Author(s): Lyyra, Nelli; Heikinaro-Johansson, Pilvikki; Lyyra, Mikko

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Original Article

Exploring in-class physical activity levels during physical education lessons in Finland

NELLI LYYRA[1], PILVIKKI HEIKINARO-JOHANSSON[1], MIKKO LYYRA[1]
[1]Faculty of Sport and Health Sciences, University of Jyväskylä, Jyväskylä, FINLAND

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Abstract:
This research aimed to measure in-class physical activity levels during physical education in grades seven to nine, and to determine the influence of gender and lesson content on such activity levels. Data was collected from 96 lessons across 14 secondary schools. Heart rate data consisted of 821 valid measurements. The mean heart rate across the data set was 135 beats per minute and students engaged in moderate-to-vigorous physical activity 41% of lesson time. Students were most active during game lessons and there was an evident gender difference, with boys being more active. However, when the impact of lesson content and gender on physical activity were tested simultaneously by multi-level logistic regression, the impact of gender was no longer significant. The findings indicate that the gender difference in the activity levels was rooted in having different lessons content for gender groups with boys having games more often than girls do.
Key words: Physical education, physical activity, hear rate, adolescents

Introduction

The evidence base for the beneficial effects of physical activity (PA) on the health of young people is relatively solid (Strong et al., 2005). Based on such evidence, policies around the world recommend that school-aged youth participate daily in 60 minutes or more of moderate to vigorous physical activity (MVPA) (Chief Medical Officers, 2011; United States Department of Health and Human Services, 2008; World Health Organization, 2010). However, worldwide, just one in five 13-15-year-olds currently meet PA recommendations (Hallal et al., 2012). Consistent with worldwide trends, it has recently been found that just one fifth of Finnish young people aged 11 to 15 currently meet the recommendations of 60 minutes or more of MVPA. Among 15-year-old Finns, this proportion drops to just one tenth (Kokko & Hämylä, 2015). Young people spend a significant proportion of their waking hours in school and for this reason school is often identified as a key site in efforts to increase the daily physical activity levels of this population (McKenzie & Lounsbery, 2014; Pate et al., 2006; Sallis et al., 2012). Physical education (PE), in particular, is seen by some researchers as an untapped source of potential for young people's achievement of daily PA recommendations (McKenzie & Lounsbery, 2009, 2014).

In the United States (US), the Comprehensive School Physical Activity Program (CSPAP) movement represents a co-ordinated effort to promote all school-related components of physical activity participation, with quality physical education seen as the foundation for promoting physical activity in schools (Centers for Chronic Disease Prevention, 2013). Similarly, the European Union has suggested that sufficient time devoted to sport and PA at school, either within the formal curriculum or through extracurricular activities, can make a key contribution to healthier lifestyles (European Commission, 2013).

Racette et al. (2015) have provided evidence that PE can make a significant contribution to daily PA, with young people accumulating more minutes of MVPA on the days during which they participate in PE compared to days during which they do not. In the US, it has been recommended that students in elementary schools should have the opportunity to take part in PE for 150 minutes per week and that this figure should increase to 225 minutes for students in middle school (Institute of Medicine, 2013). Between European countries, the time allocated to PE within the curriculum differs greatly, as do both the degree to which such time allocation changes from year to year and the levels of autonomy schools have in determining time allocation (European Commission, 2013). Currently, the average weekly allocation for PE across Europe is 109 minutes in elementary schools (ranging from 30 to 240 minutes) and 101 minutes in secondary schools (ranging from 45 to 240 minutes) (Hardman, 2008).

Within PE lessons, recommendations suggest that students should spend at least half of lesson time engaged in MVPA (Institute of Medicine, 2013). Results of studies attempting to measure the efficacy of PE in reaching such in-class PA targets vary somewhat, partly due to variation in PA measurement methods and different interpretations of MVPA. Fairclough and Stratton (2005b) reviewed 40 studies measuring activity

Corresponding Author: NELLI LYYRA, E-mail: nelli.lyyra@jyu.fi

levels of young people during secondary school PE. Comparing levels of MVPA obtained using different instruments is problematic because each method measures one or more different dimensions of PA. Among the included studies from which data was obtained during regular PE, students engaged in MVPA for between 27% and 47% of class time.

