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Young Children's Physical Activity Levels in Primary (Elementary) Schools:

What Impact Does Physical Education Lessons have for Young Children?

Dr Kristy Howells¹, Dr Ian Wellard² and Dr Kate Woolf-May²

Canterbury Christ Church University

School of Childhood and Education Sciences¹ School of Human and Life Sciences²

Young children's physical activity levels in primary (elementary) schools: what impact does physical education lessons have for young children?

Abstract

Objectives

This paper explores the impact of PE lessons, focusing on children aged 6–7 years, an under represented age in physical activity research.

Methods

10 children wore Actigraph accelerometers recording physical activity throughout the school day (9am until 3.10pm), for a year. Repeated measures ANOVA analysed: type of day (days including PE and days that did not) and gender ($p < 0.05$).

Results

Boys achieved 88% (girls 70%) of the recommended daily physical activity levels on PE days compared to 77% (girls 63%) on non PE days. Significant differences occurred, boys more active than girls also PE days being more active than non PE days.

Conclusion

The novel findings indicate PE lessons significantly contributes to children's physical activity levels.

Keywords

Physical Education; Children's Physical Activity

Introduction

A report by the Chief Medical Officer in England ⁽¹⁾ and the World Health Organisation ⁽²⁾ globally recommends a minimum level of at least 60 minutes per day of moderate intensity physical activity for children aged between the ages of 5 to 18 years. Moderate intensity has previously been defined by X, (2011) as exercise that results in an increase in breathing rate, an increase in heart rate, to the level where the pulse can be felt and feeling warmer possibly accompanied by sweating on hot or humid days or indoors. There is much debate surrounding the levels and extent of children's physical activity and pressure has been put upon the education system as potentially a place to increase these levels ⁽³⁾. Especially as school has been suggested as a "key setting to promote physical activity" ^(4, p.300). Yet there is a lack of knowledge as the specific physical activity levels that are possible for young children within the school day. One of the reported goals of the Chief Medical Officer's was to encourage activity in the early years and within school ⁽¹⁾, but the report did not state whether this level of physical activity was actually being successfully achieved, nor did the report state where within the school day these activity levels would be best met. This highlights a gap in the field of physical activity and the paper investigates this and considers what's even possible for our young children within the primary school setting.

Why Infants?

Within England those young children in this case study aged 6 – 7 years are referred to within the school setting as infants. When physical activity levels of children have been examined and researched previously, the focus has been mainly on children aged seven and upwards, who are in the upper part of primary schools (within the UK) and those in secondary schools ^(5; 6; 7). This case study wanted to focus on a novel area of research to be able to contribute to the field of knowledge also as the authors were aware that children's physical activity and their experiences in school such as within their Physical Education lessons can determine their engagement in lifelong physical activity ⁽⁸⁾ as well as it

being a time when children importantly make decisions about what they like and dislike (X, 2012). Pearce ⁽⁹⁾, also highlighted the importance of young children's experiences as "physical activity patterns established in childhood continue into adulthood" (p.169).

The Influence of Primary School Setting

The focus within this paper and investigation was on the younger aged children in particular not only due to the limited research on this age group but as Owens ⁽¹⁰⁾, highlighted they spend half of their waking hours within a school setting. He proposed that young children were awake for 14 hours a day and 7 of those are spent within an English primary school setting. There is such potential for the 7 hours to be a time to inspire, motivate and allow children to develop lifelong habits that will help them undertake physical activity for life. According to Radford,⁽¹¹⁾ school can have a very big influence on children, which is not a surprise due to the amount of time they spend within the school, but Radford warned that school is a complex and potentially chaotic place. Previous research has focused mainly on older children those aged seven and upwards, who would be in the upper part of primary schools in England and referred to as juniors ⁽³⁾. Also previous research has focused in particular with secondary (high school) aged children and their physical activity habits ^(5; 6). However, Ridgers et al. ⁽¹²⁾, did consider preschool and early years' physical activity levels and found that the proportion reaching the recommended guidelines varies from 2.5% to 97% of children and they recommended further research is needed with this particular age group.

