ORIGINAL ARTICLE

Relationship between the intensity of physical activity, inactivity, cardiorespiratory fitness and body composition in 7–10-year-old Dublin children

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Br J Sports Med 2007;41:311–316. doi: 10.1136/bjsm.2006.032045

Objective: To investigate the relationships between the time spent in specific intensities of activity and inactivity, cardiorespiratory fitness and body composition in children.

Methods: A cross-sectional study was conducted in a random sample of schools. Height, weight and waist circumference were measured in 224 children aged 7–10 years. Cardiorespiratory fitness was estimated by the 20 m multistage running test, and physical activity was measured over 4 days by the RT3 (a triaxial accelerometer). Time each day spent in moderate and vigorous intensities of activity was calculated.

Results: Twelve schools agreed to participate in the study. Body composition and fitness data were obtained for 224 children and activity data for 152 children. Boys were found to take part in about twice as much vigorous and hard activity as girls (mean (95% confidence interval) 64.3 (53.2 to 75.4) min in boys compared with 37 (33.1 to 40.9) min in girls; $p<0.001$). In boys there was significant difference between those defined as normal, overweight and obese in the time spent in vigorous activity ($p<0.05$), but no such difference was found in girls. A significant negative correlation between waist circumference and time spent in vigorous activity ($r=-0.31$, $p<0.05$) was found in boys but not in girls. Time spent sedentary was positively correlated with waist circumference in boys ($r=0.33$, $p<0.01$) but not in girls. In both boys and girls there were significant negative correlations between fitness and both body mass index ($r=-0.274$, $p<0.001$) and waist circumference (boys: $r=-0.503$, $p<0.01$; girls: $r=-0.286$, $p<0.01$).

Conclusion: In boys, body composition was inversely related to fitness and to vigorous activity and was positively related to inactivity. In girls, body composition was related to fitness but not to specific components of physical activity.

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Accepted 4 December 2006

I ncreasing evidence suggests that low levels of physical activity in children and adolescents are related to increased levels of cardiovascular risk.^{1,2} A recent investigation from the European Youth Heart Study group found that the odds ratio for clustered risk was 2.03–3.29 in children from the least active quintiles of physical activity compared with the most active.³

Obesity is a cardiovascular risk factor that is causing increased concern, especially in children. It would appear plausible to assume that higher levels and intensities of physical activity in children result in a more favourable body composition. Studies investigating this relationship have demonstrated conflicting results, with some finding no association,^{4,5} whereas others have found that higher activity levels are correlated with lower fat mass.^{6–10} A meta-analysis by Rowlands *et al* showed that there is a small to moderate relationship between body fat and activity in children.¹¹ There is further uncertainty when one examines gender differences as some investigators have found a relationship between levels of physical activity and body composition in boys but not in girls.^{12–14}

Studies examining the relationship between intensity of activity and body composition have also found varying results. Abbott and Davies found that times spent in vigorous and hard activity (as defined by accelerometer counts per minute) correlated significantly with percentage body fat but not with body mass index (BMI) in 5–10.5-year-olds.¹⁵ Moderate intensity activity, however, was not found to correlate with measures of body composition. In preschool children it has been found that the amount of moderate to vigorous activity is significantly greater in non-overweight boys than in overweight

boys, but no such relationship was seen in girls.¹³ The relationship between time spent sedentary and body fat was investigated in a one year longitudinal study and an increase in inactivity was found to be associated with an increase in BMI in adolescent girls.¹⁶

A definitive understanding of the relationship between activity levels and body composition in children may not be possible owing to methodological differences in the above studies. First, various techniques have been used to determine body composition—for example, BMI, waist circumference and skinfolds. Second, there is variation in the methods used to measure physical activity, with many studies using subjective methods.^{1,7,8,12,16} In studies using more objective methods (for example, accelerometers) there has been limited examination of the influence of the various intensities of physical activity, including inactivity, on body composition.^{9,13}

To clarify the relationship between body composition and activity our study investigated the relationships between body composition, intensity of physical activity and inactivity, and aerobic fitness. The specific objectives of this study were:

- To determine the relationship between moderate, vigorous and hard activity and body composition in children aged 7–10 years.
- To determine the relationship between time spent sedentary and body composition in children aged 7–10 years.
- To determine the relationship between cardiorespiratory fitness levels and body composition in this cohort.

