

# Contribution of Primary School Physical Education to Health Enhancing Physical Activity

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## *Abstract*

**Objectives:** To assess the contribution of primary school physical education (PE) to current physical activity (PA) targets in 9-year old Irish children from the greater Belfast and Limerick areas.

**Methods:** 267 (115 M) children had their PA assessed on two weekdays using an Actigraph GT3X accelerometer. On one day the children had PE, while on the other they did not. The order of the PE day non-PE day was randomised. Accelerometer PA data was converted to minutes of moderate and vigorous PA (MVPA) using the methods of Mattocks et al (2007). Standard anthropometric data (ht, wgt, skin-fold thickness) were collected from the children.

**Results:** All results mean, 95% CI. Children took more minutes of MVPA on PE days (38.6, 36.3-40.9), than non-PE days (27.7, 25.2-30.1). Boys accumulated more minutes MVPA than girls on both PE days (43.9, 40.0-47.9, versus 34.5, 31.9-37.0) and non-PE days (30.9, 26.4-35.5, versus 25.1, 22.5-27.8). Northern children accumulated more minutes of MVPA than Southern children on both PE (44.0, 40.4-47.5, versus 31.1, 29.2-33.1) and non-PE days (32.6, 28.7-36.5, versus 20.8, 18.9-22.8). PE days were associated with 10.9 (8.4-13.5) more minutes of MVPA than non-PE days. The difference in MVPA on PE days compared to non-PE days was greater for boys than girls (13.0, 8.2-17.7, versus 9.3, 6.6-12.0). 68 % and 56% of Northern males and 14% and 10% of Northern females fulfilled the current PA recommendations (60 mins MVPA per day) on PE and non-PE days respectfully. None of the Southern children studied fulfilled current PA recommendations.

**Conclusions:** PE makes a significant contribution to the daily MVPA of children. A large proportion of the children studied do not take sufficient MVPA according to current recommended levels for health.

## *Introduction*

This study was initiated to explore the contribution of physical education to health enhancing physical activity (PA) in the context of primary schools in the greater Belfast and Limerick areas.

There is a well developed field of literature on the links between children's PA levels and risk factors for developing chronic diseases in adulthood (Boreham et al, 1997) and there is general agreement that PA is an important aspect of children's lives for optimum health (Dept of Health, 2004). What is less clear is the contribution of school PE to current PA guidelines, with some US reports suggesting that children are physically active for around 8.5% of time spent in PE classes (Simons-Morton et al, 1993). This is in spite of the widespread assumption that PE is an important factor in attaining PA recommendations for children (Dept of Health, 2004). In part, the

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limited data on the contribution of primary school PE to children's PA may be due to the well documented difficulties in obtaining adequately precise measures of children's PA as a consequence of children's sporadic intermittent activity patterns coupled to limitations in children's ability to accurately recall patterns of PA (Freedson et al, 2005, Rowlands and Easton 2007). To a major extent these issues have been overcome with the development of accelerometers to assess children's PA. Accelerometers are small, lightweight devices which continuously monitor and quantify movements children undertake using preset sampling epochs. The most widely used accelerometer for PA monitoring, the Actigraph (Actigraph, Pensacola, Florida), has been extensively validated in both adults (Welk et al, 2007) and children (Ekelund et al 2001, Mattocks et al, 2007, Sirard and Pate 2001). The current study was initiated to provide objective data on the levels of physical activity children attain during week days with and without PE using Actigraph accelerometers.

## ***Methodology***

The purpose of the present study was to provide an objective measurement of the levels and patterns of physical activity among primary eight to ten year old children using accelerometers and from this data to explore the contribution that P.E. makes towards daily physical activity levels.

### **Research Design**

The present study was conducted in Limerick during November and December 2009 and in the greater Belfast area from February to April 2010. Ethical approval for the study was obtained from Stranmillis University College Research and Ethics Committee.

