

‘Physical education makes you fit and healthy’. Physical education’s contribution to young people’s physical activity levels

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Abstract

The purpose of this study was to assess physical activity levels during high school physical education lessons. The data were considered in relation to recommended levels of physical activity to ascertain whether or not physical education can be effective in helping young people meet health-related goals. Sixty-two boys and 60 girls (aged 11–14 years) wore heart rate telemeters during physical education lessons. Percentages of lesson time spent in moderate-and-vigorous (MVPA) and vigorous intensity physical activity (VPA) were recorded for each student. Students engaged in MVPA and VPA for 34.3 ± 21.8 and $8.3 \pm 11.1\%$ of lesson time, respectively. This equated to 17.5 ± 12.9 (MVPA) and 3.9 ± 5.3 (VPA) min. Boys participated in MVPA for $39.4 \pm 19.1\%$ of lesson time compared to the girls ($29.1 \pm 23.4\%$; $P < 0.01$). High-ability students were more active than the average- and low-ability students. Students participated in most MVPA during team games ($43.2 \pm 19.5\%$; $P < 0.01$), while the least MVPA was observed during movement activities ($22.2 \pm 20.0\%$). Physical education may make a more significant contribution to young people’s regular physical ac-

tivity participation if lessons are planned and delivered with MVPA goals in mind.

Introduction

Regular physical activity participation throughout childhood provides immediate health benefits, by positively effecting body composition and musculo-skeletal development (Malina and Bouchard, 1991), and reducing the presence of coronary heart disease risk factors (Gutin *et al.*, 1994). In recognition of these health benefits, physical activity guidelines for children and youth have been developed by the Health Education Authority [now Health Development Agency (HDA)] (Biddle *et al.*, 1998). The primary recommendation advocates the accumulation of 1 hour’s physical activity per day of at least moderate intensity (i.e. the equivalent of brisk walking), through lifestyle, recreational and structured activity forms. A secondary recommendation is that children take part in activities that help develop and maintain musculo-skeletal health, on at least two occasions per week (Biddle *et al.*, 1998). This target may be addressed through weight-bearing activities that focus on developing muscular strength, endurance and flexibility, and bone health.

School physical education (PE) provides a context for regular and structured physical activity participation. To this end a common justification for PE’s place in the school curriculum is that it contributes to children’s health and fitness (Physical Education Association of the United Kingdom, 2004; Zeigler, 1994). The extent to which this rationale is accurate is arguable (Koslow, 1988;

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Michaud and Andres, 1990) and has seldom been tested. However, there would appear to be some truth in the supposition because PE is commonly highlighted as a significant contributor to help young people achieve their daily volume of physical activity (Biddle *et al.*, 1998; Corbin and Pangrazi, 1998). The important role that PE has in promoting health-enhancing physical activity is exemplified in the US 'Health of the Nation' targets. These include three PE-associated objectives, two of which relate to increasing the number of schools providing and students participating in daily PE classes. The third objective is to improve the number of students who are engaged in beneficial physical activity for at least 50% of lesson time (US Department of Health and Human Services, 2000). However, research evidence suggests that this criterion is somewhat ambitious and, as a consequence, is rarely achieved during regular PE lessons (Stratton, 1997; US Department of Health and Human Services, 2000; Levin *et al.*, 2001; Fairclough, 2003a).

The potential difficulties of achieving such a target are associated with the diverse aims of PE. These aims are commonly accepted by physical educators throughout the world (International Council of Sport Science and Physical Education, 1999), although their interpretation, emphasis and evaluation may differ between countries. According to Simons-Morton (Simons-Morton, 1994), PE's overarching goals should be (1) for students to take part in appropriate amounts of physical activity during lessons, and (2) become educated with the knowledge and skills to be physically active outside school and throughout life. The emphasis of learning during PE might legitimately focus on motor, cognitive, social, spiritual, cultural or moral development (Sallis and McKenzie, 1991; Department for Education and Employment/Qualifications and Curriculum Authority, 1999). These aspects may help cultivate students' behavioural and personal skills to enable them to become lifelong physical activity participants [(thus meeting PE goal number 2 (Simons-Morton, 1994)]. However, to achieve this, these aspects should be delivered within a curriculum which provides a

diverse range of physical activity experiences so students can make informed decisions about which ones they enjoy and feel competent at. However, evidence suggests that team sports dominate English PE curricula, yet bear limited relation to the activities that young people participate in, out of school and after compulsory education (Sport England, 2001; Fairclough *et al.*, 2002). In order to promote life-long physical activity a broader base of PE activities needs to be offered to reinforce the fact that it is not necessary for young people to be talented sportspeople to be active and healthy.