Abbreviations: ANOVA, analysis of variance; BMI, body mass index

Table 1 Mean and 95% confidence intervals of height, body mass index, waist circumference, $\text{VO}_{2\text{max}}$ (ml/kg/min)

Age (years)	Height (cm)	BMI	BMI (z score)	Waist (cm)	$\text{VO}_{2\text{max}}$ (ml/kg/min)
<i>Boys</i>					
7–8 (n=37)	132.9 (131.1 to 34.7)	16.2 (15.3 to 17.1)	−0.013 (−0.48 to 0.46)	61 (58.7 to 63.3)	51.7 (50.2 to 53.2)
8.1–9 (n=37)	135.2 (133.9 to 136.5)	16.8 (16.0 to 17.6)	0.307 (−0.07 to 0.69)	62 (60.1 to 63.9)	55.0 (53.6 to 56.5)
9.1–10 (n=10)	139.3 (135.1 to 143.5)	19.4 (17.8 to 21.5)	1.175 (0.39 to 2.00)	70 (62.5 to 77.4)	51.7 (47.9 to 55.5)
Total (n=84)	134.7 (133.5 to 135.9)	16.9 (16.3 to 17.5)	0.269 (−0.02 to 0.56)	62 (60.3 to 63.7)	64.3 (53.2 to 75.4)
<i>Girls</i>					
7–8 (n=49)	131.6 (130.3 to 132.9)	16.6 (13.0 to 20.2)	0.133 (−0.22 to 0.48)	62 (60.0 to 64.0)	50.5 (49.5 to 51.5)
8.1–9 (n=81)	133.3 (132.2 to 134.4)	16.6 (16.1 to 17.1)	0.047 (−0.18 to 0.28)	62 (60.5 to 63.5)	48.9 (48.2 to 49.6)
9.1–10 (n=10)	136.2 (130.6 to 141.8)	17.8 (15.8 to 19.8)	0.346 (−0.77 to 1.46)	66 (59.8 to 72.2)	49.8 (47.0 to 52.6)
Total (n=140)	132.9 (132.0 to 133.8)	16.7 (16.3 to 17.1)	0.10 (−0.09 to 0.29)	62 (60.8 to 63.2)	49.5 (48.9 to 50.1)
Significance	p=0.023	p=0.59	p=0.31	p=0.78	p<0.001

METHODS

Subjects

Subjects in the study comprised 224 children aged 7–10 years from national primary schools in Dublin.

Children with conditions that might have led to limitations in physical activity and mobility were excluded. Ethical approval for the study was obtained from the joint research ethics committee of St James's Hospital/Adelaide and Meath incorporating the National Children's Hospital.

Measures

Body composition

All anthropometric measures were carried out by the same investigator. Height was measured by a portable stadiometer (SECA, Vogel and Halke, Germany) to the nearest millimetre. Weight was measured, using SECA electronic scales, to the nearest 0.1 kg. Both were measured with the child in light clothing (school tracksuit) without shoes. BMI was computed as kg/m^2 . Overweight and obesity were defined using the international cut-off points.¹⁷ The BMI was also standardised to the British reference population and converted to z scores.¹⁸ Waist circumference (to the nearest millimetre) was measured with a tape measure at the level of the narrowest point between the lower costal border and the iliac crest, and measures obtained were compared with centiles in British children.¹⁹ Waist circumference is a measure of central fat, but the BMI was required in order to assign children to categories of normal weight, overweight and obese.

Cardiorespiratory fitness

The 20 m multistage running test²⁰ was used to measure cardiorespiratory fitness. This test has been found to be a valid

predictor of $\text{VO}_{2\text{max}}$ in children and adolescents.^{21–22} It was explained in full before the start and all testing was done in dry weather conditions in school yards with concrete surfaces.

Physical activity

The RT3 accelerometer (Stayhealthy Inc, Monrovia, California, USA) was used for the objective measurement of physical activity. The RT3 can assess activity in three planes, and records intensity, frequency and duration of activity. Physical activity can be expressed as total energy expenditure or as minutes spent each day in different intensities (the output is expressed as mean counts per minute). Activity was quantified as overall energy expenditure in physical activity and minutes in light (VM (Vector Magnitude): 100–970), moderate (VM: 971–2333), vigorous (2334–3500)⁹ and hard or vigorous activity (>3500).²³ These intensities mean that walking at 3 km/h would be classified as moderate, walking at 6 km/h would be vigorous and running at 9 km/h would be hard activity. Data were averaged over the four days and expressed as mean minutes spent daily. The days of the week varied and 38 children had both two days of weekend and week days monitored, 26 had three week days and one week end day and the rest had all week days measured. The validity of the RT3 in the measurement of physical activity in boys of this age has been established²³ and the Tritrac (predecessor to the RT3) has been validated in both genders of this age.²⁴

Sampling and design of the study

To determine a correlation of 0.2 or greater between activity levels and BMI it was calculated that 195 children would be required for the study to have 80% power of detecting a correlation and a two tailed level of significance of 5%.

