An investigation into the relationship between Physical activity and playground size

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Abstract
Playtime has been an effective and important part of school days, enabling children to achieve the numerous benefits gained from exercising. The guidelines currently state that children need at least sixty minutes of moderate to vigorous activity per day to gain these benefits (World Health Organisation, 2011). There is growing concern that playground activities are not given the recognition they deserve by teaching bodies as an important part of the holistic development of the child.

The aims of this paper were to investigate the potential relationship between PA (Physical Activity) and the size of the playground. The area of playground research is fairly limited despite the fact that many schools recognise the important contribution it has to the overall activity levels in a child's life.

Data were gathered from 277 subjects in 6 schools across the Northern Ireland library boards. It showed no correlations between the size of a school's useable playground space and PA levels, but did show a difference between the sexes. It also made clear how schools utilise playground space in the most efficacious way.

It is my aim that this paper will highlight the need for schools to become more efficient in their use of their playground, particularly when it comes to female PA levels which are most affected by smaller playgrounds. Effective strategies shown to increase efficiency of playground space are also discussed.

Key words
Physical Activity, Playground.

Introduction

1.1 Background to Study

It has been suggested that the epidemic of childhood obesity will lead to a phenomenon seen for the first time in recent history whereby children will have a shorter life expectancy than their parents (Olshansky et al. 2005). Playtime and PE has been an effective and important part of school days, enabling children to achieve the numerous benefits gained from exercising. The guidelines currently state that children need at least sixty minutes of moderate to vigorous activity per day to gain these benefits (World Health Organisation, 2011). There is growing concern that PE, but particularly playground activities are not given the recognition they deserve by teaching bodies as an important part of the holistic development of the child. Research by *Play England* (2011) highlighted this growing trend saying 72 per cent of adults played outside rather than indoors, compared to only 40 per cent of children today, with children now at risk of losing out on essential childhood experiences that outdoor play brings, as well as the benefits of not being sedentary.

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Indeed it could be argued that it is becoming increasingly important with technology such as video games, tablet computers, and social media being the recreational activity of choice for most modern children. The National Wildlife Federation of America (2014) have recognised this and have created an initiative that aims to get ten million more children outdoors and moving, commenting that the amount of time children spend outside is alarmingly low, only minutes per day, while screen time is at an all-time high (upwards of seven hours). By age 11, children who watched 3.0 hours or more of television per day had a mean sum of skinfolds of 106.2 mm, compared with a mean sum of skinfolds of 76.5 mm for those who watched less than 1.75 hours per day, showing a correlation *(P=0.007)* between body fat and amount of TV watched (Proctor et al, 2005).

With the growing rates of chronic diseases such as heart disease, type II diabetes and cancer, it is evident interventions need to be made earlier in people's lives to combat the onset of these diseases, PA is a way of doing that. Bassuk (2005) comments that epidemiological studies suggest that physically active individuals have a 30–50% lower risk of developing type II diabetes than do sedentary persons and that physical activity confers a similar risk reduction for coronary heart disease. The Chronic Disease Action Group was established to encourage, support, and monitor action on the implementation of evidence-based efforts to promote global, regional, and national action to prevent and control chronic diseases.

In light of this, I believe an investigation of a sample of schools in Northern Ireland will help to identify the importance of school playgrounds in children's overall Physical Activity (PA) levels, and find if any relationship exists between them.

1.2 Need for study

From a review of the literature, there are no studies investigating the correlation between playground size and the amount of PA a child does in school. There have been numerous studies investigating the effectiveness of interventions and its effect on the PA, but no such research has been carried out in this area. Schools play a major role in promoting and ensuring children get the required amount of PA set out by the governing bodies in order for them to be at optimal health. As a specialist PE teacher I am passionate about the importance of PA for the holistic development of the child, and is also concerned about the decreased value that is being placed on it. In a study of school staff's perceptions on PA in school, participants felt PA was important but believed several factors impacted children's ability to be more active: (i) lack of time due to increasing academic demands, (ii) peer pressure (especially in girls) not to be active and (iii) lack of space and equipment. Young people would like to be active but are often constrained by external factors such as school policy or curricula, parental rules in relation to safety and convenience, and physical environmental factors (Dollman et al, 2005).

It is my view that some schools and their students are missing out on PA due to the playground size of the school. Those children finding themselves in a densely populated playground are at a disadvantage and are not getting the required levels of PA that other schools are. Extrapolated over the months and years of the students' school lives they are at a substantial disadvantage than those who have sufficient space in other schools. There should be a minimum playground space available for children according to the pupil size of the school, so that all children gain the opportunity to express themselves physically in a surrounding that is sufficient for them and their peers, and they enjoy the health benefit that is inextricably linked to PA.

1.3 Aims and Objectives

The aims and objectives of this paper are to investigate the potential relationship between PA and the size of the playground. The area of playground research is fairly limited despite the fact that many schools recognise the important contribution it has to the overall activity levels in a child's life.

Data were gathered from approximately 280 subjects in 6 schools across the Northern Ireland library boards. The height, weight and body composition of the children were collected. PA levels were measured using pedometers from the St. Mary's University PE department. Playground size was measured using a trundle wheel measuring the perimeter and calculated in m^2. In order to evaluate the collected data I used Microsoft Excel and SPSS programs and following a statistical analysis, results were formulated and discussed to reach conclusions about the correlations between the two variables.

Review of Literature

In order for man to succeed in life, god provided him two means, education and physical activity, one for the soul and the other for the body, but for the two together. With these two means, man can attain perfection
(PLATO, 4th Century BC)

2.1 Benefits of Physical Activity

The World Health Organisation (WHO, 2011) states that 'Physical activity is any bodily movement produced by the skeletal muscles that uses energy. This includes sports, exercise and other activities such as playing, walking, doing household chores or gardening'. There is a marked trend which has developed in recent decades which indicate the growing sedentary habits of school-aged children. Physical Activity (PA) levels guidelines require 'Children and youth aged 5–17 years should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity (MVPA) daily' set out by the WHO. The 'Health Behaviour in School-aged Children' survey (2006), conducted across 35 countries in Europe and the United States of America, revealed that only 27% of all girls and 40% of all boys achieved these guidelines (Verstraete *et al.* 2006). Intensity levels refers to the rate of the activity being performed, a simple measure being an observation of how hard the children are working to perform the task or activity, e.g. brisk walking / jogging constitutes moderate intensity, whereas sprinting would constitute vigorous intensity. It well documented in tracking studies that low PA levels during childhood can be extrapolated into adulthood, according to Ridgers *et al.* (2006) '*…an active lifestyle during childhood reduces the risk of health problems in later years, and that levels of physical activity during childhood track into adulthood, although this tracking evidence is weak.'* This is in line with the work of Telamar *et al.* (2005) who conducted a 21-year tracking study of childhood physical activity behaviours into adulthood and concluded that 'a high level of physical activity at ages 9 to 18, especially when continuous, significantly predicted a high level of adult physical activity'. Although the correlations were low or moderate, it is evident that school-age physical activity appears to influence adult physical activity, and through it, the public health of the general population.