The influence of the Physical Education lesson

Physical Education lessons have been seen as "the most suitable vehicle" ⁽¹³⁾, p.97) to encourage healthy and physically active lifestyles. The WHO ⁽¹⁴⁾, suggested that by increasing the number of Physical Education lessons is the most direct way to increase pupil's physical activity, implying that

Physical Education lessons are about being active. However the WHO (¹⁴), did not identify the current physical activity levels within primary school Physical Education lessons. Physical Education lessons have also been targeted by the Department of Health (¹) as being a prime outlet for increasing childhood physical activity. It is important to have a clearer understanding of the intensity levels of physical activity within Physical Education lessons, which this case study provides.

Difficulty measuring physical activity of children

Children's physical activity is rarely lengthy and is more often than not made of intermittent and spontaneous patterns, making activity profiling difficult as identified by both ³ and ¹⁵. Transitions between light and moderate physical activity may be sporadic as children move between these frequently and the different physical activity levels are not sustained for a long period of time. Intensity also varies from person to person and the WHO (¹⁶), referred to intensity as how hard a person is working during a particular type of physical activity, it is the rate at which the activity is performed. Light physical activity is when the body is moving for example, for a short walk round the classroom, going up stairs or playing (¹⁷). Moderate to vigorous physical activity is when the body begins to sweat and breathing increases. Examples of these types of activities would include brisk walking, jogging, running and playing football (¹⁸). Therefore it is important to explore the physical activity levels that currently exist within the primary school setting, as this case study investigated.

Methods

The research questions for this study were:

- How physically active are young children during the primary school day
- What are the differences between boys and girls?

- To what extent does the primary school setting contribute to children's recommended levels of physical activity (¹; ²)?
- What contribution do Physical Education lessons make to primary young children's physical activity levels?

Instruments

In order to ascertain the children's physical activity levels the ActiGraph accelerometer model 7161 with the use of ActiSoft analysis software 3.2 system (¹⁹) was used to collect the children's physical activity data. Oliver et al. (²⁰), proposed that accelerometers "are arguably the most appropriate objective measurement tool for quantifying physical activity" (p.185) and that the objective measurements such as accelerometers are more likely to "yield the most accurate information on physical activity (²⁰, p.1047). The use of accelerometers has been shown by both ²¹ and ²² to be a valid, reliable and objective method of monitoring physical activity in children in field settings. The ActiGraph accelerometer itself weighs only 1.5 ounces the equivalent to 44 grams, as such a small weight the accelerometer would not impact on the children's normal physical activity routines. The accelerometers were placed in a pouch on a belt and worn around the waist on the hip. Previous research (²³) has indicated that there is little evidence to suggest that one wearing position is better than another, though the hip is the most common site, often the right hip and the key according to Fairweather et al. (²⁴), is to ensure it is standardised throughout. Therefore round the waist on the right hip was the place that the children wore the accelerometer throughout all data collection days, the use of belt made it accessible and easy to change to be worn with Physical Education uniform as well as normal day uniform.

Accelerometry is defined as: "the quantitative determination of acceleration and deceleration in the entire human body or a part of the body in the performance of a task" (²⁵, p.12). The data from the accelerometers were analysed using a positivist perspective, associated with objective assumptions,

viewing the world as a concrete structure. The data analysis, as Cohen et al. ⁽²⁶⁾ describes was the “search for the truth” (p.5) to find out what was happening in terms of physical activity levels within both the school day, the Physical Education lessons, the potential differences in gender and how close the children were able to get to the recommended levels of physical activity. Quantitative data analysis was completed to understand the levels of physical activity as Dempsey and Dempsey ⁽²⁷⁾, defined quantitative research as researched that is aimed at discovery and that was the focus of this case study research.

Participants and school setting

All 10 participants, 5 girls (mean age at start of data collection was 6 years, 6 months) and 5 boys (mean age at start of data collection was 6 years 4 months) attended the same rural village Church of England school which is relatively small with less than 200 children within seven classes, all children were from the same class. The school followed the English National Curriculum ⁽²⁸⁾ and was geographically located in the South East of England outside a large town. The school had been awarded the health school mark ⁽²⁹⁾. A school with healthy school status; “seeks to achieve healthy lifestyles for the entire school population by developing supportive environments conducive to the promotion of health” ⁽²⁹⁾, p.88). The head teacher felt that within the school they were providing every possible opportunity for the children to be physically active. She identified break times and Physical Education lessons as possible places for the children to be physically active, however she was unaware of how physically active the children were within these lessons.

