Is there any relationship between the variables of physical fitness and academic achievement within a Primary School context?

Name: Paul Smart

Tutor: Dr Elaine McLaughlin

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Abstract

This study was carried out to determine whether there was a positive correlation between physical fitness and academic attainment due to the extensive number of benefits already known to be attained as a result of good physical fitness, for example increased levels of cognitive development. The subjects of this study were 295 children working in Key Stage Two in Primary Six and Seven. A total of 15 schools were sampled in both rural and urban settings across Northern Ireland. Due to the qualified nature of the study it inevitably produced results which were less incisive than a full study.

INCAS scores for literacy and numeracy were used as a means of assessing each child's level of academic attainment, with each score given a corresponding reading or maths age. In order to assess the overall fitness level of the children it was determined that they should be assessed across five components of fitness and then ranked accordingly against their peers. Research indicated an appropriate test to use with the children for each component with the "20 metre Shuttle Run/Bleep Test" used to test endurance, the "T" test used to assess agility, the "Sit and Reach Test" used to investigate flexibility, the "Handgrip Dynamometer" used to test strength while speed was assessed by the "20 metre Dash".

The findings of the testing were very wide ranging with regard to the scores attained in the academic assessment and those attained in fitness tests by the children. Although there were a few cases where a child performed highly in both a fitness test and academically, overall this was not reflective of the sample group. However it is interesting to note that the boys outperformed the girls in maths while the girls tested better in reading.

The conclusion can be made with the help of the Spearman Rank Test that there is no positive correlation between the variables of physical fitness and academic achievement, although the benefits to a child's physical and social development are unquestionably enhanced by physical activity.

Introduction

1.1 Background to the study

Being physically active and maintaining a relatively high level of physical fitness brings with it numerous physiological and psychological benefits. Research has proven that self-esteem can be drastically improved through participation in physical activity as well as improving levels of concentration and also aiding the development of social skills. Cale and Harris (2005) and Howley and Thompson (2012) are all of the opinion that a person who has a poor level of physical fitness is at an increased risk of developing chronic diseases, lowering their heart rate or becoming obese, all of which become more detrimental to the body as the person gets older. The area that has drawn the attention of many researchers is the increased level of cognitive functioning that occurs as a result of a child engaging in physical activity. This has caused many experts in the field to speculate about the possible correlation between physical fitness levels and an increased level of academic attainment.

1.2 Need for the study

Within Primary Education there is little doubt that teachers need to make a conscious effort to continually assess the levels of academic attainment within their class as this will allow them to address any issues that their class are having at an early stage. In addition to this, with levels of childhood obesity on the increase teachers need to be proactive in helping to curb the trend by providing their pupils with ample opportunities to engage in physical activity. The British Heart Foundation (2010) outline that children in Northern Ireland should be engaging in at least 60 minutes of physical activity per day which is unlikely to be attained by the majority of children without the support of their class teacher. Due to the high level of importance placed on both physical fitness and academic attainment in young children it is not surprising that research into these areas has been extensive. However research conducted to assess the potential correlation between physical fitness and academic attainment has been inconclusive. In a recent study Sport NI (2009) carried out an investigation with primary school children to assess what percentage of them were meeting the 60 minute guideline set out for daily physical activity, with only 24% of 9-11 year olds attaining the target. If future research is able to show that there is a positive correlation between physical fitness and academic attainment then this would massively increase the pressure on schools to meet daily physical activity guidelines.

1.3 Aims and Objectives

Fundamentally the aim of this study is to assess the full extent, if any, that a primary school child's level of physical fitness has on their ability to attain academically. The subjects in this study attend primary schools across a variety of rural and urban settings within Northern Ireland. In total there are 295 pupils involved across 15 different schools with 138 females and 157 males making up that number. The children are currently in Key Stage Two in either Primary Six or Seven. In order to assess the level of physical fitness that the children have 5 tests will be carried out, each addressing one of the major fitness components outlined by researchers such as Cale and Harris (2005). Speed will be assessed using the "20 meter dash", cardiovascular endurance will be measured using the "bleep test", the "T-Test" will be used to assess agility, the "Handgrip Dynamometer" will be used to assess muscular strength and the "Sit and Reach" test will be used to measure flexibility. INCAS (Interactive Computerised Assessment System) will be utilised as a means of assessing the children academically for the purposes of this study. INCAS are used by teachers to continually assess each child in numeracy and literacy each year and as the results provide a corresponding reading and numeracy age it will allow for comparisons to be made against their actual age. When all of the relevant data has been collected it will be logged immediately with the aid of a spread sheet. This will allow for easier interpretation and analysis of the results before then concluding on what the data highlights with regard to the two variables under investigation. Should this study need to be used to assist with future research recommendations will be made to assist in that process.