It is widely accepted that physical activity promotes both psychological and physiological benefits. The growing rates of obesity and mental disability issues around the world cannot be denied, the WHO (2012) reports that over forty million children under the age of five are obese. Depression rates also continue to grow exponentially, with it anticipated to be the second most disabling condition in the western world by 2020 behind heart disease.

The psychological benefits enjoyed by a child through attaining the recommended PA levels can be divided into three main groupings:

- Improved Cognitive Performance
- Improved Academic Achievement
- Improved Mental Health

Improved cognitive performance relates largely to a child's ability to concentrate and their memory capacities. A recent randomised trial examining the effects of aerobic physical activity on attention-deficit/hyperactivity disorder (ADHD) symptoms in young children concluded that daily aerobic activities before school reduced the symptoms of at-risk children in the classroom and at home (Hoza *et al.* 2014). Another study investigating resistance training demonstrated that *'a single bout of resistance exercise performed…can enhance episodic memory'* (Weinberg *et al.* 2014) which give rise to the arguments for 'PA Breaks' in schools (Wadsworth *et al*. 2011).

Improved academic performance relates to more objective means of psychological ability such as end of year school tests and reading levels. Erwin *et al.* (2013) published results showing that students had significantly higher reading fluency and mathematics scores post-intervention (daily PA breaks) and higher means for standardised reading, mathematics scores as well as grades. I concluded that *'Short bouts of PA are important for improving math and reading fluency scores. Classroom teachers should be encouraged to devote time during academic learning to incorporate PA'.* Scudder *et al.* (2014) concur with these findings remarking that higher fitness may be associated with a richer network of words and their meanings. Taras (2009) on the other hand, found that whilst there may be some short term improvements, over the longer term academic performance benefits are not well substantiated.

Mental health studies have shown that those people undertaking regular PA show fewer signs of mental health issues and greater self-esteem. Sandhu *et al.* (2013) report that PA is inversely correlated with symptoms including anxiety and insomnia, social dysfunction, and severe depression, concluding that better mental health is evident when adult males are physically active. The most widely stated mental health benefits due to physically activity in children and adolescents, cited by Eime et al (2013) include: higher self-esteem (Pedersen et al, 2004), improved social skills (Howie et al, 2010), reduced depressive symptoms (Boone et al, 2006) and feeling more confident (Holt et al, 2011). A "review of reviews" published by the British Journal of Sports Medicine (2011) however does report weak evidence for positive correlations between physical activity and depression, anxiety/stress, self-esteem, and cognitive functioning. However it did conclude that *'studies showed consistent negative associations between mental health and sedentary behaviour'* thus it is safe to conclude that PA can have a beneficial effect on children's mental health state.

PE is where children get the majority of their PA, therefore it is important to consider its role and trends. The Northern Ireland Curriculum (NIC, 2007) PE program cites that teachers should *'provide the opportunity for specific attention to be given to the physical development, health and well-being of children.'* Indeed this is where the majority of the benefits of PA lie, in the reduction of sedentary related diseases such as obesity, which has strong links to other diseases such coronary heart disease (CHD), type II diabetes, cardiovascular disease and some cancers. A recent OFSTED (2013) report "Beyond 2012 – outstanding physical education for all" reported that PE in general was in good health, however it cited the need for lessons to be more active in nature citing that over a quarter of schools did not improve on the children's physical fitness. As well as this, the report also concluded that there was little evidence of a coordinated approach to childhood obesity, even though almost 3 in 10 children between the ages of 2 – 15 are classed as obese according to NHS Information Centre figures (NHS, n.d.). Another issue within PE is the gender differences in PA levels within the lessons, as well as in participation levels overall. A recent article publish by the National Health Service based on a report from the Women's Sport and Fitness Foundation (WSFF), found that only 12% of girls aged 14 get enough physical activity each week – this is approximately half the number of boys at the same age.

The reasons for the growing rates of obesity across the world are multivariate; including low resting metabolic rates (Hardman and Stensel, 2003), physical inactivity (Fox and Hildson, 2007) and dietary

patterns (Hensrud, 2004), amongst others. It cannot be denied however that PA can play a substantial part in reducing the instances of these diseases and arguably through mitigating the effect of the other causes highlighted. A review of the current evidence by Wareham *et al.* (2005) concluded increasing PA provided *'uncertain'* results in its effectiveness for reducing obesity. Thus one must conclude that a "PA only" intervention may be ineffective in reducing the obesity problem.

PA and PE programs are beneficial for motor learning of children. The NIC (2007) affords children the opportunity to participate in athletics, dance, games, gymnastics and swimming activities at Key Stage 1 and 2. The nature of these activities lends them to increase the fine and gross motor skills of children which undoubtedly contribute positively to the classroom, particularly for younger children who are still developing these attributes, indeed Malina *et al.* (2004) discuss the link between motor development and brain growth.

2.2 Playground literature

There is limited literature available investigating playground size and dimensions. The main document used in this review is the Department for Education (DfE, 2014) document detailing notes on area guidelines for mainstream schools. The document sets out non-statutory guidelines for school sites for all age ranges from 3-19 years. The Schedule of Accommodation (SoA) tool is used by schools to determine the dimensions required for new school buildings; classrooms, PE hall, stores, staff rooms etc. in relation to how many pupils there are, no such strategy is used in relation to an outdoor site.

The UK Department for Education sets out school grounds into three main areas:

- Net Site area**:** this is the usable site area available to pupils for activities.
- Non-net site area: this includes the building and access areas such as paths, car parking and so on.
- Supplementary area: this is used for non-school or support functions such as special needs facilities.