While motor, cognitive, social, spiritual, cultural and moral development are valid areas of learning, they can be inconsistent with maximizing participation in health-enhancing physical activity [i.e. PE goal number 1 (Simons-Morton, 1994)]. There is no guidance within the English National Curriculum for PE [NCPE (Department for Education and Employment/Qualifications and Curriculum Authority, 1999)] to inform teachers how they might best work towards achieving this goal. Moreover, it is possible that the lack of policy, curriculum development or teacher expertise in this area contributes to the considerable variation in physical activity levels during PE (Stratton, 1996a). However, objective research evidence suggests that this is mainly due to differences in pedagogical variables [i.e. class size, available space, organizational strategies, teaching approaches, lesson content, etc. (Borys, 1983; Stratton, 1996a)]. Furthermore, PE activity participation may be influenced by inter-individual factors. For example, activity has been reported to be lower among students with greater body mass and body fat (Brooke *et al.*, 1975; Fairclough, 2003c), and higher as students get older (Seliger *et al.*, 1980). In addition, highly skilled students are generally more active than their lesser skilled peers (Li and Dunham, 1993; Stratton, 1996b) and boys tend to engage in more PE activity than girls (Stratton, 1996b; McKenzie *et al.*, 2000). Such inter-individual factors are likely to have significant implications for pedagogical practice and therefore warrant further investigation.

In accordance with Simons-Morton's (Simons-Morton, 1994) first proposed aim of PE, the

purpose of this study was to assess English students' physical activity levels during high school PE. The data were considered in relation to recommended levels of physical activity (Biddle *et al.*, 1998) to ascertain whether or not PE can be effective in helping children be 'fit and healthy'. Specific attention was paid to differences between sex and ability groups, as well as during different PE activities.

Method

Subjects and settings

One hundred and twenty-two students (62 boys and 60 girls) from five state high schools in Merseyside, England participated in this study. Stage sampling was used in each school to randomly select one boys' and one girls' PE class, in each of Years 7 (11–12 years), 8 (12–13 years) and 9 (13–14 years). Three students per class were randomly selected to take part. These students were categorized as 'high', 'average' and 'low' ability, based on their PE teachers' evaluation of their competence in specific PE activities. Written informed consent was completed prior to the study commencing. The schools taught the statutory programmes of study detailed in the NCPE, which is organized into six activity areas (i.e. athletic activities, dance, games, gymnastic activities, outdoor activities and swimming). The focus of learning is through four distinct aspects of knowledge, skills and understanding, which relate to; skill acquisition, skill application, evaluation of performance, and knowledge and understanding of fitness and health (Department for Education and Employment/Qualifications and Curriculum Authority, 1999). The students attended two weekly PE classes in mixed ability, single-sex groups. Girls and boys were taught by male and female specialist physical educators, respectively.

Instruments and procedures

The investigation received ethical approval from the Liverpool John Moores Research Degrees Ethics Committee. The study involved the monitoring of heart rates (HRs) during PE using short-

range radio telemetry (Vantage XL; Polar Electro, Kempele, Finland). Such systems measure the physiological load on the participants' cardiorespiratory systems, and allow analysis of the frequency, duration and intensity of physical activity. HR telemetry has been shown to be a valid and reliable measure of young people's physical activity (Freedson and Miller, 2000) and has been used extensively in PE settings (Stratton, 1996a).