Table 2 Mean and 95% confidence intervals of minutes per day spent in inactivity, moderate activity, vigorous activity, hard activity and hard/vigorous activity as estimated by triaxial accelerometry

Age (years)	Sedentary	Moderate	Vigorous	Hard	Vigorous/hard
<i>Boys</i>					
7–8 (n=23)	927.6 (897.1 to 958.0)	115 (100.7 to 129.3)	40.6 (33.2 to 48.0)	23.4 (16.1 to 30.7)	56 (43.8 to 68.2)
8–9 (n=23)	917.5 (880.8 to 954.2)	117 (104.7 to 129.3)	33.8 (25.1 to 42.5)	22.3 (13.7 to 30.9)	56 (43.8 to 68.2)
9–10 (n=6)	1028.5 (951.4 to 1105.6)	70 (52.4 to 87.6)	21.0 (13.4 to 28.6)	16.2 (12.3 to 30.1)	66.3 (15.1 to 117.5)
Total (n=52)	935.1 (910.8 to 959.4)	110.5 (101.0 to 120.0)	37.6 (32.3 to 42.9)	22.1 (16.9 to 27.3)	64.3 (53.2 to 75.4)
<i>Girls</i>					
7–8 (n=36)	945.6 (909.3 to 981.9)	95 (83.9 to 106.1)	22.6 (19.0 to 26.2)	9.4 (6.6 to 12.1)	30 (24.6 to 35.4)
8–9 (n=59)	970.5 (950.9 to 990.2)	98 (92.0 to 104.0)	26.1 (23.4 to 28.8)	13.9 (10.5 to 17.3)	41 (35.9 to 46.1)
9–10 (n=5)	1015.0 (965.4 to 1064.5)	82 (62.7 to 101.3)	16.0 (9.95 to 22.0)	6.7 (2.7 to 10.7)	22.2 (14.2 to 30.2)
Total (n=100)	963.8 (945.8 to 981.8)	96.1 (90.6 to 101.6)	24.5 (22.3 to 26.6)	12.1 (9.8 to 14.4)	37 (33.1 to 40.9)
Significance	p=0.068	p=0.007	p<0.001	p=0.068	p<0.001

Figure 1 Centiles of height, BMI, waist circumference with respect to the British 1990 growth references ($n = 224$).

Stratified (geographically) random sampling was used in this cross-sectional study. Schools were identified from the Department of Education and Science website (<http://www.education.ie>, accessed 31 January 2007) and were randomly selected from each of the four Dublin borough areas (Dublin Borough, Dublin Fingal, Dublin South, Dun Laoghaire-Rathdown) on a proportional basis. Principals of the schools were contacted, the aims of the study were explained and the call was followed up with a letter to be approved by the school boards, where necessary. Once a school had agreed to participate in the study, letters to parents and consent forms were distributed. A convenient morning was arranged with each school for testing and children were asked to wear their school tracksuit/gym clothing for the day of testing.

The procedure required a number of visits to each school. At the first visit height, weight, waist circumference, and cardiorespiratory fitness were measured. The RT3 was given to six children for four days with instructions on its use. Four days of activity has been found to be a sufficient length of time to determine habitual activity levels in children.²⁵ On collection the RT3s were downloaded, re-initialised and given to the next group of six children.

Statistical analysis

Activity was described by the minutes spent in various intensities of activity as stated above (see "Measures"). Descriptive analyses are presented for continuous data as means and confidence intervals, and for categorical data as percentages. BMI was standardised for age and gender, and also categorised into three divisions (body composition) based on the international cut-off points for BMI for overweight and obesity in children. Although there are Irish growth references,²⁶ these do not include waist circumference, so for consistency the British standards were used. Comparison of height, weight, BMI, standardised BMI, activity and Vo_2 levels

between the genders was made using an independent t test, and between the body composition variables using analysis of variance (ANOVA). Pearson correlations were calculated between standardised BMI and activity and fitness levels and repeated for boys and girls separately. Multiple regression analysis was performed for various dependent variables (see table 5) and in all cases the model included age, gender, BMI z score and waist circumference adjustment. All variables other than minutes spent in vigorous activity (which were subsequently log transformed for analysis) were normally distributed. Significance was assumed at $p < 0.05$ and all analyses were performed using SPSS version 12 (SPSS Inc).