For the purposes of this study, I am only concerned with the Net Site Area (NSA). Section 77 of the School Standards and Framework Act (1998) divides the NSA, also referred to as 'Playing Fields', into five categories:

- soft outdoor PE area: including sports pitches laid out to suit team games, all-weather pitches such as synthetic surfaces which can be counted twice given their multiple uses.
- hard outdoor PE area: multi-use sports area (MUGA) to include netball and tennis courts. *'Laying out a variety of courts within a single multi-use games area makes supervision easier and extends the range of games.'*
- soft informal and social area: Grass, sand or bark mulch areas, grassed banks or terraces, shrubs and planted areas, and meadow- or woodland.
- hard informal and social area: *'for the encouragement of healthy, active, creative, outdoor play'.*
- habitat areas**:** such as bird feeders, ponds, outdoor science areas, gardens, etc. as an outdoor school resource.

The department recommend that the net site area should be 80-90% of the total site area commenting that *'The net site area for infants' schools is likely to be smaller as there is no requirement for soft outdoor PE areas (such as pitches)'.* In 2012, the education secretary, Michael Gove, relaxed government regulations that set out the minimum outdoor space schools have to

provide pupils for playing team games. The Education (School Premises) Regulations (1999) previous figures set out the following guidelines for various school sizes in England, shown in Table 1.

Table 1. Minimum area of team game playing fields for schools in m2

	Minimum total area in m^2	
Total number of pupils who have attained the age of 8 years (entries to be construed inclusive of both numbers specified)	*Schools with pupils who have not attained the age of 11 years (Primary)*	*Other schools*
100 or fewer	2,500	5,000
101 to 200	5,000	10,000
201 to 300	10,000	15,000
301 to 400	15,000	20,000
401 to 500	20,000	

The most recent School Premises [England] Regulations (2012) for schools state simply that "suitable" outdoor space must be provided to teach PE and let pupils play outside providing no numerical guidelines. The DfE (2014) outline that the NSA for mainstream primary schools should be between 2.9 – 3.1 m^2 per pupil, adding firstly that where there is limited outdoor space available consideration should primarily be given to hard informal and social, hard outdoor PE space (ideally in the form of a MUGA), then soft informal and social area, and finally soft outdoor PE area, respectively. The DfE (2014) add that restricted sites that do not have enough outdoor space to meet the site requirements: *'pupils will need to be provided with access to suitable off-site provision.'*

2.3 Physical activity levels in school playgrounds

School PE, break and lunch times, as well as extra – curricular activities offer an excellent opportunity for children to achieve the guidelines stated and ensure they gain the inherent physiological and psychosocial benefits discussed earlier in this chapter.

Ridgers *et al. (2006)* cite that *'playtime can contribute to between 5-40% of recommended daily physical activity levels where no interventions have been utilised'.* Additionally, Dale *et al.* (2000) report that children do not compensate for a sedentary school day by increasing their activity levels after school. Children undertake approximately 400 playtime periods each year, based on the calculation of 39 – 40 weeks of school with 2 breaks per day, school playtimes offer significant opportunities for children to make up the recommended one hour of MVPA per day. There are limited studies investigating the level of PA during playtimes, those of which have concluded that children spent less than 50% of recess time engaged in moderate to vigorous physical activity during that time (Verstraete *et al.* 2006). Within this, there are also gender differences with Nettlefold *et al. (2010)* finding that girls accumulated less MVPA and are more sedentary than boys throughout the school day. Playground markings and physical resource structures are also said to enhance children's activity levels during school break and lunch times; *'The results suggest that a playground redesign, which utilizes multicolor playground markings and physical structures, is a suitable stimulus for increasing children's school recess physical activity levels.'* (Ridgers *et al.* 2007).

The accumulation of school playtime across the months and years of children's school lives means that schools play a leading role in ensuring children are meeting these PA levels to ensure they are gaining the numerous benefits it has to offer children, both physiologically and psychosocially.

Methodology

3.1 Research Design

The goal of this research study is to achieve a quantitative assessment of children's PA levels and how this may be affected by the playground size within the school. In order to ensure accurate and reliable results I ensured the instruments were in working order, and the necessary staff within the school were aware of the research aims and objectives. Each pupil in each class group participating in the study received a pedometer, which the research staff ensured was fastened onto their trouser / skirt just above their right hip bone. The pedometers were put on at the beginning of the school day, that is, when the children arrive at school. The reasoning for this is that some schools may allow students to undertake some PA before the beginning of the school day in the school playground. The school was be advised to let the pupils use the school Net Set Area that was usual for them during their day-to-day recess time in order to ensure an accurate measurement is gained. As well as this, the school was asked not to provide more than the usual quota of outdoor equipment as this can have an effect on PA levels according to the literature. The teachers and support staff on the school playground are encouraged to continue their normal duties during the break and lunch time periods so as to limit their role in encouraging the children to 'play more' or 'run around more' thus distorting the results and not giving a true reflection of the children's activity levels during the normal school day. Children were not informed of the purposes of the pedometers until after the experiment to prevent them from increasing their activity levels purposely. At the end of the school day, the children were asked to remove their pedometers and the data were uploaded onto Microsoft Excel and SPSS for subsequent interpretation.

3.2 Subjects

The study sample is made of 277 *(n)* participants attending primary schools in Northern Ireland. It is a convenient sample consisting of mixed – gender pupils at Key Stage Two level, with the ages ranging from 8 – 11 years old.

3.3 Procedure

Before undertaking this study, it was important to undertake steps prior to the investigations. Firstly, the school was contacted via a consent letter (Appendix A) to the principal of the school asking if they would participate in the study. The letter details the purposes of the study to be done and the school's role in helping to gain accurate results for analyses. The results obtained would be collected and used for the purposes outlined in the letter, and any information pertaining to the school would be treated with strict confidentiality. Once these procedures were completed the research could progress.

3.4 Test

3.41 Testing Measures for Physical Activity

Pedometers provided a quantifiable means to measure the children's PA levels. Given the limited resources and budget available in this study it was unfeasible to use more advanced equipment such as GPS monitoring systems, which would have allowed me to delve somewhat deeper into the PA levels, particularly in relation to intensity levels of the children during their play. However for the purposes of the study I only require to see overall PA levels which can be successfully achieved using pedometers. Conclusions by Strycker *et al.* (2007) comment that pedometers use offers an easy-to-use and cost-effective objective measure of physical activity in both youth and older adult populations. Once the data were gathered, the results were uploaded onto Microsoft Excel and SPSS for interpretation and analysis.

3.42 Testing Measures for Playground Size

The other variable in the research is that of playground size. The Net Site Area, defined previously as the usable site area available to the pupils, was measured using a trundle wheel. This was measured by the research staff and calculated in metres squared (m^2).