### **Participants**

12 primary schools from Limerick and greater Belfast were selected to participate in the study with a target of assessing 150 children from each jurisdiction. The parents of all children who participated in the study gave informed consent for their child to participate, in addition the children were asked for their verbal assent to participate.

### **Anthropometric Measures**

Anthropometric measures were employed to collect information on children's height, weight, body mass index (BMI) and sum of skin-folds in accordance with recommended procedures (Franklin 1995), before children were fitted with an accelerometer.

Height was measured to the nearest 0.1cm using a Leicester Height Measure. Body weight was measured in socks and normal clothing using portable electronic scales (Seca) to the nearest 0.1kg. This information was used to calculate body mass index (BMI). As children are still growing adult cut points for normal weight, overweight and obesity are inappropriate. To control this BMI scores were converted to age and gender specific standard deviation scores (Cole et al 2000).

Skin-fold thickness was measured to the nearest 0.1cm using specialist callipers (Harpender Skin-fold Calliper) on the left side of the body at four sites: mid-biceps, mid-triceps, sub-scapular and suprailiac in accordance with recommended procedures

(Lohman et al 1988). Skin-fold measurements were carried out twice to ensure reliability and accuracy (Ekelund et al 2001). The average of the two measurements was used.

### **Assessment of physical activity**

Children had their physical activity levels monitored using the uni-axial Actigraph (GT3X). These have been shown to be valid and reliable methods of measuring physical activity levels in children (Ekelund et al 2001, Sirard and Pate 2001). An Actigraph is a small (4.5 x 3.5 x 1.0 cm), unobtrusive, lightweight (43 g) accelerometer that allows data on the frequency, duration and intensity of activity to be collected (McClain et al 2008, Trost et al 2005 and Freedson et al 2005).

Children and parents/guardians were given verbal and written instructions on how to use the Actigraph correctly and complete the record sheet which recorded times when the device was put on and taken off and the reasons for doing so. This helped to increase reliability and identify any periods of inactivity during the day.

Children wore the Actigraph on an elasticated band on the right hip for a minimum of two consecutive days during waking hours (except when swimming or washing) with a minimum wear time of 12 hours. The Actigraph was set for each individual as instructed by the manufacturer and was programmed to collect data using 1 second epochs due to the typically sporadic and intermittent nature of children's activity, usually consisting of frequent, short bouts of high intensity (Stone et al 2009). Additionally, previous research has shown shorter epochs to give a more accurate assessment of PA in children (McClain et al, 2008).

The intensity of the activity was categorised using counts which were averaged over the defined epoch (1 second). Activity count threshold values were used to determine the amount of time children spent engaged in light, moderate and vigorous activity. Values selected were taken from Mattocks et al (2007) with the following thresholds used for accelerometer count output: < 200 sedentary; 200-3599 light; 3600-6199 moderate, 6200+ vigorous.

Half of the children had their physical activity levels monitored on a non-P.E. day first followed by a P.E. day, whilst the other half had theirs monitored on a P.E. day first followed by a non-P.E.

Teachers received guidance notes and were asked to get the children to put a note in their homework books to remind them to wear the Actigraph for the entire day, complete the record sheet and return the Actigraph at the end of the two days.

### **Data Analysis**

Minutes of time children spent in moderate and vigorous PA (MVPA) were compared on PE and non PE days for the whole group, for males and females and for children North and South.

## Results

315 children (147 Southern, 168 Northern) completed the survey. Of these, 267 (112 Southern, 155 Northern) provided valid PA data. 57% of the children were female. Anthropometric data for the children is present in table 1.0. The mean (95% CI) age of the children was 9.4 (9.3-9.5) years. The main reason for the reduction in Southern children providing valid data was one school not undertaking any PE during the survey week due to adverse weather conditions. The other dropouts were a combination of non-compliance by the children (not wearing the device for sufficient time) or accelerometer malfunction.