The children all volunteered to participate and the selection process was completed by the class teachers, who pulled the children’s names out of two different hats, one for boys and one for girls to ensure equal numbers of each gender. The children saw this method as fair and transparent way of being selected at random and a method that was often used within their own classrooms on a daily / weekly basis. This method prevented selection bias ⁽³¹⁾, however, it is acknowledged that the sample

selected is not fully random or stratified ⁽³²⁾. It does not necessarily reflect the entire population ⁽³³⁾ but does reflect the population of the class within the case study school. Permission and informed written consent was obtained from the head teacher and from the children's parents / carers. Assent was received from the children within the study and approval was sought and received from the institutional research ethics committee (ref no: 08/SAS/0). The class teacher within the study had specialised in Physical Education during their training. Not all primary schools have Primary Physical Education Specialists (Y and X, 2008) but the class teacher of the investigation was a full time class teacher who had over 20 years of experience of teaching within this age group and was the school's Physical Education coordinator. It is acknowledged that whilst the class teacher was very knowledgeable about Primary Physical Education the data collection, analysis and focus of this paper is on the children's physical activity levels within the school day and not on the pedagogy or the teaching of the class teachers.

Procedure

36 days were recorded in total. 18 days that included Physical Education lessons (PE days) were recorded during the spring and summer terms (January to July) as well as 18 days that did not include Physical Education lessons (non PE days) to allow for comparison between PE days and non PE days. The autumn (fall) term (Sept – Dec) was used for pilot study and during this term one of the two Physical Education lessons was a swimming lesson, which meant the accelerometer recordings could not be undertaken due to lack of waterproofing.

School day set up

The school day runs from 9am until 3.10pm, the day is a total of 371 minutes and Physical Education lessons lasted 40 minutes and occurred twice per week. (Table 1 sets out the school day set up.)

Different intensity levels

The data was recorded at different intensity levels according to the different levels of METs recorded. All METs at and over 3 METs were identified as moderate to vigorous and referred to as MVPA. All METs at and over 2 METS and under 3 METs were identified as light physical activity and referred to as LPA. All METs identified as under 2 METs were identified as static activity referred to as SA. The total number of minutes accumulated at MVPA, LPA and SA were recorded per child, for every part of the school day, including within Physical Education lessons. All children attended every recording data day, so no data was missing.

Main Study data collection and analysis

The data discussed within this paper is the data collected between January and June. The accelerometers were programmed to record activity counts using a 60 second cycle time sampling interval (epoch). The 60 second interval have been used previously by ³⁴ and ³⁵. It has been proposed by Nilsson et al. ³⁶, that 60 second intervals were appropriate when observing prolonged activity patterns. As this case study explores the physical activity of the whole school day this was regarded as observing prolonged activity patterns. Rowlands (²²), also within their field studies used 60 second epochs as “the use of epochs lower than this resulted in limited recording time” (p.52). The 60 second activity counts were downloaded and converted into a Microsoft (MS) Excel file for analysis of the accumulation of the different intensity levels and then imported into SPSS 17.0 for further statistical analysis using repeated measures ANOVA and a statistical significance value of $P < 0.05$ was used.

Results

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Insert Figure 1 here

Insert Figure 2 here

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Insert Figure 3 here

Insert Table 4 here

Insert Figure 4 here

Discussion

The physical activity levels of young children during the primary school day

The data of the physical activity levels of the young children within the primary school day within this case study school indicates that overall on average there was a difference between boys and girls and for type of day. Boys were able to significantly achieve more minutes of MVPA than girls on both types of day. There was on average a difference of 11 minutes, on PE days and 8 minutes on Non PE days. Most importantly both boys and girls achieved more than expected, with boys achieving an outstanding 53 minutes on PE days, 88% of the daily recommended MVPA levels and 46 minutes on Non PE days, 77% of the daily recommended MVPA levels, whilst the girls were able to achieve 42 minutes within a PE day, 70% of daily recommended MVPA levels and 38 minutes on Non PE days 63% of daily recommended MVPA levels. This level of data is surprising when considering previous research such as ³⁷. Dale et al. ³⁷ observed a slightly older group of children than in this case study, their children were aged 8 – 10 years old (n – 76) over four non-consecutive days within American elementary schools and stated that from their results “opportunities for children to be physically active during school time are sparse” (p.240). This indicates that there are potentially not only differences between results found in American and English primary schools but in any education system, it is important to recognise that there will be differences in school day set up, probable classroom layout and or the curriculum that may have allowed for more possibilities for children to be

more physically active within the English primary school of this case study than previously found in 2000.