Results and Discussion

4.1 Introduction

This chapter details the key findings of the study which investigated the relationship between school playground size and PA levels. The data were collected using the pedometers as a measure of PA over the course of one school day for the six participating schools in the study. The playground size was measured using a Trundle Wheel which gave an accurate reading of the Net Site Area and was calculated in square metres. I, with help from other researchers, conducted a randomised sample of schools across Northern Ireland from both rural and urban locations and different socioeconomic backgrounds. The researchers completed a statistical analysis through standard deviation to interpret the results using Microsoft Excel and SPSS programs. The analysed results provide an insight into whether the useable outside playground space of a school is a determinant of the overall PA levels of the children across the school day

4.2 Subjects Details

A total of 408 invitations to participate were invited to take part in the study. A response rate of 67.9% (n=277) was achieved. There was a representative spread of participants across the demographics. There are 277 subjects in the cohort with 49.1% female (*n= 136*) and 50.1% males (*n=141*). The subjects ranged in age but all are in the Key Stage Two level age groups ranging from 84 months to 139 months averaging at 122 ± 12.9 months. Table 1 shows the data for the age of subjects.

Table 4.1. Age in months

Age in months		
N	Valid	277
	Missing	0
Mode		132.00
Range		55.00
Minimum		84.00
Maximum		139.00

The mean height of the subjects was 140.095 ± 7.550 cm with males averaging higher at 140.5 cm compared to 139.67 cm for females.

Body composition was calculated using bioelectrical impedance analysis to measure the body fat percentage of the subjects, the results can be used to identify the incidence of obesity in the subjects, but are not needed for the purposes of this study. The overall mean weight of the subjects in the study was 37.385 ± 7.842 kg with weight ranging from 23.2 to 59.4 kg.

There was no statistical difference between gender and other independent variables (Age, Height and Weight) indicating that participants were well distributed across demographic cohorts (See table 4.2).

Table 4.2. Statistical Differences between Gender and Age, Height, and Weight.

	gender	N	Mean	Std. Deviation
Age in months	Males	140	122.8429	12.67483
	Female	135	121.8222	13.22417
Height in cm	Males	140	140.5143	7.25665
	Female	135	139.6904	7.85119
weight in kg	Males	140	37.7150	7.84724
	Female	135	37.3063	7.86366

There was a moderate and statistically significant correlation between age of participants; height and weight (See Table 4.3). The relationship between age, height and weight is as expected with an aging and growing school age sample.

Table 4.3. Correlation between Age, Height and Weight of participants

	Age in Months	Height in CM	Weight in KG
Age in Months	1		
Height in CM	0.455**	1	
Weight in KG	0.300**	0.682**	1

**** Correlation is significant at 0.01 level**

4.4 Playground size

Figure 4.4 shows the Net Site Area (NSA) for each school presented in metres squared.

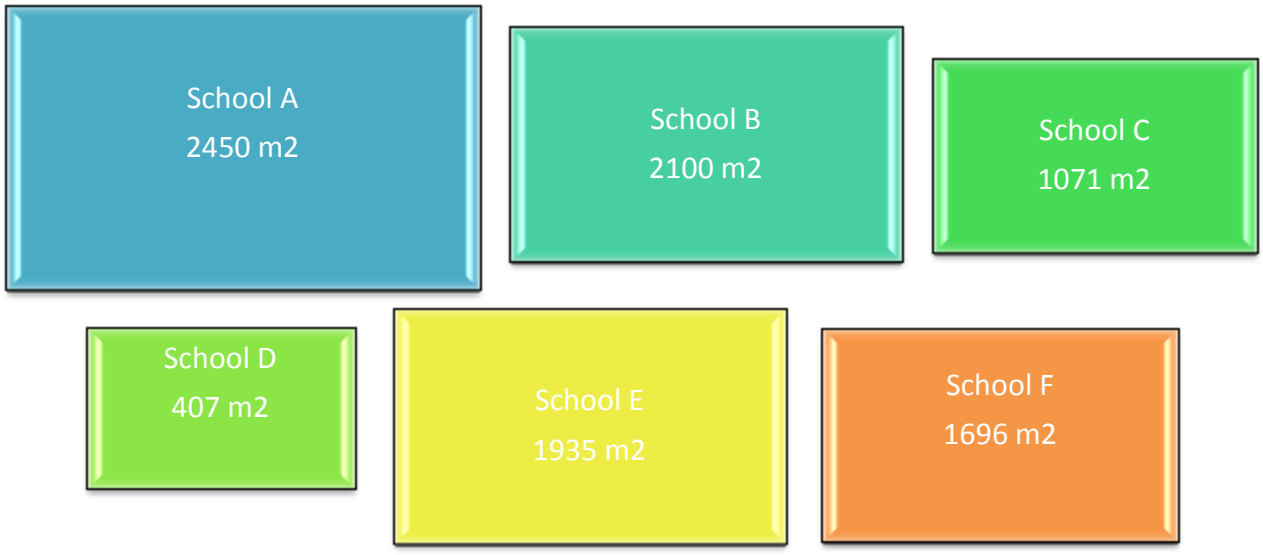

Figure 4.4. Net Site Area of the different schools in the study.

The diagram shows the largest school NSA was School A with 2450 m^2 playground space and smallest being School D at 407 m^2 usable space. The mean Net Site Area for the schools in the study was 1609.33 $\pm$ 747.86 m^2. Schools A, B, E, and F did not have any significant playground markings on the school grounds except court markings, which noteably the children did not play during their

recess times due to the lack of equipment for that sport. School D had numerous playground markings including a road, board games, a compass, snakes and other animals, and numerous hopscotch markings thorughout the playground. School C had also some hopscotch markings and other simple games on the playground concrete, however the paint was quite difficult to see and worn therefore it would have little to no effect on children's PA level.

4.3 Physical Activity

The mean steps taken by the subjects in the study were 3642.484 ± 1487.989 with overall steps ranging from 364 to 10065 making a range difference of 9701.

Overall, females took less steps than their male counterparts as shown in Figure 4.5. This confirms previous findings that boys were more active than girls (Riddoch et al.2004). Although in this study the difference was minimal with a 1% difference between gender.