The students were fitted with the HR telemeters while changing into their PE uniforms. HR was recorded once every 5 s for the duration of the lessons. Telemeters were set to record when the teachers officially began the lessons, and stopped at the end of lessons. Total lesson 'activity' time was the equivalent of the total recorded time on the HR receiver. At the end of the lessons the telemeters were removed and data were downloaded for analyses. Resting HRs were obtained on non-PE days while the students lay in a supine position for a period of 10 min. The lowest mean value obtained over 1 min represented resting HR. Students achieved maximum HR values following completion of the Balke treadmill test to assess cardiorespiratory fitness (Rowland, 1993). This data was not used in the present study, but was collated for another investigation assessing children's health and fitness status. Using the resting and maximum HR values, HR reserve (HRR, i.e. the difference between resting and maximum HR) at the 50% threshold was calculated for each student. HRR accounts for age and gender HR differences, and is recommended when using HR to assess physical activity in children (Stratton, 1996a). The 50% HRR threshold represents moderate intensity physical activity (Stratton, 1996a), which is the minimal intensity required to contribute to the recommended volume of health-related activity (Biddle *et al.*, 1998). Percentage of lesson time spent in health enhancing moderate-and-vigorous physical activity (MVPA) was calculated for each student by summing the time spent $\geq 50\%$ HRR threshold. HRR values $\geq 75\%$ corresponded to vigorous intensity physical activity (VPA). This threshold represents the intensity that may stimulate improvements in cardiorespiratory fitness (Morrow and Freedson, 1994).

and was used to indicate the proportion of lesson time that students were active at this higher level.

Design

Sixty-six lessons were monitored over a 12-week period, covering a variety of group and individual activities (Table I). In order to allow statistically meaningful comparisons between different types of activities, students were classified as participants in activities that shared similar characteristics. These were, team games [i.e. invasion (e.g. football and hockey) and striking games (e.g. cricket and softball)], individual games (e.g. badminton, tennis and table tennis), movement activities (e.g. dance and gymnastics) and individual activities [e.g. athletics, fitness (circuit training and running activities) and swimming]. The intention was to monitor equal numbers of students during lessons in each of the four designated PE activity categories. However, timetable constraints and student absence meant that true equity was not possible, and so the number of boys and girls monitored in the different activities was unequal.

Analyses

Student sex, ability level and PE activity category were the independent variables, with percent of lesson time spent in MVPA and VPA set as the dependent variables. Exploratory analyses were conducted to establish whether data met parametric assumptions. Shapiro–Wilk tests revealed that only boys' MVPA were normally distributed. Subsequent Levene's tests confirmed the data's homogeneity of variance, with the exception of VPA between the PE activities. Though much of the

data violated the assumption of normality, the ANOVA is considered to be robust enough to produce valid results in this situation (Vincent, 1999). Considering this, alongside the fact that the data had homogenous variability, it was decided to proceed with ANOVA for all analyses, with the exception of VPA between different PE activities.

Sex \times ability level factorial ANOVAs compared the physical activity of boys and girls who differed in PE competence. A one-way ANOVA was used to identify differences in MVPA during the PE activities. *Post-hoc* analyses were performed using Hochberg's GT2 correction procedure, which is recommended when sample sizes are unequal (Field, 2000). A non-parametric Kruskal–Wallis ANOVA calculated differences in VPA during the different activities. *Post-hoc* Mann–Whitney *U*-tests determined where identified differences occurred. To control for type 1 error the Bonferroni correction procedure was applied to these tests, which resulted in an acceptable α level of 0.008. Although these data were ranked for the purposes of the statistical analysis, they were presented as means \pm SD to allow comparison with the other results. All data were analyzed using SPSS version 11.0 (SPSS, Chicago, IL).

Results

The average duration of PE lessons was 50.6 ± 20.8 min, although girls' (52.6 ± 25.4 min) lessons generally lasted longer than boys' (48.7 ± 15.1 min). When all PE activities were considered together, students engaged in MVPA and VPA for 34.3 ± 21.8 and $8.3 \pm 11.1\%$ of PE time, respectively. This equated to 17.5 ± 12.9 (MVPA) and 3.9 ± 5.3 (VPA) min. The high-ability students were more active than the average- and low-ability students, who took part in similar amounts of activity. These trends were apparent in boys and girls (Table II).

Boys engaged in MVPA for $39.4\% \pm 19.1$ of lesson time compared to the girls' value of 29.1 ± 23.4 [$F(1, 122) = 7.2, P < 0.01$]. When expressed as absolute units of time, these data were the

Table I. Number and type of monitored PE lessons

PE activity category	No. of lessons		
	Boy	Girls	All students
Team games	15	7	22
Movement activities	3	13	16
Individual activities	7	10	17
Individual games	7	4	11
Total	32	34	66