Heart rate monitoring facilitates an individual assessment of the physiological demand of an activity on the participant (Simons-Morton, 1988) and is therefore widely used to measure students' activity during PE (e.g Fairclough & Stratton, 2005a, 2005b; Jago et al., 2009; Kulinna, Martin, Lai, Kliber & Reed, 2003; Racette et al., 2015; Sarradel et al., 2011; Slingerland et al., 2011). However, interpreting the results of the heart rate studies is problematic as many different interpretations of the heart rate threshold for MVPA have been used (Epstein at al., 2001). Cut-point thresholds of minutes above 140 bpm have been frequently used among children and adolescents (Armstrong, Balding, Gentle & Kirby, 1990; Armstrong, Welsman & Kirby, 2000; Jago et al. 2009; Racette et al., 2015; Simons-Morton, 1988). Other investigators have employed manipulations of the participant's heart rate reserve, which takes account of the participant's resting and maximal heart rates (Fairclough & Stratton 2005a, 2005b; Stratton 1996).

International evidence indicates that boys are more active than girls during PE lessons (Fairclough & Stratton, 2005b; Jago et al. 2009; McKenzie, Marshall, Sallis & Conway, 2000; Mersh & Fairclough 2010). Fairclough and Stratton (2005b) assessed the activity level of 122 students (62 boys, 60 girls, aged 11-to 14) during secondary school PE using heart rate telemeters. According to their results, 34% of lesson time was spent in MVPA with boys being significantly more active (MVPA 39%) compared to girls (MVPA 29%). Similarly, in observing 430 middle school PE lessons, McKenzie et al. (2000) found that boys were more active than girls in terms of proportion of lesson time engaged in MVPA (46% for boys, 40% for girls) and a more recent study carried out in the UK showed that boys engaged in MVPA 60% of lesson time compared to 46% for girls (Mersh & Fairclough, 2010). A study conducted in the Netherlands supported this trend of boys being more active than girls among ages 13 to 16 (Singerland et al., 2011).

Lesson content has also been shown to have a significant impact on student activity levels, with team games and invasion games seen to be particularly effective in promoting a high level of activity among students. Fairclough and Stratton (2005b) found that students participated in most MVPA during team games (MVPA 43%) and least MVPA during movement activities (MVPA 22%). Similarly, Mersh and Fairclough, who observed 15 seventh grade lessons, recorded the highest levels of activity during PE lessons under curricular content theme 'Outwitting Opponents', which included a significant amount of lesson time devoted to the game play (Mersh & Fairclough, 2010). McKenzie et al. (2000) found fitness activities to result in the highest level of PA, followed by free play, game play and skill drills. Higher activity during game play for boys compared to girls was also reported in coeducational setting (McKenzie at al., 2000). Similar findings in a study carried out in the Netherlands indicate that boys were more active during team games than girls (46% vs. 35%) (Singerland et al., 2011).

In studies in which student gender, content and heart rates are analysed simultaneously, researchers have reported that gender alone did not contribute to observed differences in student activity levels and significant gender-by-context interactions do exist. These findings indicate that girls' and boys' activity levels respond differently to various lesson contexts (Kulinna et al. 2003; Laurson, Brown, Dennis & Cullen, 2008; McKenzie et al., 2000). In addition, the curriculum content to which boys are exposed is often different to that which girls experience, with boys tending to participate in more team games and other movement activities, which might be one reason for boys achieving higher level of activity during PE (Fairclough & Stratton, 2005b).