Table 1.0 displays mean (95% CI) for height, weight, BMI and sum of skin-folds for the total group, males and females, and children from the North and South. With the exception of sum of skin folds the children from North and South are broadly similar in terms of physical characteristics.

	Ht (cm)	Weight (kg)	BMI (Kg/m <sup>2</sup> )	Sum of Skin-folds (mm)
<b>Total Group (N=267)</b>	136.5 (135.6-137.4)	33.9 (32.9-34.9)	18.1 (17.7-18.5)	35.7 (33.3-35.7)
<b>Males (N=115)</b>	137.2 (135.9-138.5)	34.5 (32.9-36.1)	18.3 (17.7-19.0)	34.6 (31.0-38.3)
<b>Females (N=152)</b>	136.0 (134.8-137.2)	33.5 (32.2-34.7)	17.9 (17.5-18.4)	36.6 (33.4-39.7)
<b>North (155)</b>	137.6 (136.4-138.8)	34.0 (32.8-35.3)	17.9 (17.4-18.4)	29.8 (27.7-32.0)
<b>South (112)</b>	135.3 (134.0-136.6)	33.8 (32.1-35.4)	18.3 (17.6-18.9)	42.8 (38.7-46.9)
<b>Northern Males (N= 74)</b>	138.6 (136.8-140.5)	34.8 (3.0-36.7)	18.1 (17.2-18.9)	29.7 (26.3-33.1)
<b>Southern Males (N= 42)</b>	135.3 (133.5-137.1)	34.0 (31.1-37.0)	18.4 (17.2-19.6)	41.4 (34.5-48.4)
<b>Northern Females (N= 81)</b>	136.7 (135.0-138.4)	33.3 (31.6-35.0)	17.7 (17.0-18.4)	29.9 (27.1-32.8)
<b>Southern Females (N=70)</b>	135.3 (133.5-137.1)	33.6 (31.6-35.6)	18.2 (17.4-19.0)	43.6 (38.4-48.9)

Table 1.0. Mean (95% CI) anthropometric data for children in the current study.

### Children's PA levels

Table 1.1 displays mean (95% CI) for PA on PE and non PE days together with the difference between the two days for the total group, males and females and children from the North and South.

	Minutes of MVPA		
	PE Day	Non PE Day	Difference between PE and non-PE
<b>Total Group (N=267)</b>	38.6 (36.3-40.9)	27.7 (25.2-30.1)	10.9 (8.4-13.5)
<b>Males (N=115)</b>	43.9 (40.0-47.9)	30.9 (26.4-35.5)	13.0 (8.2-17.7)
<b>Females (N=152)</b>	34.5 (31.9-37.0)	25.1 (22.5-27.8)	9.3 (6.6-12.0)
<b>North (155)</b>	44.0 (40.4-47.5)	32.6 (28.7-36.5)	11.4 (7.3-15.5)
<b>South (112)</b>	31.1 (29.2-33.1)	20.8 (18.9-22.8)	10.3 (8.0-12.6)
<b>Northern Males (N= 74)</b>	49.8 (44.1-55.5)	36.1 (29.6-42.5)	13.7 (6.7-20.7)
<b>Southern Males (N= 42)</b>	33.7 (31.1-36.3)	21.9 (17.8-26.1)	11.7 (7.0-16.4)
<b>Northern Females (N= 81)</b>	38.7 (34.6-42.7)	29.4 (25.0-33.9)	9.2 (4.6-13.9)
<b>Southern Females (N=70)</b>	29.6 (26.9-32.3)	20.2 (18.1-22.3)	9.4 (7.0-11.8)

Table 1.1. Mean (95% CI) minutes of MVPA on school days with and without PE.