Table II. Mean (\pm SD) MVPA and VPA of boys and girls of differing abilities

Sex	Ability	<i>n</i>	MVPA (% lesson)	VPA (% lesson)
Boys	high	22	49.9 \pm 19.8	13.2 \pm 13.5
	average	21	35.7 \pm 17.7	7.4 \pm 9.3
	low	19	39.3 \pm 20.0	10.1 \pm 10.5
	combined abilities	62	39.4 \pm 19.1 ^a	10.3 \pm 11.4 ^b
Girls	high	22	33.7 \pm 22.9	8.8 \pm 12.4
	average	18	25.5 \pm 23.2	3.3 \pm 7.5
	low	20	27.3 \pm 24.5	5.9 \pm 10.0
	combined abilities	60	29.1 \pm 23.4	6.2 \pm 10.4
Boys and girls	high	44	38.3 \pm 21.7	11.1 \pm 13.0
	average	39	31.0 \pm 20.8	5.5 \pm 8.7
	low	39	33.1 \pm 22.9	8.0 \pm 10.3
	combined abilities	122	34.3 \pm 21.8	8.3 \pm 11.1

^aBoys > girls, $P < 0.01$.^bBoys > girls, $P < 0.05$.

equivalent of 18.9 ± 10.5 (boys) and 16.1 ± 14.9 (girls) min. Furthermore, a 4% difference in VPA was observed between the two sexes [Table II; $F(1, 122) = 4.6$, $P < 0.05$]. There were no significant sex \times ability interactions for either MVPA or VPA.

Students participated in most MVPA during team games [$43.2 \pm 19.5\%$; $F(3, 121) = 6.0$, $P < 0.01$]. Individual games and individual activities provided a similar stimulus for activity, while the least MVPA was observed during movement activities ($22.2 \pm 20.0\%$; Figure 1). A smaller proportion of PE time was spent in VPA during all activities. Once more, team games ($13.6 \pm 11.3\%$) and individual activities ($11.8 \pm 14.0\%$) were best suited to promoting this higher intensity activity ($\chi^2(3) = 30.0$, $P < 0.01$). Students produced small amounts of VPA during individual and movement activities, although this varied considerably in the latter activity (Figure 2).

Discussion

This study used HR telemetry to assess physical activity levels during a range of high school PE lessons. The data were considered in relation to

recommended levels of physical activity (Biddle *et al.*, 1998) to investigate whether or not PE can be effective in helping children be 'fit and healthy'. Levels of MVPA were similar to those reported in previous studies (Klausen *et al.*, 1986; Strand and Reeder, 1993; Fairclough, 2003b) and did not meet the US Department of Health and Human Services (US Department of Health and Human Services, 2000) 50% of lesson time criterion. Furthermore, the data were subject to considerable variance, which was exemplified by high standard deviation values (Table II, and Figures 1 and 2). Such variation in activity levels reflects the influence of PE-specific contextual and pedagogical factors [i.e. lesson objectives, content, environment, teaching styles, etc. (Stratton, 1996a)]. The superior physical activity levels of the high-ability students concurred with previous findings (Li and Dunham, 1993; Stratton, 1996b). However, the low-ability students engaged in more MVPA and VPA than the average-ability group. While it is possible that the teachers may have inaccurately assessed the low and average students' competence, it could have been that the low-ability group displayed more effort, either because they were being monitored or because they associated effort with perceived ability (Lintunen, 1999). However, these suggestions are speculative and are not supported by the data. The differences in activity levels between the ability groups lend some support to the criticism that PE teachers sometimes teach the class as one and the same rather than planning for individual differences (Metzler, 1989). If this were the case then undifferentiated activities may have been beyond the capability of the lesser skilled students. This highlights the importance of motor competence as an enabling factor for physical activity participation. If a student is unable to perform the requisite motor skills to competently engage in a given task or activity, then their opportunities for meaningful participation become compromised (Rink, 1994). Over time this has serious consequences for the likelihood of a young person being able or motivated enough to get involved in physical activity which is dependent on a degree of fundamental motor competence.

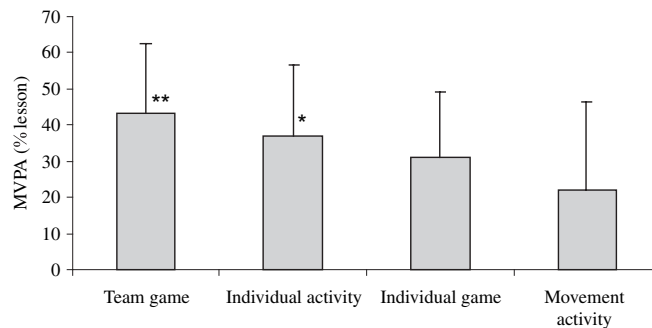


Fig. 1. Mean (\pm SD) MVPA during different PE activities. **Team games > movement activities ($P < 0.01$). *Individual activities > movement activities ($P < 0.05$).

