18 [a]		Very active vs. inactive			Very active vs. inactive	
Low activity	1.00			1.00		
Average activity	0.33	0.15–0.73	0.006	0.76	0.42–1.40	0.379
High activity	0.13	0.06–0.31	<0.001	0.28	0.13–0.59	0.001
		Active vs. inactive			Active vs. inactive	
Low activity	1.00			1.00		
Average activity	0.59	0.37–0.93	0.024	0.73	0.45–1.18	0.198
High activity	0.55	0.32–0.97	0.037	0.39	0.20–0.74	0.004
FI at age 12–18 [b]		($n=245$)			($n=219$)	
		Very active vs. inactive			Very active vs. inactive	
Low fitness	1.00			1.00		
Average fitness	0.55	0.19–1.61	0.274	0.96	0.34–2.70	0.935
High fitness	0.24	0.07–0.81	0.020	0.79	0.23–2.73	0.703
		Active vs. inactive			Active vs. inactive	
Low fitness	1.00			1.00		
Average fitness	0.70	0.34–1.44	0.333	0.67	0.32–1.53	0.430
High fitness	0.54	0.22–1.31	0.173	0.64	0.33–2.04	0.374

*Odds ratios from multinominal regression analyses.
[a] Inactive is the reference category. [b] Low fitness is the reference category.

those in the lowest fitness group in adolescence; for females this odds ratio was not significant.

Discussion

The aim of this study was to investigate longitudinal associations of physical fitness (aerobic fitness and muscular fitness) with participation in leisure-time physical activity from adolescence (age 12–18 years) into adulthood (age 37–43 years) over a period of 25 years. The main finding was that physical activity in adolescence significantly predicted adult physical activity in both males and females. The risk of adult inactivity was significantly lower for individuals who were physically very active in adolescence compared with their inactive counterparts. In males, the association between the physical activity index in 1976 and the physical activity index in 2001 was significant in both the age groups investigated. Among females, the association was found only in the older age group. A high level of physical fitness in adolescence predicted a reduced risk for adult physical inactivity among males. However, among females a significant association between fitness in adolescence and adult physical activity was not observed.

We found statistically significant, but only low to moderate, correlations between the fitness indices and physical activity in adolescence. Previous studies have found only weak evidence for the relationship between habitual physical activity and health-related fitness in youth, as against a strong relationship in adulthood. Individuals who are more active in youth have been found to be fitter at tasks that demand good aerobic fitness, but associations with the other components of health-related fitness have been inconsistent (Ara et al., 2004; Katzmarzyk, Malina, Song, & Bouchard, 1998; Malina, 2001; Rowlands, Ingledew, & Eston, 2000). Previous secular trend studies have shown that people who are physically active in youth have both better aerobic fitness and muscular fitness than their physically inactive peers (Huotari, Nupponen, Laakso, & Kujala, 2010).

The results showed a low correlation between aerobic fitness index and adult physical activity among males, while high physical fitness in adolescence predicted a lower risk for inactivity in adulthood. Physical fitness is to a large extent determined by heredity, and thus it could affect physical activity in all life phases. In addition, males participate more in competitive and vigorous physical activity, which may partly explain the observed difference between the sexes. Previous longitudinal studies of physical fitness from youth to adulthood are limited and suggest generally better tracking for physical fitness than for physical activity, while some data suggest that those who are fitter in youth tend to be more active in adulthood (Barnekow-Bergkvist et al., 1998; Dennison et al., 1988; Kemper et al., 2001; Matton et al., 2006). Although our results showed longitudinal associations between physical fitness and physical activity only among males, in some shorter-term studies this association has also been found among females (Barnekow-Bergkvist et al., 1998; Dennison et al., 1988).