The differences between boys and girls

One of the most interesting differences between boys and girls was the significant difference in the findings of afternoon break in particular MVPA where boys completed significantly more and for girls they completed significantly more on Non PE days than PE days. The timing of afternoon break needs to be considered in the future for encouraging the girls to be active during afternoon break. Currently Physical Education lesson is just before afternoon break and the girls were asked about their activity post study in the afternoon break it was enlightening to hear their thoughts. In their words:

'I needed a rest'

'I wanted to have a sit down after PE'

'I wanted time to think about what we just did'

'I didn't want to run around anymore'

This feedback highlights a limitation of considering just quantitative data and shows that perhaps in the search of the truth ⁽²⁶⁾, that individual participant interpretation of the data is also needed from young children prior to suggesting improvements to help with their physical activity. The recommendations given to the school were to consider when afternoon break was on PE days, or alternatively consider when Physical Education lessons were during the day. The school are going to try having Physical Education lessons at different times during the school day including before lunch time and after afternoon break to see if it is having the lesson within the day that has the same result in afternoon break or the immediateness of having it before the break time. Further results will be reported on in the future.

The contribution Physical Education lessons make to primary young children's physical activity levels and the implications of school health behaviour or policy

The case study data has shown that the young children within the case study school were able to complete on average between seven (for the girls) and nine (for the boys) minutes of MVPA within Physical Education lessons. This time equates to between 17.5% and 22.5% of the total time of the Physical Education lesson. This result was much higher than that found by Simons-Morton et al.³⁸ who observed levels of physical activity in Physical Education lessons for children aged ten and eleven in primary and middle schools in America, which had identified themselves as having excellent Physical Education programmes. Their study found that only 8.6% of the Physical Education time was at a MVPA. Other researchers, such as⁶ have found similar percentage number of minutes of MVPA within Physical Education lessons. In their review of physical activity levels within elementary school, Physical Education lessons indicated that pupils were at a MVPA level for 27 – 47% of the lesson time. Mersh and Fairclough⁽³⁹⁾, found that within secondary school children aged eleven and twelve that MVPA levels varied from 38.7% to 63% of the lesson time and that the intensity of the activity levels was dependent on the type of Physical Education lesson with those focused on outwitting opponents producing the highest MVPA. The lower level of physical activity within the young children may be explained due to the children still learning and developing skills and are therefore not as proficient as the secondary aged children and it would be assumed therefore that the young children would not be as physically active due to their skill development. Jess and Dewar⁽⁴⁰⁾, link to these ideas and suggested that primary school Physical Education was about developing basic skills and movements. It is important to recognise the overall impact and contribution that for the girls the Physical Education lesson made to overall 12% of their daily recommended MVPA and that for boys this level was higher at 15%.

If the other intensity levels are considered within the Physical Education lesson, then young children are physically active at a MVPA and LPA level for between 22 and 24 minutes which equates to 55%

to 60% of the Physical Education lessons. The data also indicates that on average between 16 and 18 minutes of SA which equates to 40% to 45% of the Physical Education lesson, which sounds like they are static for a long time. Shaljean (⁴¹), suggested that Physical Education lessons should consist of high quality learning experiences. He predicted based on his own experience of having taught Physical Education for twelve years that out of a 60 minute lesson that maybe only 10 minutes were physically active, 6% of the lesson. He claimed that this was due to “health and safety issues, kit checks, not to mention demonstrations and stretching that all have to be gone through before the lesson itself can kick off”. If the case study data is therefore compared to ⁴¹ prediction, the young children are exceeding all expectations. Waring et al.’s (³), findings were similar to ⁴¹ prediction in that ³ found very low levels of MVPA within Physical Education lessons. Yelling et al. (⁵), within their case study investigation suggested that physical activity is “only one consideration of Physical Education” (p.62). ⁸ and X (2012) agreed with ⁵ and suggested that Physical Education lessons are much more than just an opportunity to be physically active. In that the whole child is educated within Physical Education and includes social, emotional, moral and cognitive developments as well as opportunities for learning how to share and take turns, listening to instructions and watching demonstrations. For young children learning how to share is important to develop them socially and emotionally and would account for the 16 to 18 minutes of static activity found within the case study.