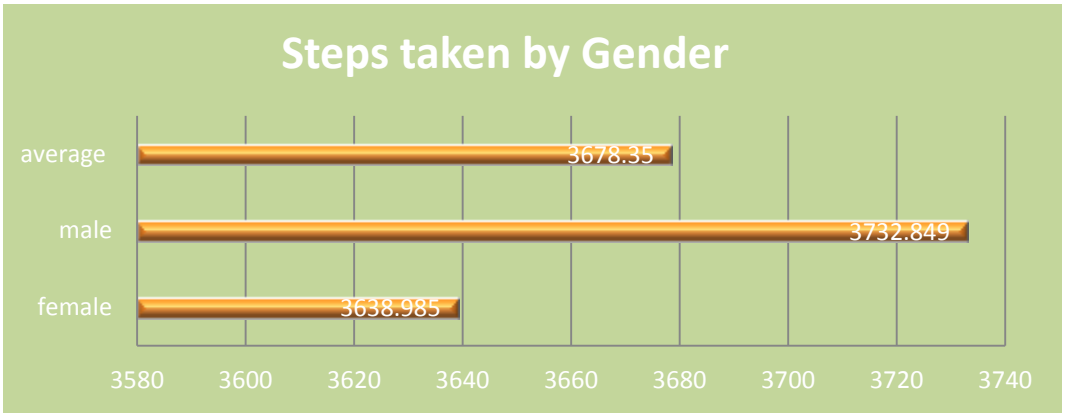

Figure 4.5. Steps taken by gender across all participating school.

The statistics indicate that PA levels differ greatly from school to school as shown in figure 4.6 which details the mean number of steps in each school. These differences were at a statsitically significant level (f=26.87, df = 4, p=0.001).

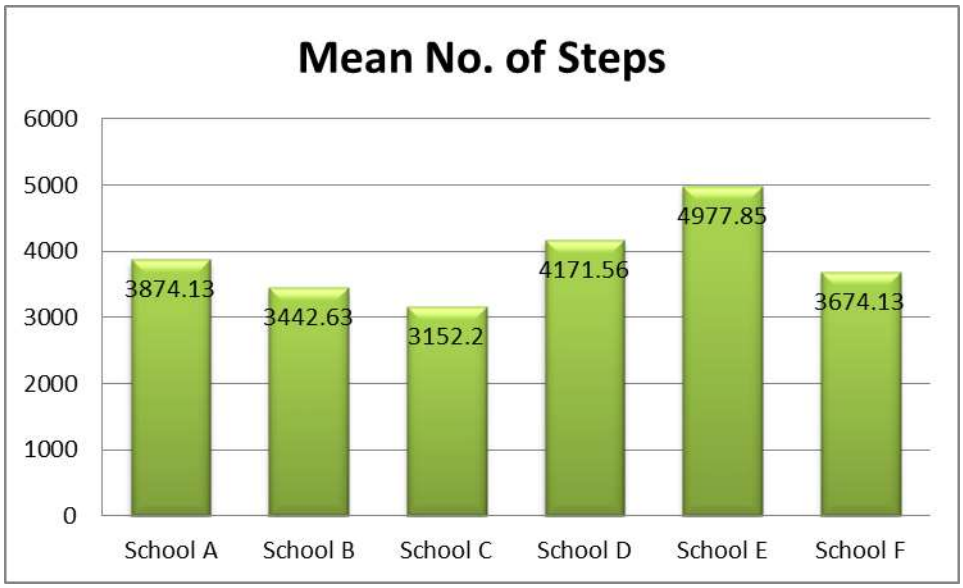

Figure 4.6. Mean Number of steps across particpating schools .

Examination of the relationship between age, height and weight and total steps taken show no significant relationship between steps taken and age and weight. A mild positive and statistically significant relationship existed between height in centimetres and steps taken (See table 4.7).

Total Steps Taken	Age in Months	Height in CM	Weight in KG
Pearson Correlation	.099	.140*	.074
Sig. Level	0.103	.021	.224
N	N=273	n=273	n=273

Table 4.7:. Correlation between Total Steps taken and independent variables Age, Height and Weight of participants..

*** Correlation is significant at 0.05 level**

School E averaged 1025.65 steps more than the lowest school (School C) in the study which is significant for it being over just one school day which raises questions as to how there could be such a difference given children stay in the schools for relatively the same amount of time. The intra-individual differences show that within the schools the range of steps taken also varied significantly, with the most noteable being School E which had the largest range of scores at 10065 for the most and 2135 for the least (Range = 7930). The mean range for all the schools together was 5470.33 which is quite large from student to student, again raising questions over the opportunities schools are giving to *all* the pupils in the promotion of physical activites across Northern Ireland which the study aims to help address.

4.5 PA levels and playground size

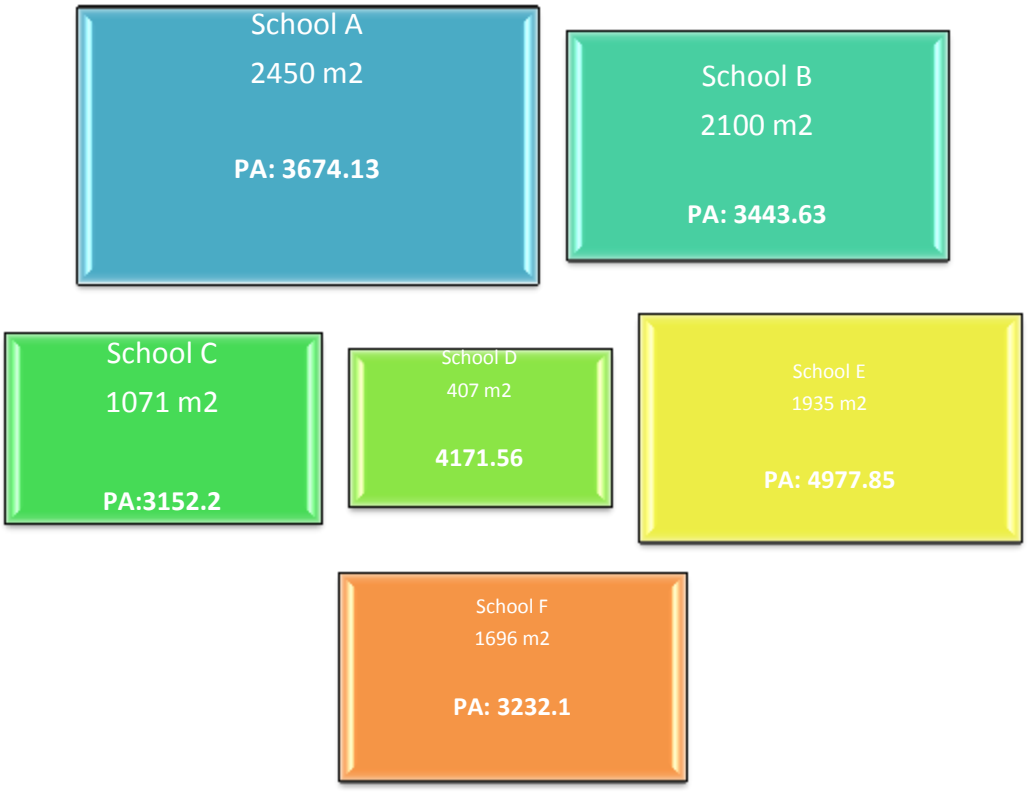

Figure 4.8a. Net Site Area and mean PA levels.