Table 1.0 illustrates that children accumulate more MVPA on school days with PE compared to non-PE days. On both days boys are more active than girls and boys experience a larger increase in MVPA on PE days. Children in the North accumulate more MVPA than children in the South on both PE and non-PE days, though the difference between the two days are broadly similar for the two genders North and South. The difference in children's MVPA North and South of the boarder may be related to differences in the ages of the children. The children in the North were older (9.9 (9.8-9.9) versus 8.9 (8.8-9.0) years). The children in the current study accumulated more MVPA than a large scale prospective English study which employed the same methods to assess PA (Riddoch et al, 2007). Riddoch et al (2007) reported 11 year old children to accumulate 20 mins (males 25, females 16 mins) MVPA per day.

The modest increase in MVPA on PE days (circa 11 minutes) should be seen in the context of the daily target for MVPA for children of 60 minutes (Dept of Health, 2004) and the mean duration of PE lessons in the current study of 34.7 (33.8-35.7) minutes. That teachers achieve MVPA for approximately one third of the total PE time is probably realistic given that the lesson time includes time for changing and instruction/ organisation. It is of interest that the children do not compensate for the additional MVPA associated with PE by displacing MVPA which normally occurs during other times of the day. This is in contrast to the work of Mallam et al (2003) who suggested increasing the participation of children in PA during school displaced PA which occurred at other times.

### Percentage of Children achieving current PA recommendations for health on PE and non-PE days

Figure 1.0 (below) shows the percentage of children achieving 60 minutes of MVPA on PE and non-PE days.

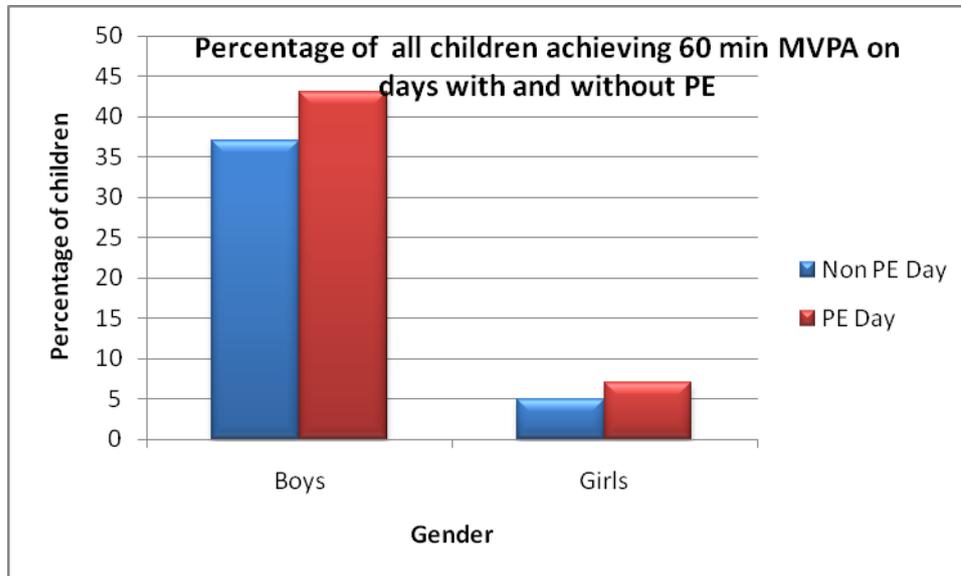


Fig 1.0. Percentages of all children (N=267, 115 males) accumulating 60 mins of MVPA per day

Figure 1.1 (below) shows the percentage of Northern children achieving 60 minutes of MVPA on PE and non-PE days.