Limitations of the Study

The key limitation of this case study is that it focused on one class, in one school in one part of England. However, the data was collected over a longitudinal period of time to give a depth of knowledge and understanding of the current physical activity intensity levels of young children as well as the contribution that Physical Education lessons make to physical activity levels. Therefore there is a limitation in generalisation to other schools and other settings, however through the use of an objective measurement, it is proposed that this study is repeatable, reliable and valid. One other

limitation of the study is that the focus was on the physical activity not on what was undertaken in terms of teaching and learning within Physical Education lessons, it is acknowledged that the areas of activity changed within the school terms and that the activity areas included invasion games, striking and fielding, athletics and outdoor and adventure activity, with dance and gymnastics being undertaken during the pilot study time. Further analysis will be undertaken to consider the physical activity levels within each activity area so any differences or impact of activity area can be shared.

Conclusion and Implications for School Health Behaviour or Policy

Overall the results from the study, are novel, positive and identified that young children are surprisingly active within the school day, and achieved between 63 and 88% of the daily recommended MVPA (¹; ²). Showing that school can be a place for achieving and a place for opportunities of high physical activity levels. Especially as these daily recommendations are not limited to just the school day, this research shows that it is possible for school can make a significant contribution to a child's health and that school has the potential to have a significant impact on the children's lives it is a place that the children spend half of their waking hours. Further research into the active transport and the other waking hours of the children is needed to see if how far and the impact of home life on their physical activity levels to truly show how important an impact these achievements within school life really are.

The case study has identified implications for school health and that there are spaces and places within school beyond Physical Education that physical activity of both MVPA and LPA can take place, and the case study school since the end of the research has extended their outdoor environment through the introduction of a pirate ship for the children to climb, swing, play on and a trim trail for the children to develop balance skills. Both the pirate ship and the trim trail were designed to encourage physical activity during break times, in recognition from the results of this research, as potential extra key

places and spaces for the children within this school case study to continue their physical activity. In the future the impact of the introduction of this outdoor play equipment will also be examined.

To conclude, Hills ⁴² highlighted that Physical Education was a place and “space in schools” where children can develop not only skills but also “knowledge that may form a basis for lifelong participation in physical activity” (p.104), therefore as in this study it is important to identify all levels of intensity to consolidate knowledge into participation levels within Physical Education, and the impact and contribution the school setting can have, especially for young children.

Human Subjects Approval Statement

Ethical clearance was gained from the Faculty of Social and Applied Sciences, Faculty Research Ethics Committee at Canterbury Christ Church University, reference number 08/SAS/0 for undertaking research with children within their school setting.

Conflict of Interest Disclosure Statement

No conflict of interests exist. The research reported was part of a PhD.

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	Time (minutes)	Time (minutes)
Part of day \ Type of day	PE days	Non PE days
Curriculum time	236	279
Morning break	20	20
Lunch time	60	60
Afternoon break	15	15
Physical Education	40	*

Table 1 – Daily set up in minutes.

Gender \ Type of Day	PE day	Non PE day
Boys	53 ± 22 (88%)	46 ± 17 (77%)
Girls	42 ± 13 (70%)	38 ± 11 (63%)

Table 2 - Overall mean number of minutes ± SD of MVPA during school day for gender and type of day and the percentage achieved of the daily recommended number of minutes per day (DH, 2005, WHO 2010)

Gender \ Intensity levels	MVPA	LPA	SA
Boys	9 ± 3 (22.5%) (15% of overall daily MVPA)	15 ± 2 (37.5%)	16 ± 2 (40%)
Girls	7 ± 2 (17.5%) (12% of overall daily MVPA)	15 ± 2 (37.5%)	18 ± 2 (45%)

Table 3 - Overall mean number of minutes ± SD of MVPA during school day for gender and type of day and the percentage the Physical Education lesson spent at each intensity level.