In Finland, PE is a compulsory subject for all students in basic education (the first nine years of schooling) and students also have the option to take PE as an elective course. At the time of this study, young people aged 7 to 16 participated in 90 minutes of compulsoryPE per week, although this allocation was recently increased, in accordance with a decision of the Finnish Board of Education, to an average of 105 minutes per week. This increase is a positive sign, especially in light of a decreased time allocation for the subject in other countries (Hardman 2008; Sallis et al., 2012). Class sizes are small in Finland; the average class size in basic education is 20 students. PE is most commonly taught in single-sex lessons, with female teachers teaching girls and male teachers teaching boys. Subject specialists who have completed a master's degree in PE teach secondary school PE in Finland. Schools follow the nationally-established curriculum in which the overall goal is to prepare young people for a lifetime of physical activity. In achieving this purpose, equal importance is afforded to the development of psychomotor, cognitive, affective and behavioural skills (Finnish National Board of Education, 2004, 2014). Despite a general awareness that PEhas the potential to contribute to the accumulation of the daily PA amounts of school-aged children and adolescence, there is currently an absence of data on the PA levels of young people in regular PE lessons in Finland. The aim of this study was to assess PA levels of students in seven to ninth grade during PE lessons and to explore their heart rate responses to different types of lesson content. Attention was paid to the MHR and the proportion of time students spent engaged in MVPA and the impact of gender and lesson content on this proportion.

Material & methods

Participants - Participants in this study were 821 students (413 girls, 408 boys) from grades seven to nine (mean age 13.81 ± 0.73) in 14 basic education schools located in urban, suburban and rural areas of Central Finland. The majority of participants were Finnish-speaking and a variety of socioeconomic backgrounds were represented. Following approval from the university ethics committee, school principals and physical education teachers in all 14 schools were contacted, procedures explained and informed consent obtained. During the 2005-06 school year, 96 regular physical education lessons were observed. All lessons took place indoors in school gymnasia and were taught by specialist physical education teachers (n=31; 15 female teachers, 16 male teachers) using their own curriculum-aligned lesson plans. Activity types were divided into two categories in order to facilitate statistically meaningful comparisons. Lesson content was classified as either 'games content', which included both team games (e.g., volleyball, basketball) and individual games (e.g., badminton, tennis), or 'non-games content', which included movement activities such as dance and gymnastics as well as individual activities such as fitness training. The researchers had no influence on lesson content.

Data collection

This study used heart rate monitoring (Polar Team System) as the means to measure PA levels of participants during PE lessons. Although heart rate is not a direct measure of PA, it does measure the relative stress placed on the cardiopulmonary system during activity (Armstrong, Balding, Gentle, & Kirby, 1990) and is a valid and reliable measure of PA among adolescents (Allor & Pivarnik, 2001; Janz, 2002).

Prior to each lesson, 10 randomly-selected students were fitted with heart rate monitors that averaged and stored their heart rates at five-second intervals throughout the lessons. The lesson time and duration, the class size and the lesson content were recorded on an observation sheet immediately after each observed lesson and heart rate files were downloaded for statistical analyses.

Heart rate data was analysed by Polar Precision Performance software. A mean heart rate (MHR) and the percentage of lesson time each student's heart rate was in the health-enhancing zone of MVPA was calculated. In this study, MVPA was represented by heart rates equal to or above 140bpm, which is a commonly accepted heart rate cut-off value for MVPA among adolescents (Armstrong, Welsman & Kirby, 2000; Epstein et al., 2001; Jago et al. 2009; Racette et al, 2015) and has shown to result in improvements in lipid levels and blood pressure among obese adolescents (Kang et al., 2002).

Statistical analyses

Prior to statistical analyses, data was checked for outliers and erroneous values were removed. Incomplete or partial heart rate files were also excluded and from the 960 measurements taken, the final data set consisted of 821 valid heart rate files.

The MHR and percentage of lesson time boys and girls engaged in MVPA during different activities were explored (see Table 1). The two measures (MHR and MVPA percentage) were compared separately between gender and lesson content, testing for statistical significance using independent sample t-tests. The effect size was evaluated using Cohen's d, which was calculated using group means and standard deviations. The following cut-off points were used: 0.20 = small effect, 0.50 = medium effect, and 0.80 = large effect (Cohen, 1988). Descriptive analyses and group comparisons were conducted using SPSS statistics, version 24 (IBM SPSS Statistics Products, NY, USA). The association between students' activity levels, gender and lesson content was examined through multi-level logistic regression (MLR). To measure the effect of the lesson from which data was obtained, the lesson representing the treatment at the class level was included on the model as a second-level factor. Multi-level modelling was carried out using STATA 14 software (Stata Corp LP, Colloge Station, TX, USA). A significance level of 0.05 and confidence level of 95% was adopted for all statistical analyses.