In his review, Telama (2009) found that in many previous physical activity tracking studies, the follow-up times were shorter than in the present study, the median being 9 years. According to these studies, among men the stability of physical activity was significant but low or moderate during all life phases, whereas in females the tracking correlations were lower and in many cases non-significant (Barnekow-Bergkvist et al., 1998; Parsons et al., 2006; Scheerder et al., 2006). In our study, physical activity in adolescence correlated at a low but significant level with physical activity in adulthood in both males and females from age 16–18 to age 41–43 and this finding is in accordance with previous results. The correlation coefficients were consistent with those of studies of populations with a similar age range (Parsons et al., 2006; Telama et al., 2005). However, the obtained correlations were rather weak compared with the odds ratios between the low and high physical activity categories. Our results indicate that risk for adult inactivity is remarkably stronger among those who are inactive in adolescence compared with their very active counterparts. The reason for that could be that tracking of physical activity from adolescence to adulthood is not linear but the tracking of inactivity and high-level activity is strong. These findings support the view that it is very important to enhance adolescents' physical activity in order for this to persist through adolescence, and that more attention should be paid to the amount of physical activity in later adolescence to prevent inactivity in adulthood. In particular, different ways to increase the amount of physical activity among the most inactive adolescents should be identified. It is well known that the amount of physical activity declines with increasing age through adolescence into adulthood (Kemper et al., 2001; Telama & Yang, 2000). Therefore, reasons for the difference between the age groups examined here could be a high drop-out from physical activity between early (12–15 years) and later adolescence (16–18 years), and lower participation in physical activities at age 37–40 years than at age 41–43 years.

The reason for differences between the sexes are not clear, but apart from the fact that timing of maturation between the sexes is different (Sherar, Cumming, Eisenmann, Baxter-Jones, & Malina, 2010), it could be because males participate more in vigorous physical activity, such as competitive sport, in all life phases, while females prefer more individual, flexible and non-competitive physical activities to participate in easily. In addition, physical activity at a young age is more unstable among girls than boys because they participate less than boys in organized and competitive sports, and some life changes such as getting married and having children may have a marked effect on physical activity in adulthood in women (Telama, 2009).

A limitation of this study was that physical activity was examined only using self-reports. More reliable results for investigation of physical activity could be obtained by using both objective and self-report research methods. Baseline measurements of this study were carried out in 1976 and at that time objective measurements of physical activity were not readily available. For this reason, physical activity was examined using a similar method in 2001. Future longitudinal studies should use both self-report questionnaires and objective methods, such as accelerometers, to document physical activity, as both methods have their own advantages. Objective physical activity monitoring tends to have higher stability and involve a smaller measurement error than self-report methods. On the other hand, self-report methods may better capture specific activities and seasonal variation (Telama, 2009). However, further longitudinal physical activity studies with objective physical activity measurements are needed to verify tracking of inactivity found in this study.

Another limitation was that the physical activity questionnaires given to the adolescents and adults were not identical because adolescents also participate in school sport and this had to be taken into consideration. Although the questions for adolescents and adults were not the same, the previously examined dimensions of physical activity (i.e. the frequency and intensity of leisure-time physical activity, participation in sport club training, and participation in competitive sport events) were investigated at both assessment points and taken into account in calculating the physical activity index. Furthermore, although the age interval was rather long in this study, we did not control for individual differences in the timing and tempo of the participants' growth spurt and sexual maturation at the first assessment. Recent evidence has indicated interactions between individual differences in maturity status and physical activity and this has to be taken into consideration in the interpretation of the results (Sherar et al., 2010). In addition, physical fitness was measured by field tests instead of laboratory tests. Muscular fitness was measured by four field tests and aerobic fitness by one field test. Compared with testing in the laboratory, field tests may result in errors at the individual level, although they work rather well at the group level. In physical education in Finland, health-related fitness has been measured using these tests over a long period, and acceptable results for validity and reliability have been reported. Investigation of physical fitness in the laboratory using more sophisticated instruments would have enabled a more detailed description of the fitness characteristics. However, the participation rate in laboratory examinations among less active individuals is likely to be lower than that in our school-based measurements.

Our results indicate an association between leisure-time physical activity and fitness at age 12–18 years. Leisure-time physical activity significantly predicted adult physical activity in both males and females, the correlation coefficients were consistent with previous studies, and risk for adult inactivity was reduced among very active adolescents. As with physical activity, fitness in adolescence significantly predicted physical activity in adulthood among males but not among females. Our study supports the view that enhancement of physical activity in all phases of adolescence is important from the standpoint of adult physical activity, although physical activity counselling strategies are also needed in adulthood.

Acknowledgements

Support from the Sport Institute Foundation is acknowledged. The funding sources had no role in any aspects of this study.

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