RESULTS

Twenty eight schools were contacted, 12 replied positively and were scheduled into the study. The numbers in each area were: two from Dublin Borough, four from Dublin South, four from Dublin Fingal and two from Dun Laoghaire-Rathdown. Therefore the sample was geographically spread. Data were obtained for a total of 224 children (140 (62.5%) girls, 84 (37.5%) boys). Activity data via accelerometry was obtained for 152 (67.9%) children (100 girls, 52 boys). The remaining 64 accelerometers were returned with fewer than three days of data (probably because either the child had not worn the device or had interfered with the unit and lost the initial data set up).

Height, weight, waist circumference and fitness data were obtained in 140 girls and 84 boys in a total of 12 schools. Table 1 summarises the descriptive data by gender and age into height, BMI and BMI z score, waist circumference and $\text{Vo}_{2\text{max}}$. Table 2 presents data by gender and age in minutes each day spent sedentary, in moderate, vigorous and hard activity, and in the sum of vigorous and hard activity. Tables 1 and 2 also present the difference between the genders for the described variables (last row in each). When heights of children were divided into centiles using the British 1990 growth reference¹⁸ it was found that 15% of the cohort were above the 97th centile for height and 27% were above the 91st centile. For waist circumference 76% of subjects were above the 75th centile. For BMI 20.7% of girls and 20.2% of boys were overweight, with 6.3% being obese (5% of girls, 8.3% of boys). Figure 1 presents the centiles of height, BMI and waist circumference.

Table 3 details the means of time spent in varying intensities of activity by body composition group (normal, overweight and obese) and gender. To examine activity of at least a vigorous level the time for "vigorous" and "hard" activity were combined. This overall mean vigorous/hard activity score was 64.3 minutes in boys and 37 minutes in girls (table 2). There was a significant difference between the categories of body composition for boys and the time spent in vigorous activity (ANOVA linear trend $p < 0.03$). A significant difference between the genders in overall energy expended in daily physical activity

Table 3 Mean and 95% confidence intervals of activity (minutes) and fitness in boys and girls by body composition

Body composition	Sedentary	Moderate	Vigorous	Hard	$\text{Vo}_2 \text{ max}$
Boys					
Normal weight ($n = 43$)	927.9 (900.7 to 955.0)	114.3 (103.9 to 124.7)	39.1 (33.2 to 44.9)	23.9 (18.1 to 29.7)	54.2 (52.8 to 55.6)
Overweight ($n = 6$)	902.5 (864.6 to 940.4)	122.3 (90.4 to 154.1)	40.0 (27.6 to 52.4)	23.9 (18.1 to 29.7)	50.5 (47.6 to 53.4)
Obese ($n = 3$)	1045.5 (933.8 to 1157.2)	58.5 (38.3 to 78.7)	14.0 (11.1 to 16.9)	4.7 (0.7 to 8.7)	46.6 (44.2 to 49.0)
Total ($n = 52$)	935.1* (910.0 to 960.2)	110.5** (100.6 to 120.4)	37.6* (32.3 to 42.9)	22.1 (16.9 to 27.3)	53.2 *** (51.8 to 54.6)
Girls					
Normal weight ($n = 78$)	962.8 (940.9 to 984.7)	96.6 (90.2 to 103.4)	24.4 (22.0 to 26.8)	12.7 (9.9 to 15.5)	49.9 (49.1 to 50.7)
Overweight ($n = 18$)	974.7 (943.6 to 1005.8)	94.4 (80.4 to 108.4)	24.2 (19.0 to 29.4)	9.4 (5.1 to 13.6)	48.4 (47.2 to 49.6)
Obese ($n = 4$)	935.0 (795.3 to 1074.7)	93.0 (73.6 to 112.4)	28.8 (14.4 to 43.2)	12.5 (1.1 to 23.9)	47.7 (44.1 to 51.3)
Total ($n = 100$)	963.8 (945.7 to 981.9)	96.1 (90.6 to 101.6)	24.5 (22.3 to 26.7)	12.1 (9.8 to 14.4)	49.5 (48.8 to 50.2)

Significance for linear trend for body composition divisions-ANOVA.