	Intensity Levels	MVPA		LPA		SA	
		PE	Non PE	PE	Non PE	PE	Non PE
	Gender \ Type of day						
Curriculum time	Boys	17 ± 9	20 ± 7	80 ± 19	92 ± 20	152 ± 20	182 ± 20
Curriculum time	Girls	13 ± 5	18 ± 6	71 ± 15	86 ± 21	159 ± 19	188 ± 21
Morning break	Boys	10 ± 4	8 ± 3	8 ± 3	10 ± 2	3 ± 2	4 ± 2
Morning break	Girls	8 ± 2	5 ± 1	9 ± 2	11 ± 1	4 ± 2	5 ± 2
Lunch time	Boys	15 ± 6	15 ± 7	22 ± 3	23 ± 3	23 ± 6	23 ± 6
Lunch time	Girls	11 ± 4	11 ± 4	21 ± 2	23 ± 3	28 ± 5	26 ± 5
Afternoon break	Boys	3 ± 1	3 ± 1	6 ± 1	6 ± 1	6 ± 2	7 ± 1
Afternoon break	Girls	2 ± 1	3 ± 1	6 ± 0	6 ± 1	7 ± 1	7 ± 1

Table 4 - Overall mean number of minutes ± SD for the different physical activity levels during different parts of the primary school day for all the different intensity levels.

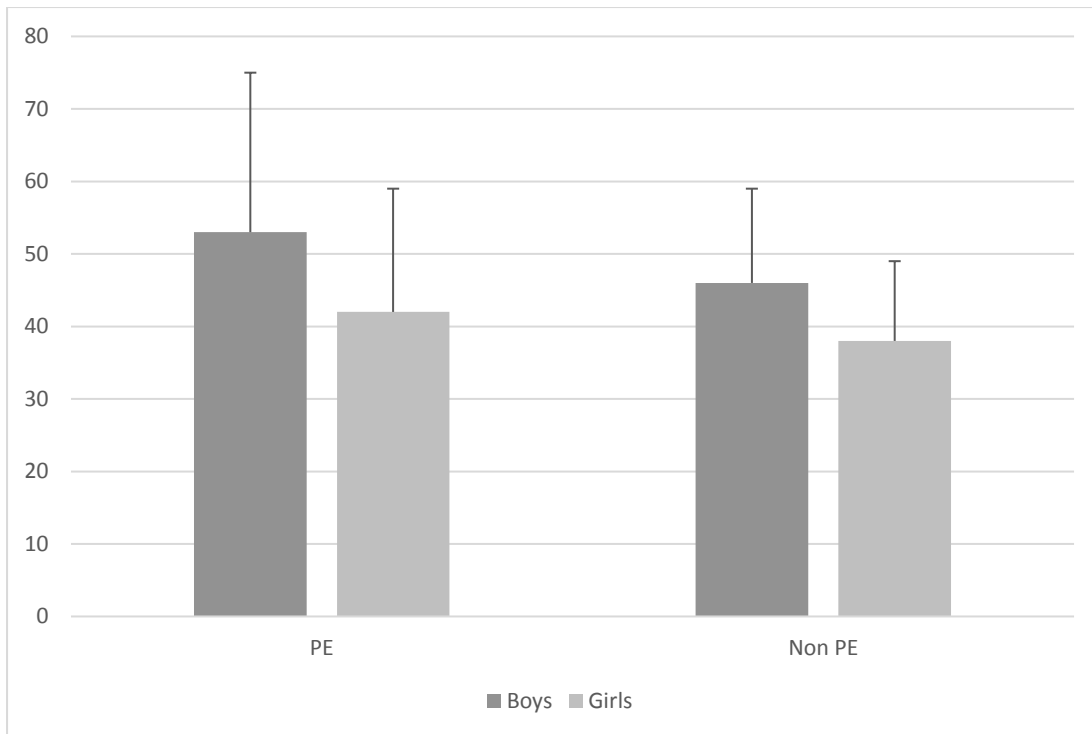


Figure 1 – Overall mean number of minutes \pm SD of MVPA during school day for gender and type of day