Results

Descriptive results

Overall, 67% of heart rate observations were taken from lessons with games content and 33% of heart rate observations were taken from lessons with non-games content (see Table 1). There was a significant difference in the proportion of games content versus non-games content between boys and girls, $\chi^2(1)=91.66$, $P<0.001$. Of the heart rate measurements taken from boys, 81% were during lessons with games content. This compared to 52% of measurements taken from girls. The most common games content was team games; there were only a few lessons containing individual games such as badminton or tennis. A significant correlation was evident between MHR and time spent in MVPA (r=0.92, $P<0.001$); the lessons with the highest MHR also had the highest percentage of time spent in MVPA. The two activities with the highest MHR and highest percentage time spent in MVPA among boys were soccer (MHR=150bpm, MVPA=62%) and a lesson including a variety of games (MHR=149bpm, MVPA=63.6%). However, it should be noted that there was only one lesson of soccer and one lesson with a variety of games. Dance (MHR=116bpm, MVPA=11%) and volleyball (MHR=123bpm, MVPA=27%) content resulted in the lowest activity levels among boys. Among girls, the most active lessons were those in which students played a variety of team games (MHR=143bpm, MVPA=58%), or basketball (MHR=145bpm, MVPA=55%). The lowest activity levels among girls were evident during tennis

(MHR=124bpm, MVPA=12%) and dance (MHR=118bpm, MVPA=19%). Girls were more active than boys during basketball and volleyball, while during floorball the activity levels were similar. Descriptive data of lesson content and student activity are presented in Table 1.

The average recorded actual lesson time in this study was 68.62 minutes (± 8.34), which is 76% of a scheduled lesson. The overall MHR among observed lessons was 134.54bpm (± 18.20), ranging from 62bpm to 188bpm. The overall percentage of PE lesson time spent in MVPA was 41.14% (±25.34). This percentage corresponds to an average of 28.11 minutes (±17.55).

Differences in physical activity between gender and lesson content

Gender differences for MHR and MVPA were examined via independent samples t-tests followed by a Cohen d test for effect size. Boys were found to have a significantly higher MHR than girls (t_{819}=-3.44, P=0.001, d= -0.24). Tests also indicated that boys spent significantly more time in MVPA during PE lessons than girls (t_{819}=-3.37, P< 0.01, d= -0.23).

The impact of lesson content on student activity levels was also analysed by comparing the students' activity levels and MHRs during games content to those during non-games content. Results indicated that MHRs were significantly higher during lessons with games content compared to lessons containing non-games content ($t_{581.0}$ = -11.00, P<0.001, d= -0.80). Students also spent more time in MVPA during lessons containing games content compared to those containing non-games content ($t_{628.5}$= -11.09, P<0.001, d= -0.80). The MHR and MVPA of categorized activity type by gender can be found in Table 2.

The impact of gender and lesson content on physical activity

For MHR, the MLR indicated no significant effect of gender (P=0.81). However, lesson content was a significant predictor for MHR (P<0.001). Similarly, the MLR indicated that students' proportion of MVPA during a PE lesson was not affected by gender (P=0.88) but lesson content was a significant predictor for student activity (P<0.001). Results indicate that boys and girls are equally active during games content and during non-games content and gender differences are rooted in the different lesson content to which girls and boys are exposed. In the MLR analyses, the intra-correlation within lessons were also analyzed and results showed significant intra-correlation within each lesson (P<0.001). Results of MLR analyses are reported in Table 3.

Discussion

With the growing focus on PE as a site for assisting youth to meet PA recommendations, this study has attempted to provide data for PA levels in typical Finnish PE lessons. Overall, findings show that the MHR of secondary school students during PE lessons was 134.5bpm, which is close to the cut-off value for MVPA utilized in this current study (HR≥140bpm). Students spent 41.1% of lesson time in MVPA when a 140bpm definition was employed. This compares to 42.6% among young people of similar ages in non-intervention PE lessons in the UK (Fairclough & Stratton 2005b), 40.6% in Spain (Sarradel et al., 2011), 35% in China (Chow, McKenzie, & Louie, 2009) and 40.1% in the Netherlands (Singerland, et al., 2011). Thus, consistent with their peers in other countries, Finnish young people come close to, but do not reach, the target of half of PE lesson time spent in MVPA. Considering the suggestion by some scholars that PE should play a role in meeting daily PA recommendations for young people (McKenzie & Lounsbery, 2014; Pate et al., 2006; Sallis et al. 2012), our study found that Finnish students gained an average of 28 minutes of MVPA per scheduled 90-minute PE lesson, equivalent to half of their recommended 60 minutes of MVPA for a given day. It seems, therefore, that PE lessons may only be an effective strategy to increase youth PA if the number of number of lessons per week is increased, as suggested by Racette et al. (2015).