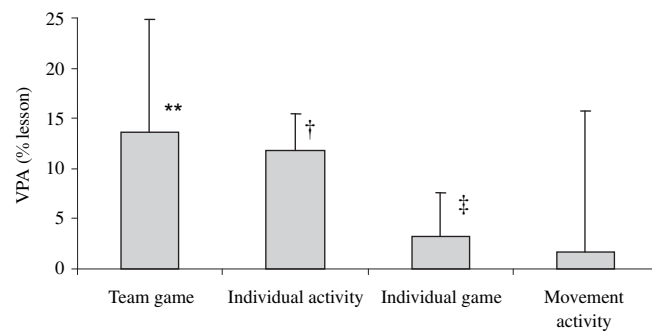


Fig. 2. Mean (\pm SD) VPA during different PE activities. **Team games > movement activities ($Z(3) = -4.9, P < 0.008$) and individual games ($Z(3) = -3.8, P < 0.008$). †Individual activities > movement activities ($Z(3) = -3.3, P < 0.008$). ‡Individual game > movement activities ($Z(3) = -2.7, P < 0.008$).

Boys spent a greater proportion of lesson time involved in MVPA and VPA than girls. These differences are supported by other HR studies in PE (Mota, 1994; Stratton, 1997). Boys' activity levels equated to 18.9 min of MVPA, compared to 16.1 min for the girls. It is possible that the characteristics and aims of some of the PE activities that the girls took part in did not predispose them to engage in whole body movement as much as the boys. Specifically, the girls participated in 10 more movement lessons and eight less team games lessons than the boys. The natures of these two activities are diverse, with whole body movement at differing speeds being the emphasis during team games, compared to aesthetic awareness and control during movement activities. The monitored lessons reflected typical boys' and girls' PE curricula, and the

fact that girls do more dance and gymnastics than boys inevitably restricts their MVPA engagement. Although unrecorded contextual factors may have contributed to this difference, it is also possible that the girls were less motivated than the boys to physically exert themselves. This view is supported by negative correlations reported between girls' PE enjoyment and MVPA (Fairclough, 2003b). Moreover, there is evidence (Dickenson and Sparkes, 1988; Goudas and Biddle, 1993) to suggest that some pupils, and girls in particular (Cockburn, 2001), may dislike overly exerting themselves during PE. Although physical activity is what makes PE unique from other school subjects, some girls may not see it as such an integral part of their PE experience. It is important that this perception is clearly recognized if lessons are to be seen as

enjoyable and relevant, whilst at the same time contributing meaningfully to physical activity levels. Girls tend to be habitually less active than boys and their levels of activity participation start to decline at an earlier age (Armstrong and Welsman, 1997). Therefore, the importance of PE for girls as a means of them experiencing regular health-enhancing physical activity cannot be understated.

Team games promoted the highest levels of MVPA and VPA. This concurs with data from previous investigations (Strand and Reeder, 1993; Stratton, 1996a, 1997; Fairclough, 2003a). Because these activities require the use of a significant proportion of muscle mass, the heart must maintain the oxygen demand by beating faster and increasing stroke volume. Moreover, as team games account for the majority of PE curriculum time (Fairclough and Stratton, 1997; Sport England, 2001), teachers may actually be more experienced and skilled at delivering quality lessons with minimal stationary waiting and instruction time. Similarly high levels of activity were observed during individual activities. With the exception of throwing and jumping themes during athletics lessons, the other individual activities (i.e. swimming, running, circuit/station work) involved simultaneous movement of the arms and legs over variable durations. MVPA and VPA were lowest during movement activities, which mirrored previous research involving dance and gymnastics (Stratton, 1997; Fairclough, 2003a). Furthermore, individual games provided less opportunity for activity than team games. The characteristics of movement activities and individual games respectively emphasize aesthetic appreciation and motor skill development. This can mean that opportunities to promote cardiorespiratory health may be less than in other activities. However, dance and gymnastics can develop flexibility, and muscular strength and endurance. Thus, these activities may be valuable to assist young people in meeting the HDA's secondary physical activity recommendation, which relates to musculo-skeletal health (Biddle *et al.*, 1998).