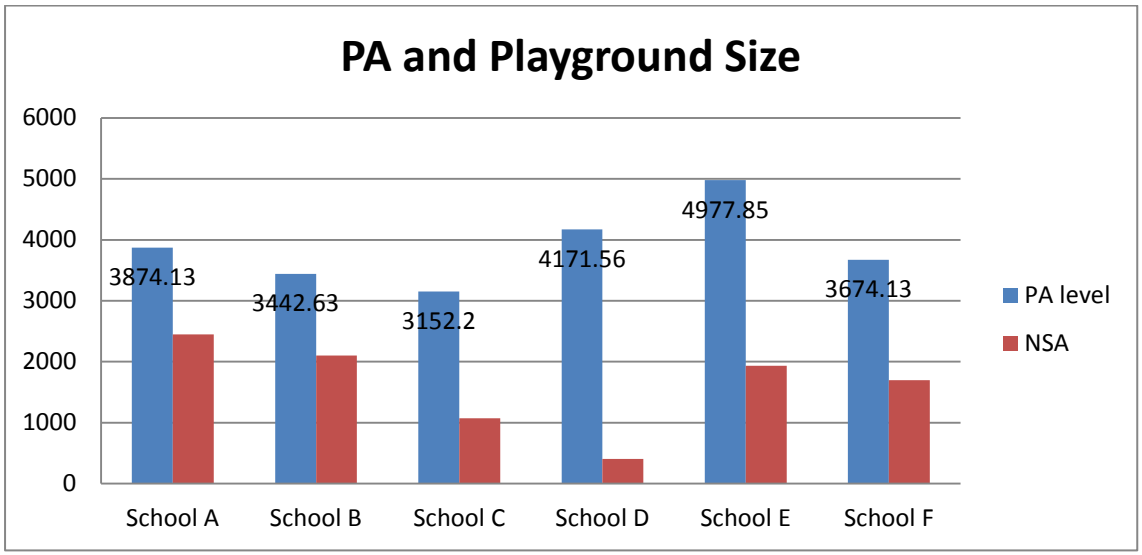

Figure 4.8b. Graph representation of mean steps for each school and NSA.

The information presented in the Figure 4.8a and 4.8b shows no correlations between the size of a school's useable playground space and the PA levels of the children. The mean PA level across all schools in the study was 3882.08 ± 640.88 steps per day. Most notably, School D had the lowest NSA, but the second highest average at 4171.56 ± 1417.95. School E was the overall highest mean PA level at 4997.85, and had the third largest playground space available (1935 m^2). School C had the lowest mean PA level at 3152.2 ± 1321.39 and the second lowest NSA. Schools A, B and F had similar PA average scores at 3874.13, 3442.63 and 3674.13 respectively. The NSA of these schools however differed significantly with School having the largest playground in the study at 2450m^2, School B at 2100m^2 the second highest in the study, and School F at 1696m^2 the third lowest NSA.