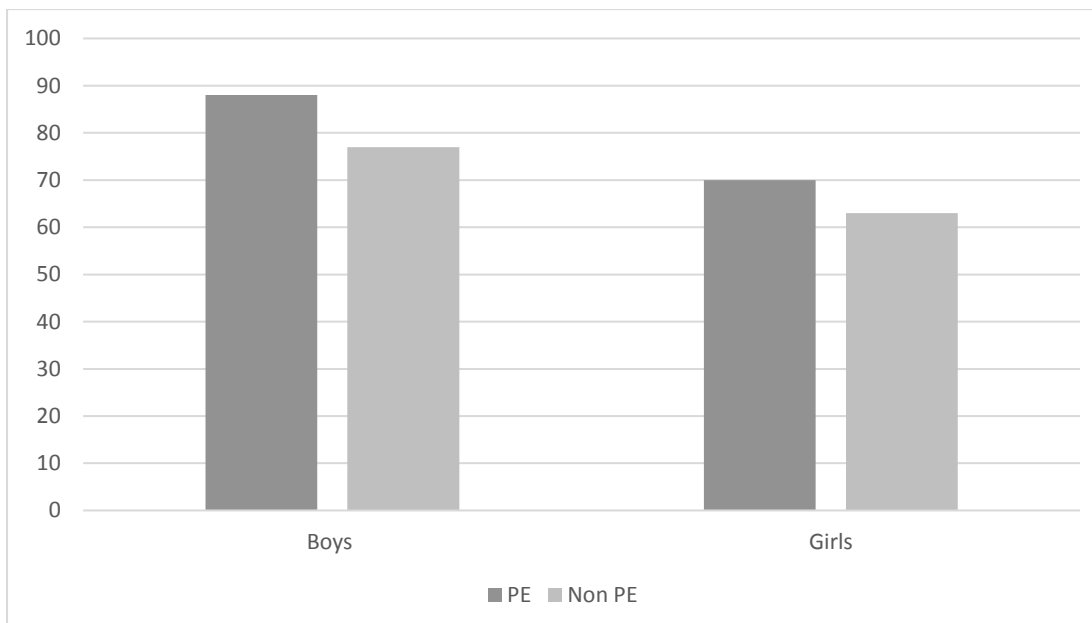


Figure 2 - Percentage average number of minutes achieved of the daily recommended MVPA.

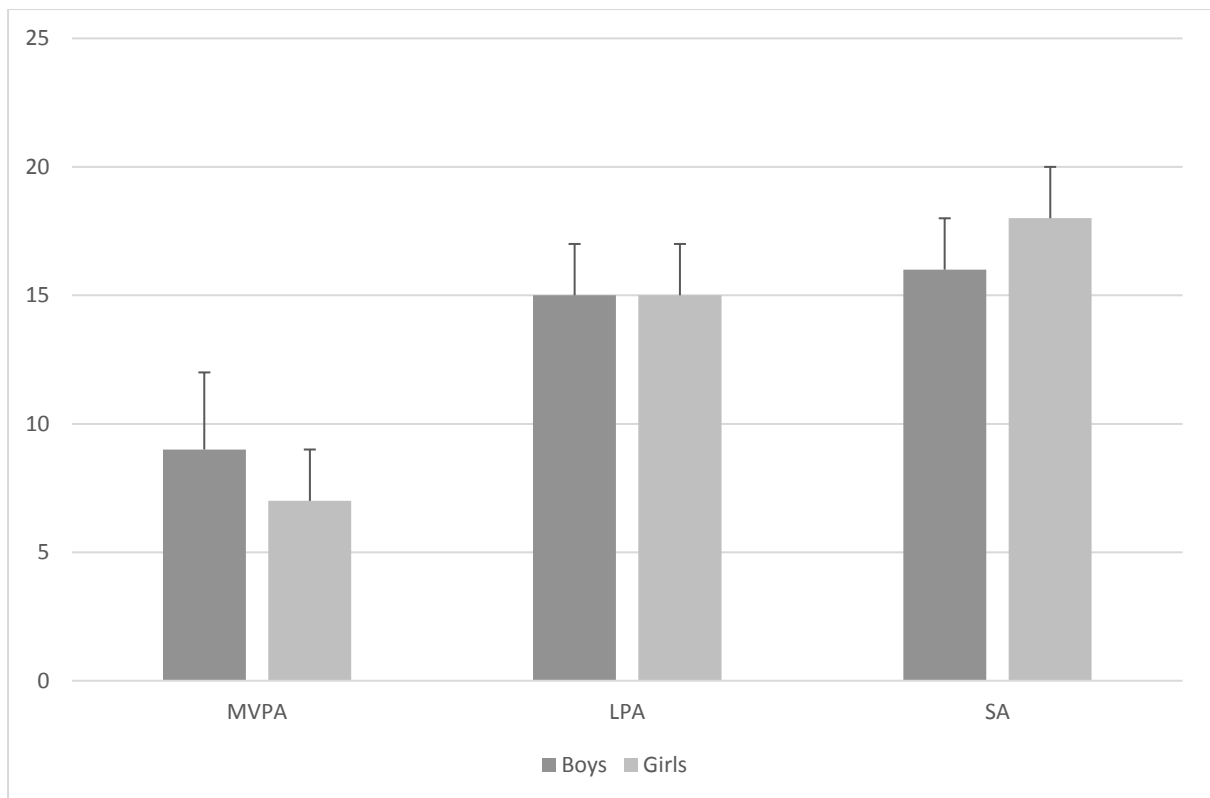


Figure 3 - Overall mean number of minutes \pm SD of MVPA during school day for gender and type of day and the percentage the Physical Education lesson spent at each intensity level.