The question of whether PE can solely contribute to young people's cardiorespiratory fitness was clearly answered. The students engaged in small

amounts of VPA (4.5 and 3.3 min per lesson for boys and girls, respectively). Combined with the limited frequency of curricular PE, these were insufficient durations for gains in cardiorespiratory fitness to occur (Armstrong and Welsman, 1997). Teachers who aim to increase students' cardiorespiratory fitness may deliver lessons focused exclusively on high intensity exercise, which can effectively increase HR (Baquet *et al.*, 2002), but can sometimes be mundane and have questionable educational value. Such lessons may undermine other efforts to promote physical activity participation if they are not delivered within an enjoyable, educational and developmental context. It is clear that high intensity activity is not appropriate for all pupils, and so opportunities should be provided for them to be able to work at developmentally appropriate levels.

Students engaged in MVPA for around 18 min during the monitored PE lessons. This approximates a third of the recommended daily hour (Biddle *et al.*, 1998). When PE activity is combined with other forms of physical activity support is lent to the premise that PE lessons can directly benefit young people's health status. Furthermore, for the very least active children who should initially aim to achieve 30 min of activity per day (Biddle *et al.*, 1998), PE can provide the majority of this volume. However, a major limitation to PE's utility as a vehicle for physical activity participation is the limited time allocated to it. The government's aspiration is for all students to receive 2 hours of PE per week (Department for Education and Employment/Qualifications and Curriculum Authority, 1999), through curricular and extra-curricular activities. While some schools provide this volume of weekly PE, others are unable to achieve it (Sport England, 2001). The HDA recommend that young people strive to achieve 1 hour's physical activity each day through many forms, a prominent one of which is PE. The apparent disparity between recommended physical activity levels and limited curriculum PE time serves to highlight the complementary role that education, along with other agencies and voluntary organizations must play in providing young people with physical activity

opportunities. Notwithstanding this, increasing the amount of PE curriculum time in schools would be a positive step in enabling the subject to meet its health-related goals. Furthermore, increased PE at the expense of time in more 'academic' subjects has been shown not to negatively affect academic performance (Shephard, 1997; Sallis *et al.*, 1999; Dwyer *et al.*, 2001).

Physical educators are key personnel to help young people achieve physical activity goals. As well as their teaching role they are well placed to encourage out of school physical activity, help students become independent participants and inform them about initiatives in the community (McKenzie *et al.*, 2000). Also, they can have a direct impact by promoting increased opportunities for physical activity within the school context. These could include activities before school (Strand *et al.*, 1994), during recess (Scruggs *et al.*, 2003), as well as more organized extra-curricular activities at lunchtime and after school. Using time in this way would complement PE's role by providing physical activity opportunities in a less structured and pedagogically constrained manner.

This research measured student activity levels during 'typical', non-intensified PE lessons. In this sense it provided a representative picture of the frequency, intensity and duration of students' physical activity engagement during curricular PE. However, some factors should be considered when interpreting the findings. First, the data were cross-sectional and collected over a relatively short time frame. Tracking students' activity levels over a number of PE activities may have allowed a more accurate account of how physical activity varies in different aspects of the curriculum. Second, monitoring a larger sample of students over more lessons may have enabled PE activities to be categorized into more homogenous groups. Third, monitoring lessons in schools from a wider geographical area may have enabled stronger generalization of the results. Fourth, it is possible that the PE lessons were taught differently, and that the students acted differently as a result of being monitored and having the researchers present during lessons. As this is impossible to determine, it is unknown how this

might have affected the results. Fifth, HR telemetry does not provide any contextual information about the monitored lessons. Also, HR is subject to emotional and environmental factors when no physical activity is occurring. Future work should combine objective physical activity measurement with qualitative or quantitative methods of observation.

During PE, students took part in health-enhancing activity for around one third of the recommended 1-hour target (Biddle *et al.*, 1998). PE obviously has potential to help meet this goal. However, on the basis of these data, combined with the weekly frequency of PE lessons, it is clear that PE can only do so much in supplementing young people's daily volume of physical activity. Students need to be taught appropriate skills, knowledge and understanding if they are to optimize their physical activity opportunities in PE. For improved MVPA levels to occur, health-enhancing activity needs to be recognized as an important element of lessons. PE may make a more significant contribution to young people's regular physical activity participation if lessons are planned and delivered with MVPA goals in mind.

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