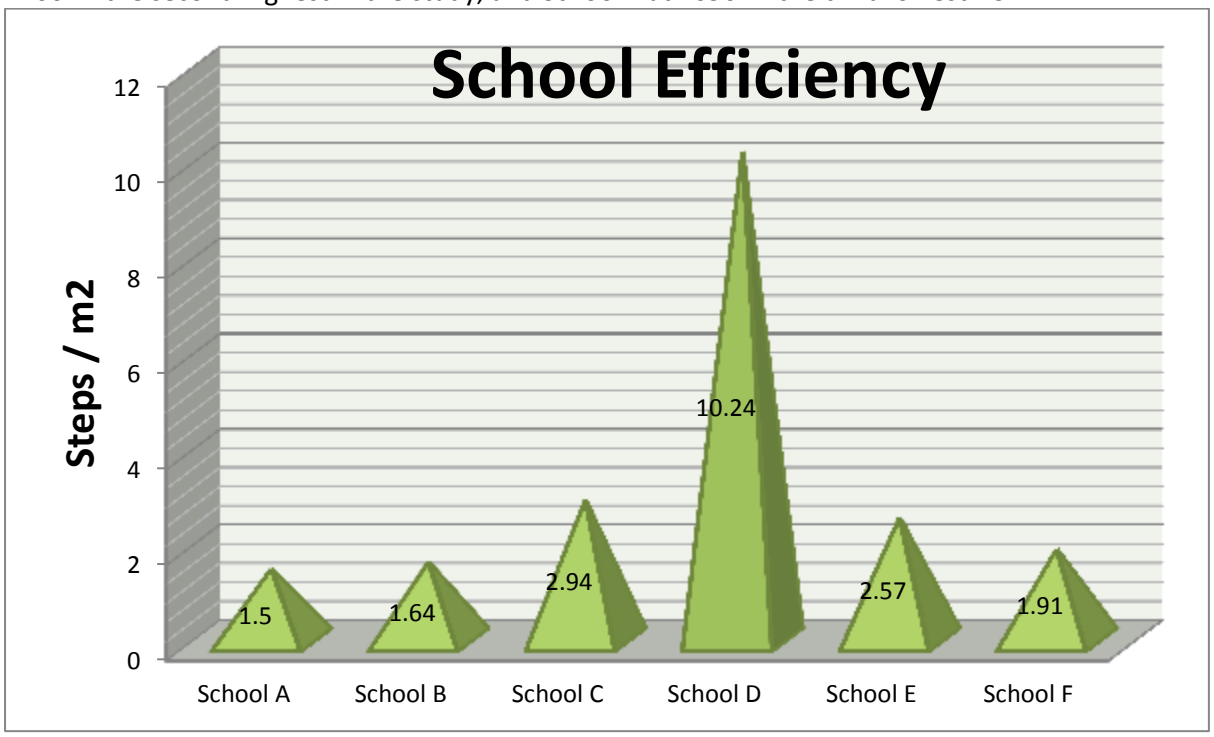

Figure 4.9. Graph showing school efficiency measured in steps per m^2

The previous data explain that it is not the size of the NSA a school has available that allows for greater PA, but how they utilise in the most efficacious way what they have for children to get the recommended PA as set out in the literature. School D was the most efficient school as it averaged at 10.24 steps per square metre as it had the lowest NSA and the second overall mean step rate. The closest school behind this was School C which averaged at 2.94 steps per square metre. The least efficient school was School A which notably had the largest NSA in the study. This suggests that a school with a larger playground available to them does not mean greater PA amongst the students, particularly girls who averaged at fewer steps overall. This could be because of nature of the games that children play between sexes (Lever, 1976). However, these results are in contrast to the findings of Mota et al. (2007) who found no differences between boys and girls in daily total accelerometer counts or the overall time spent in Moderate to Vigorous Physical Activity (MVPA). School A (the largest NSA) had the smallest range of PA levels with girls taking 135.14 steps less than their male counterparts. School D (the smallest NSA) had the biggest range between sexes with females averaging at 1311.47 steps fewer than the males. From this, one must conclude that smaller playgrounds mean less space available for girls and boys to play equally, therefore females would benefit a lot more from larger playground sizes, with it having less of an impact on male PA levels. I viewed this across all schools where children had a proportionately larger area for team games such as soccer and Gaelic sports (which was predominantly made up of males), whereas females (who are usually given the opportunity to play but don't) have to utilise the space which is left, which in the case of School D was very little explaining this large discrepancy between the sexes. Clark and Paechter (2007) note that girls and women have long been excluded from sport and physical activity due to perceptions of their inherent weakness and fragility.

Conclusion

5.1 Conclusion

Following research and data appraisal there is no correlation between playground size and PA levels in children. The Pearson Correlation was used to statistically analyse the results collected and recorded, showing that the R value equalled to 0.095 (mean difference is significant at the <0.05) and therefore indicating no significant correlation between the variables. However, from critical analysis it was found that those schools that have lower NSA's available, the female levels of PA are inhibited compared to male levels.

The literature investigating correlations between PA levels and playground size does not exist, however the work of Ridgers et al (2006, 2007, 2011, 2012), Stratton et al (2000), Verstraete (2000) and Mota (2003) have delved into the behaviours and significant role that it can play in the overall contribution to the PA guidelines set out by the World Health Organisation (WHO). This paper will highlight the need for schools to become more efficient in their use of their NSA, particularly when it comes to female PA levels which are most effected by smaller playgrounds.

5.2 Limitations to the study

Upon completion and evaluation of this study it became evident that a number of limitations which may have affected the overall outcomes of the research results. Firstly, whilst the data were collected over 6 schools across Northern Ireland, having a greater ambit of schools would give a superior overall picture of the school population and its PA habits in their respective playgrounds. Additionally, this would have increased the sample size which was quite low (*n=277)* which would also have led to more accurate conclusions.

A second limitation was that the data gathered was collected in one day across all the schools and in reflection the study would represent a more accurate set of results if the subjects' levels of physical activity were recorded over an extensive period of time. However, the time restraints of this study

meant that this method would not be possible. Due to it being over one school day, it was likely that one of the participating schools may have had PE, leading to distorted results for that schools' overall PA levels, because they were getting more recreational time than the other schools. In addition to this, none of the schools had the same exact recess times on the playground, which meant that some children were getting longer times on the playground, which would have led to greater subject averages in that school.

Another limitation was the validity of the pedometer model, before the research began I recorded my own PA levels using the pedometer, and soon recognised the ease with which the numbers could be increased on the digital screen. The pedometers were easily put on and taken off and so could be manipulated during class time with children shaking them. Whilst every measure was taken to reduce this, this is a major drawback to the reliability of the results.

5.3 *Recommendations and further research directions*

The first recommendation for more reliable results would be to run the study over the course of weeklong focus groups. Being only in for a day seemed new and novel for the children which led to them being over excited and so may have distorted the results, if this was carried over one week the researcher would get a truer gauge of the child's PA levels. In my view, increasing PA levels across Northern Ireland is a realistic and essential objective to combat the negative effects that sedentary lifestyles promote. Through some simple research proven strategies implemented on a national scale schools can increase PA levels of ALL children, and enjoy the academic and health benefits for their student population. Increasing NSA during unstructured recess time does not seem to increase children's PA. However based on the results from the study, in order for school to increase the playground efficiency schools should aim for a minimum of 3.5 steps per square metre, based on the mean values of the schools in the study.

Schools must also implement more effective strategies that are shown to increase efficiency of playground space. Some of these include:

- Providing more games equipment (Verstraete, et al, 2006)
- Social prompts from adults e.g. Playground Supervisors (McKenzie et al. 1997) [cited in Verstraete, et al, 2006]
- Playground Markings (Stratton, 2000)
- School Programmes (Trudeau and Shepard, 2005). Connolly et al. (1995) reported that elementary school children were significantly more active after playground supervisors implemented a game curriculum during recess time.
- Classroom-based health education focused on information provision (Kahn et al. 2002)
- In order to get more detailed and less distorted results, I would recommend some further changes for study in this area. A more detailed results portfolio could be investigated with the use of a Global Positioning System (GPS) and HR monitoring, which would provide real time data for the researchers, covering distance, heart rates and speed as a marker for intensity for each individual child without them being too aware of the device. In a feasibility study, Duncan et al. (2008) concluded that the combined approach of GPS and HR monitoring is a promising new method for investigating children's play-related energy expenditure. This is in contrast to the pedometer which could easily be manipulated as discussed earlier.

I would also propose that to control for the different lengths of recess time in each school, the PA data (pedometer or GPS) should be expressed as a percentage of the playtime, so that accurate conclusions can be made about how playground size truly affects children's PA levels when they are calculated to get equal amounts of time in the playground.

References

Bassuk, S. Manson, J. (2005) '*Epidemiological evidence for the role of physical activity in reducing risk of type 2 diabetes and cardiovascular disease',* Journal of Applied Physiology, Vol. 99.

Biddle, S and Asare, M. (2011) '*Physical activity and mental health in children and adolescents: a review of reviews',* British Journal of Sports Medicine.

Clark, S., and Paechter C. (2007) *'Why can't girls play football?' Gender dynamics and the playground*, Sport Education and Society, Vol 12.

Connolly, P. McKenzie, TL. (1995) '*Effects of games intervention on the physical activity levels of children at recess',* Res Q. Exerc Sport.

Dale, D. Corbin, CB. AND Dale, KS. (2000) '*Restricting opportunities to be active during school time: do children compensate by increasing physical activity levels after school*' Res Q Exerc Sport.