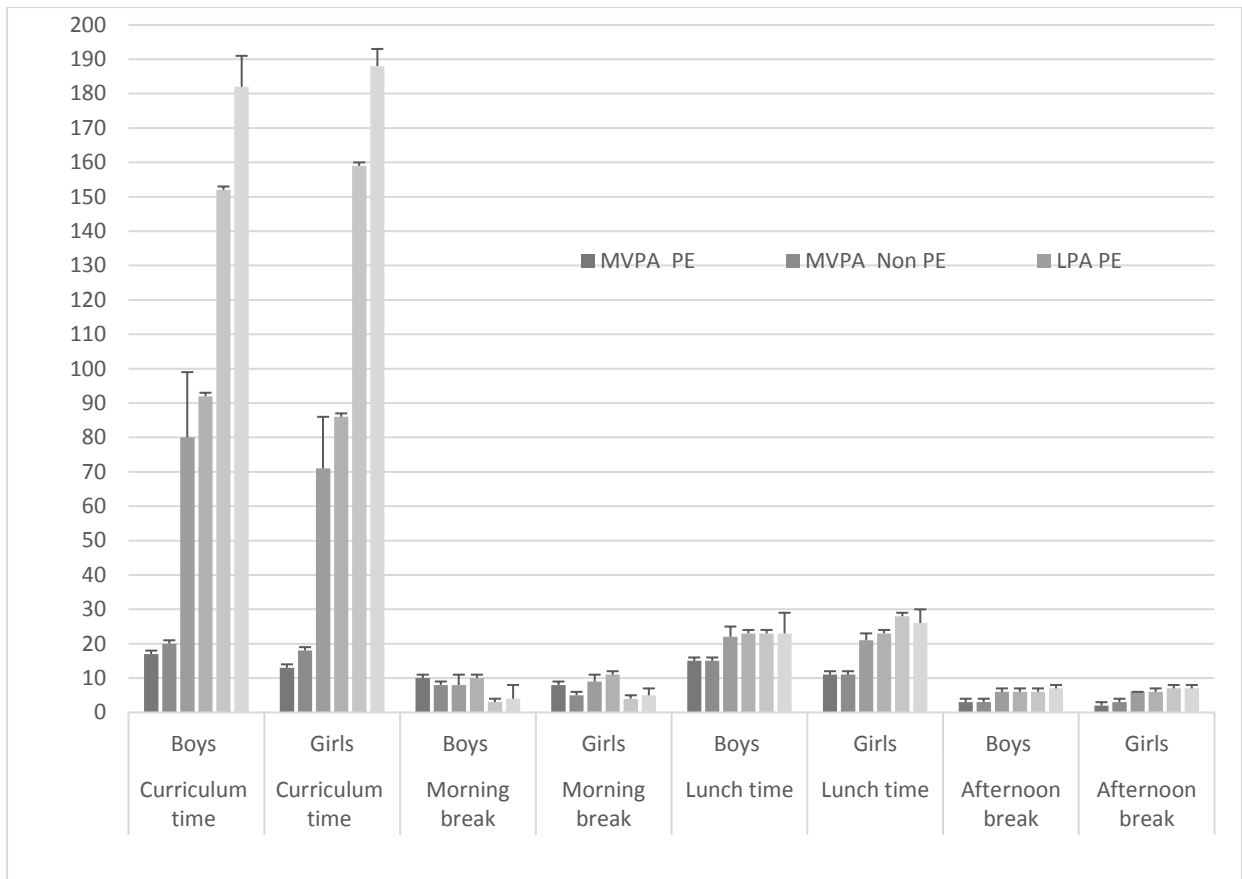


Figure 4 - Overall mean numbers of minutes \pm SD for the different physical activity levels during different parts of the primary school day for all the different intensity levels.