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

Table 4 Correlations between body composition (BMI z score, waist circumference) and $\text{VO}_{2\text{max}}$ with time in minutes spent sedentary, and in moderate, vigorous and hard activity

Variable	Moderate (min)	Hard (min)	Vigorous (min)	Sedentary (min)	$\text{VO}_{2\text{max}}$
BMI (z score)					
All	-0.14	-0.12	-0.06	0.05	-0.27**
Male	-0.42**	-0.17	-0.25	0.22	-0.43**
Female	0.07	-0.09	0.15	-0.06	-0.22**
Waist					
Male	-0.47**	-0.09	-0.31*	0.33*	-0.50**
Female	-0.01	-0.54	-0.07	-0.01	-0.33**
$\text{VO}_{2\text{max}}$					
All	-	0.21**	0.23**	-0.12	-
Male	-	0.26	0.22	-0.14	-
Female	-	-0.11	-0.10	-0.12	-

* $p < 0.05$, ** $p < 0.01$.

-, indicates no correlation analysis undertaken.

was evident (mean boys 562.88 kcal (512.5 to 613.3), girls 453.4 kcal (424.8 to 481.96) ($p < 0.0001$).

Table 4 presents the correlations and level of significance between body composition (BMI as measured by z score and waist circumference), fitness and minutes spent in sedentary, light, moderate, vigorous and hard physical activity. The results suggest that there were significant positive correlations between waist circumference and time spent sedentary in boys ($p < 0.05$), and time in both hard ($p < 0.01$) and vigorous activity ($p < 0.01$) and $\text{VO}_{2\text{max}}$ in both genders. Significant negative correlations were found between time in vigorous activity and waist circumference in boys ($p < 0.05$), but not girls, and this difference was found to be significant ($p < 0.05$). There were significant inverse correlations between $\text{VO}_{2\text{max}}$ and waist circumference ($p < 0.01$) and between $\text{VO}_{2\text{max}}$ and BMI ($p < 0.01$) in both boys and girls.

Table 5 gives the regression coefficients from multiple regression analyses for various dependent variables. These include cardiorespiratory fitness, energy expended in physical activity, time in the following: moderate/vigorous activity, vigorous activity and sedentary. In all cases the model included age, gender, BMI z score and waist circumference adjustments.

DISCUSSION

Objective measurement of physical activity using the RT3 permitted measurement of the time spent in different intensities of activity as well as time spent sedentary in a large random sample of subjects. To the authors' knowledge this is the first study to investigate the relationship between time spent in various intensities of activity and body composition and fitness in children.

Body composition

The children in this study were compared with 1990 British growth references.¹⁸ When height was compared with these

standards it was found that 48% of subjects were above the 75th centile. It would therefore seem that the present British Growth Standards, which are 15 years old, may underestimate height, and this conclusion is supported by other data from a UK study.²⁷

Of the 224 children, 46 (20.5%) were found to be overweight and 14 (6.3%) were obese by BMI criteria. These figures are slightly higher than those for children of the same age in Poland and France, where 15.4% of children were overweight and 3.6% were obese and 18.1% were overweight and 3.8% obese, respectively.²⁸ A recent publication from the 1970 British birth cohort study found that 4.3% of 10-year-olds were obese in 1980 and 16.3% of 30-year-olds were obese in 2000.²⁹ Evidence from this study suggests that use in children of the BMI as the sole identifier may substantially underestimate the incidence of overweight. However, the measure was necessary in order to categorise subjects as of normal weight, overweight or obese. Although 31% of the subjects in this study, had a BMI above the 75th centile, 76% had a waist circumference above the 75th centile.

Physical activity and inactivity

The results show that boys engaged in a mean of 64.3 minutes of hard/vigorous activity each day, whereas the mean time spent in such activity in girls was 37 minutes each day. Boys were found to spend more time in moderate and vigorous activity than girls, but there was no difference between the sexes in the time spent in hard activity or time spent sedentary. It is difficult to compare directly these findings with those of other studies owing to differences in the method of measurement of physical activity, but previous investigations have also found that girls perform less overall and vigorous activity than boys.³⁰⁻³¹ Although an examination of any difference in physical activity between weekdays and weekend days was not an

Table 5 Multiple regression analysis for various models adjusting for age, gender, BMI and waist circumference

Model	Age	Gender	BMI (z score)	Waist (cm)
Cardiorespiratory fitness	-0.17	-3.82 (0.5)***	-1.12 (0.2)***	0.22 (0.04)***
Energy expended in physical activity	-01.12 (0.2)***	-108.3 (25)***	50.4 (10.1)***	7.3 (1.8)***
Time in moderate/vigorous activity	-8.7 (7.9)	-42.7 (8.5)***	-3.8 (3.3)	-1.1 (0.6)*
Time in vigorous activity (log)	-0.12 (0.1)	0.5 (0.1)***	-0.02 (0)	-0.01 (0.01)
Time sedentary	30.6 (14.5)*	-32.4 (15.6)*	2.95 (6.1)	1.3 (1.1)

Non-standardised B coefficient (SE) and level of significance where applicable.