In this study, boys appeared to be more active than girls were. However, this gender difference was deemed to be attributable to the effect of lesson content rather than any difference between the genders themselves. Boys were exposed to more games content and games content was seen to result in higher proportions of MVPA and higher MHR. The different content emphasis between the lessons of boys and girls echoed that found in the recent national evaluation study by Palomäki and Heikinaro-Johansson (2011). The results of the present study indicate that when lesson content is taken into consideration the impact of gender on activity levels diminishes. Indeed, the MHRs and MVPA of girls were higher than those of boys were during lessons with games content. This highlights the importance of taking lesson content into account in the analysis of PA levels in PE lessons. Fairclough and Stratton (2005b), in discussing their finding that boys displayed higher physical activity levels than girls in PE, acknowledged that lesson content might have had an effect on their results, with girls being exposed to content that did not lend itself to engagement in MVPA. Slingerland et al. (2011), echoing earlier findings of Kulinna et al. (2003) and Laurson et al. (2008) among this age group, found that boys were more active than girls during team game activities, while girls were more active than boys during individual activities. The findings of Sarradel et al. (2011), on the other hand, indicated that girls were more active than boys across both games and non-games content. In our study, girls were more active than boys during games content but boys were more active during non-games content.

A number of factors should be considered when interpreting the findings of this study. The participants in this study were limited to students in upper secondary schools from Central Finland and the results may have

limited generalizability elsewhere. Data was collected in 2005-06 at the time when the last national curriculum was introduced to schools (Finnish National Board of Education 2004). A new curriculum was introduced in schools in autumn 2016 (Finnish National Board of Education, 2014) and it will be useful to examine in the future how this new national curriculum affects student activity levels as the schools are still seen as the key site for the promotion of PA for all students. Mersh and Fairclough (2010) studied student PA in PE within the revised English national curriculum for PE and found that national curriculum content themes implemented in lessons did have a significant effect on student activity (Mersh & Faircoulgh, 2010). Using heart rate measures as the means to evaluate student activity has strengths and limitations, as pointed out by Welk (2008). A strength of the method is that it is an accurate indicator of physical activity and provides good educational potential to teach about the cardiovascular system. A limitation of the measurement method is that there might be other factors affecting a student's heart rate, such as illness, anxiety and possible measuring errors (Welk, 2008).

A strength of this study was that the data was collected from 96 lessons taught by 31 teachers, which gives quite a good picture of Finnish PE. We also used a HR cut-off value of 140bpm, which has been confirmed in literature to be valid cut-off value for health-enhancing PA (Simons-Morton, 1988, Armstrong et al.1990, Jago et al., 2009; Racette et al., 2015). However, for future research in this area, it would be good to reach a consensus in the classification of MVPA as many different cut-off values are employed which can lead to confusion regarding classifications, as pointed out by Singerland et al. (2011).

Conclusions

There are two general conclusions to draw from this study. First, PE does have the potential to contribute 50% of recommended daily PA for young people on the days on which it takes place. However, given that PE does not take place every day and that the subject has goals to attain beyond maximising levels of in-class physical activity, it is the combination of PE with other school- and community-based initiatives that is likely to ensure young people engage in PA at recommended levels. Secondly, this study demonstrated that lesson content has a strong impact on students' activity levels. We recommend that more research is carried out on the effects of lesson content on PA levels within PE, as well as whether such effects are found to be different between co-educational lessons and those divided by gender. As teachers carry the responsibility for planning and selecting appropriate lesson content for PE, it is imperative that such research is available through accessible channels in order to position these educators to make informed decisions that maximise in-class physical activity of all students, while attending to the overarching educational goals to which their lessons aspire.

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