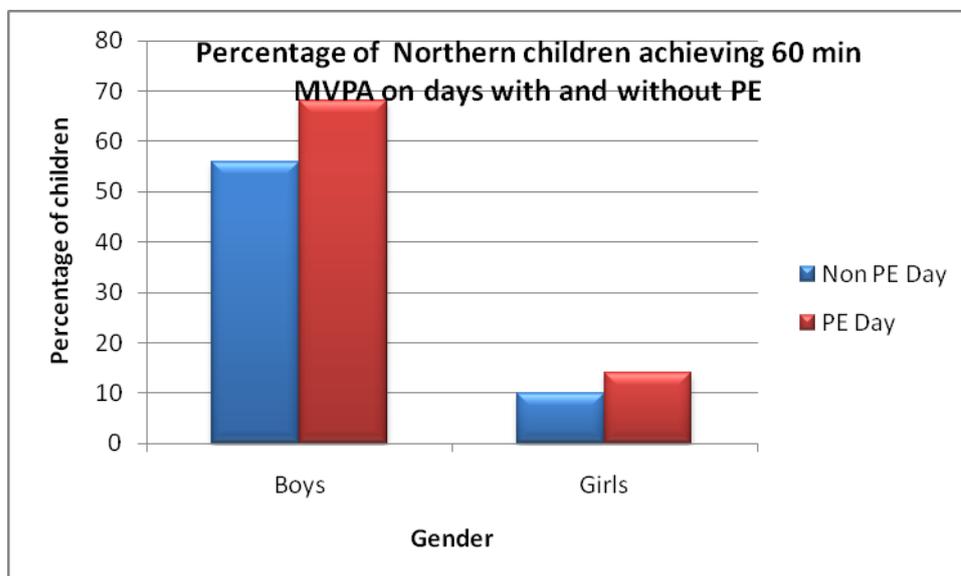


Fig 1.1. Percentages of Northern children (N=155, 74 male) accumulating 60 mins of MVPA per day

None of the Southern children accumulated 60 mins of PA on either a normal school day or on a school day with PE.

The proportion of Northern children fulfilling the current PA recommendation is considerably higher than the 2.5, 5.1 and 0.4 percent reported by Riddoch et al (2007) for all children, males and females, though lower than those reported by Stratton et al (2009). Riddoch et al (2007) values for the number of children achieving current PA recommendations are broadly similar to the values reported here for Southern children.

There was a modest relationship between MVPA on PE days and the sum of skin-fold thicknesses ( $r= 0.196$ ,  $p=0.004$ ) this is in keeping with the literature which shows a modest relationship between PA and indices of body fatness in children (Ekelund et al 2004, Riddoch et al 2009)

### **Influence of PE lesson context on MVPA**

Initial analysis indicates no relationship between lesson context (teacher training, school facilities, activity taught, lesson duration) and observed MVPA.

### ***Conclusion***

Primary school PE contributed around 10 additional minutes to children's week-day MVPA or 17% of the current recommendations for health enhancing PA in this age group. This increased level of MVPA appeared to be independent of gender and geographical location. In terms of total volume of accumulated MVPA, boys were more active than girls and children from the North were more active than children from the South. The numbers of children fulfilling current recommendations for health enhancing PA showed a minority of the children studied (37% of males, 5 % females) accumulated 60 mins of MVPA on non-PE days, with 43% of males and 7% of females achieving the target on PE days. A greater proportion of Northern children achieved the 60 min target (28% of children on non-PE days and 35% of children on PE days) compared to the Southern children (0% on either day).

### ***Limitations***

Children's PA was only assessed on two days and therefore may not be fully representative of children's normal activity patterns. Teachers and pupils were informed of the aims of the project and may therefore have amended their behaviour for the duration of the monitoring period. Accelerometers, whilst valid measures of PA, have limitations in that they are incapable of assessing non-ambulatory upper-body movement and the output has been shown to plateau at high ambulatory speeds in adults (Brage et al 2003). The children from the Limerick area were on average one year younger and had higher skin-fold thickness than their Northern counterparts. The influence of these factors on the observed MVPA levels is unknown.

### ***Acknowledgements***

The authors wish to express their sincere gratitude to the Standing Conference on Teacher Education North and South (SCoTENS) for the funding which made this project possible and to acknowledge the patience and flexibility afforded to the project by SCoTENS. We are extremely grateful to all the families and teachers who took the time to participate in this study and to Ruth Hill and Deirdre Harrington who assisted in the data collection.

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