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

What is known about the topic

Few studies have investigated the influence of the time spent in specific intensities of activity on body composition in children.

What this study adds

- The time spent in specific intensities of activity is related to BMI and waist circumference in boys but not in girls.
- In both genders fitness was related to body composition.

objective of the study, it was found that there was no significant difference in energy expenditure at these times.

The examination of body composition and time spent in vigorous activity yielded interesting results. In boys there was a significant difference between the three divisions of body composition (normal, overweight and obese) and time spent in vigorous activity, and a negative correlation between BMI and time spent in moderate activity. In girls, by contrast, there was no significant relationship between body composition and activity measures. This result is similar to a study in a younger age group, in which overweight boys were significantly less active than normal weight boys, but no differences were seen in girls.¹³

The relationship between waist circumference and activity also demonstrated gender differences. There were significant negative correlations between waist circumference and minutes spent in vigorous activity and moderate activity in boys but not in girls. Furthermore, a significant positive correlation between waist circumference and time spent sedentary was seen in boys only. In this context, it is of interest that Rush *et al* found that physical activity was inversely correlated with body fat in boys ($r = -0.43$, $p = 0.006$) but not in girls.¹⁴

Physical fitness and body composition

Physical fitness was higher overall in boys than girls, and in boys there was a significant difference between the three divisions of body composition and fitness. BMI z scores were negatively correlated with fitness in both genders, as was waist circumference and fitness. There were significant correlations between time spent in hard or vigorous activity and fitness in both boys and girls.

Clinical implications of the findings

One of the clinical implications of these findings is that BMI alone has limitations for assessing overweight and that relatively simple measures such as waist circumference, and perhaps fitness, may give a clearer picture of health risk. Janssen *et al* have provided additional evidence that a combination of BMI and waist circumference needs to be used to measure the presence of cardiovascular risk in children and adolescents.³² The high incidence of excessive waist circumference that was found in both genders is of concern because central fat carries a risk of metabolic consequences.³³ As fitness is related to body composition in both genders, regular assessment of fitness of individual boys and girls should be encouraged in schools. Recent studies reported that fit but obese children had similar levels of inflammatory measures as lean unfit children³⁴ and that fitness was inversely correlated with the proinflammatory marker C reactive protein in boys but not in girls.³⁵ This finding, together with the evidence from our study, suggests that the effects of activity on body composition differ between girls and boys.

The findings in relation to the amount of time spent in at least moderate intensity activity (boys greater than 114.3 minutes and girls greater than 96.6 minutes each day) in children of normal weight may be considered in light of recent work by Tudor-Locke *et al*.³⁶ The aim of the latter study was to establish preliminary criterion referenced standards for physical activity in children related to healthy BMI (as indicated by international cut-off points) and their results suggest that 120 minutes of activity each day for girls and 150 minutes of activity each day for boys are needed.

Limitations

Despite the value of accelerometers for the objective measurement of physical activity in children the high failure rate that occurred in this study emphasises the vulnerability of these units to subject interference and children forgetting to wear the device. It might be argued that the need for parental agreement and consent might have also led to bias, with those parents more committed to physical activity agreeing to their child's participation. This is a limitation to any such study. A further limitation may be the use of the specific cut-off points for the definition of each activity intensity. However, although each band contains a large range of movement counts it does permit some classification of activity, which cannot be done with other physical activity measures.

CONCLUSION

Boys were found to take part in more than one hour of vigorous/hard daily physical activity, whereas girls spent about half this time. However, while the time spent in various intensities of activity correlated with markers of body composition in boys, no such correlation was seen in girls. Significant correlations were found between time spent in hard or vigorous activity and fitness in both boys and girls. The evidence for a different relationship between body composition and activity components in girls and boys requires further investigation.

ACKNOWLEDGEMENTS

We acknowledge the interest and support of all the schools, principals, teachers, parents, and children involved in this study.

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Figure 1 Christopher Bladin.