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Effect of Physical Education on Health

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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.

Keywords: physical activity, valproic acid, education, physical, high schools

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; 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.

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 ≥50% HRR threshold. HRR values ≥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.

Table-1

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

Number and type of monitored PE lessons

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.

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 ± 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).**

Table II.

Mean (±SD) MVPA and VPA of boys and girls of differing abilities

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

a

Boys > girls, P < 0.01.

b

Boys > girls, P < 0.05.

Boys engaged in MVPA for 39.4% ± 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 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 × ability interactions for either MVPA or VPA.

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.

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