Department for Education (2014)
https://www.gov.uk/government/publications/mainstream-schools-area-guidelines
(Accessed 13 / 10 / 2014)

Dollman, J. Norton, K. and Norton, L. (2005) *'Evidence for secular trends in children's physical activity behaviour',* British Journal of Sports Medicine, Vol. 39, Issue 12.

Duncan, S. Badland, H. and Schofield, G (2009) *'Combining GPS with heart rate monitoring to measure physical activity in children: A feasibility study',* Journal of Science and Medicine in Sport, Vol. 12 Issue 5.

The Education (School Premises) Regulations (1999)
http://www.legislation.gov.uk/uksi/1999/2/schedule/2/made
(Accessed 13 / 10 / 2014)

The Education (School Premises) Regulations (2012)
http://www.legislation.gov.uk/uksi/2012/1943/regulation/10/made
(Accessed 13 / 10 / 2014)

Eime, R.M. Young, J.A. Harvey, J.T. Charity, M.J. And Payne, W.R. (2013) '*A systematic review of the psychological and social benefits of participation in sport for adults: informing development of a conceptual model of health through sport*' Melbourne, Australia: Institute of Sport, Exercise and Active Living. Victoria University.

Erwin, H. Fedewa, A. Ahn, S. (2013) *'Student Academic Performance Outcomes of a Classroom Physical Activity Intervention: A Pilot Study',* International Electronic Journal of Elementary Education.

Fox, K. and Hillsdown, M. (2007) '*Physical Activity and Obesity*', Obesity Reviews.

Hensrod, D. (2004) *'Diet and Obesity',* Current Opinion on Gastroenterology. Vol. 20 Issue. 2.
[http://journals.lww.com/co-gastroenterology/Abstract/2004/03000/Diet_and_obesity.12.aspx]
(Accessed 1 3/ 10 / 14)

Hardman, A. and Stensel, D. (2003) *Physical Activity and Health: The evidence explained,* Routledge, London.

Hoza, B. Smith, A. Shoulberg, E. Linnea, K.Dorsch, T. Blazo, J. Alerding, and C. McCabe, G. *'A Randomized Trial Examining the Effects of Aerobic Physical Activity on Attention-Deficit/Hyperactivity Disorder Symptoms in Young Children',* British Journal of Abnormal Child Psychology

Kahn, E. Ramsey, L. Brownson, R. Heath, G. Howze, E. Powell, K. Stone, E. Rajab, M. Corso, P. (2002) *'The effectiveness of interventions to increase physical activity',* American Journal of Preventative Medicine, Vol. 22. Issue 4.

Malina, R. Bouchard, C. and Bar-Or, O. (2004) *Growth, Maturation, and Physical Activity,* Second Edition, Human Kinetics, Champaign, IL.

Mota, J. Silva, P. Santos, M. Ribeiro, J. Oliveira, J and Duarte, J. (2005) *'Physical activity and school recess time: Differences between the sexes and the relationship between children's playground physical activity and habitual physical activity',* Journal of Sport Sciences. Vol. 23. Issue 3.

Nettlefold, L. McKay, H. Warburton, D. McGuire, D. Bredin, S. and Naylor, P.J. '*The challenge of low physical activity during the school day: at recess, lunch and in physical education',* British Journal of Sports Medicine.
NHS (n.d.)
http://www.nhs.uk/news/2012/05may/Pages/girls-put-off-exercise-school-sport.aspx
(Accessed 07 /10 / 2014)
Northern Ireland Curriculum (NIC, 2007)
http://www.nicurriculum.org.uk/key_stages_1_and_2/areas_of_learning/physical_education/
(Accessed 10 / 10/ 2014)
Ofsted (2013)
http://www.ofsted.gov.uk/news/not-enough-physical-physical-education-0
(Accessed 02 /10/ 2014)
Proctor, M. Moore, L. Gao1, D. Cupples, L. Bradlee, L. Hood, M. and Ellison, R. (2005) '*Television viewing and change in body fat from preschool to early adolescence: The Framingham Children's Study',* International Journal of Obesity.
Ridgers, N. Stratton, G. and Fairclough, S. (2006) *'Physical Activity Levels of Children During School Playtime' ,* Journal of Sports Medicine.
Ridgers, N. Stratton, G. Fairclough, and S. Twisk, J. (2007) *'Long-term effects of a playground markings and physical structures on children's recess physical activity levels',* Preventative Medicine (Journal).
Ridgers, N. Salmon, J. Parrish, AM. Stanley, R. and Okely, A. (2012) 'Physical *activity during recess',* American Journal of Preventative Medicine. Vol. 43, Issue 3.

- Riddoch, J, Andersen, B, Wedderkopp, N. Harro, M. Klasson-heggebø, l, Sardinha, B. Cooper, R and Ekelund, U. (2004) '*Physical Activity Levels and Patterns of 9- and 15-yr-Old European Children'*, Med. Sci. Sports Exerc. Vol. 36.

Scudder, M. Federmeier, K. Raine, L. Direito, A. Boyd, J. and Hillman, C. (2014) *'The association between aerobic fitness and language processing in children: Implications for academic achievement', Brain and Cognition (Journal).*
Strycker, L. Duncan, S. Chaumeton, N. Duncan, T. and Toobert . D. *'Reliability of pedometer data in samples of youth and older women',* International Journal of Behavioural Nutrition and Physical Activity.
Taras, H. (2005) '*Physical Activity and Student Performance at School',* Journal of School Health.
Telamar, R. Yang, X. Vikari, J. Valimaki, I. Wanne, O. and Raitakari, O. (2005) '*Physical activity from childhood to adulthood: a 21-year tracking study',* American Journal of Preventative Medicine. (http://www.ncbi.nlm.nih.gov/pubmed/15766614 - accessed online 10 / 12 / 2014)
Verstraete, S. Cardon, G. De Clerq, D. and De Bourdeaudhuij, I (2006) '*Increasing children's physical activity recess periods in elementary schools: the effects of providing game equipment',* European Journal of Public Health.
Wareham, N. van Sluijs, E. and Ekelund, U. (2007) '*Physical activity and obesity prevention: a review of the current evidence',* Proceedings of the Nutrition Society, Cambridge Journals.
http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=902876&fileId=S0029665105000273 (Accessed online 15 / 10 / 2014)
Weinberg, L. Hasnia, A. Shinoharab, M. and Duarte, A. *'A single bout of resistance exercise can enhance episodic memory performance'*, Acta Psychologica (Journal).
World Health Organisation (2011)
http://www.who.int/dietphysicalactivity/leaflet-physical-activity-recommendations.pdf?ua=1
(Accessed 07 /10 / 2014)