Literature Review

2.1 Children' Fitness Levels

Fitness is a term that is interpreted in a number of different ways across a variety of contexts so it is important that clarity is given to its meaning. Physical fitness is defined as "the capacity to perform physical activity, and makes reference to a full range of physiological and psychological qualities" (Ortega et al, 2008). They continue stating that physical fitness can be seen as an integrated measure of almost all the body functions involved in performing daily tasks or physical exercise (Ortega et al, 2008). From this the assumption can be made that physical fitness is an effective indicator of a person's general health.

Within a school environment physical fitness is incorporated into the curricular area of physical education and it is through this area that children have the opportunity to develop not only their physical but also their mental attributes. According to Sibley and Etnier (2003) "Physical education is a field that advocates a holistic approach to human development." This is a view shared by Weiss (2011) when stating that physical education lessons within schools provide a perfect context to promote not only physical fitness but to also help students acquire life skills as well as developing behavioural and psychosocial attributes. These skills can then be effectively transferred into other important domains either at work, home or school. Weiss (2011) emphasizes that these skills and attributes should include motor skill development, physical activity and health goals.

Maintaining a good level of physical fitness is of crucial importance to people during their childhood and adolescence as according to Ortega et al (2008) it is during these phases that people undergo the majority of their physiological and psychological development. It is for this reason that the World Health Organisation (2013) views childhood obesity as one of the most serious global public health challenges for the 21st century.

A study by Tokmakidis et al (2006) focused on a group of 709 Greek children (328 girls and 381 boys). After the appropriate fitness tests, had been carried out the results showed that almost 60% of the children had a body mass index (BMI) which was deemed to be normal, while the other 40% had a BMI of a person that was either overweight or obese. With over one third of children tested in the survey obtaining a BMI which was not within the normal bracket this substantiates the grave concerns raised by the WHO.

Vincent et al (2003) support the concerns of the WHO stating “There is much concern about the rapid increase in the percentage of overweight and obese children found in many countries. For example, in the United States the percentage of children and adolescents who are overweight has more than doubled in the past 30 years.” (Vincent et al, 2003)

This is not simply an isolated issue within the USA or Greece as in England every year The National Child Measurement Programme (NCMP) measures the height and corresponding weight of around 1 million school children in England. Their most recent results for 2011/12 highlighted just how prevalent childhood obesity is now. The findings showed that over one fifth of children aged 4-5 and also one third of children aged between 10 and 11 were overweight or obese (Public Health England, 2011). As the research that has been carried out in a number of countries has presented the same issues of an increasing level of children that are overweight or obese the assumption can be made that the falling level of children’s fitness and general health is a global issue not confined to one country or geographical region.

Fitness tests are used as a means of measuring four key health-related components of physical fitness. They are given a high level of priority because in young people they are important for maintaining their health. The four components are aerobic fitness, muscular strength and endurance, flexibility and body composition (Cale and Harris, 2005).

According to Cale and Harris (2005) a fitness test that can be used to assess aerobic fitness is the bleep test. This test involves the children running up and down a 20 metre grid to progressively faster bleeps until a point of exhaustion as it is a maximal test. Once a child has stopped the test it is important that their pulse is taken over a period of 15 seconds as a means of assessing how fast their heart rate is. The expectation is that the higher the child’s aerobic fitness level, the lower their heart rate will be. Fundamental to testing muscular strength is the movement or resistance of part or all a person’s body weight. An effective test to measure this is a progressive abdominal sit-up test where the child performs a sit-up at the sound of a bleep until exhaustion. Flexibility can be effectively tested by the sit and reach test as participants are required to reach as far over their own feet as they can while keeping their legs flat to the ground. The distance is measured on a scale and indicates their leg flexibility. Calculating the BMI for someone is a simple and effective method of testing their body composition (Cale and Harris, 2005).

In the technology driven society that we now live in there are an increasing number of factors that influence the fitness levels of children. Ortega et al (2008) state that "Physical fitness is in part genetically determined but it can also be greatly influenced by environmental factors. Physical exercise is one of the main determinants." These environmental factors are wide ranging and include the role that computer gaming has played in replacing the time that children would previously have spent outside running around and playing sports. This increase in the popularity of computer gaming has come at a time when The British Heart Foundation (2010) outlined in their physical activity guidelines for Northern Ireland that children should be engaging in at least 60 minutes of moderate intensity physical activity per day. With most of the school day being spent in the classroom and most of the evening being spent increasingly at a computer this target of 60 minutes appears to be a long way off what some children are doing. The British Heart Foundation (2010) supports this claiming that as high as 30% of boys and 40% of girls are not attaining this minimum level of physical activity.

Ortega et al (2008) state that the lifestyle choices made during these years as a child, either healthy or unhealthy will have a large bearing on their health as a child and later as an adult. The responsibility for making the correct choices is ultimately that of the parents as they are likely to be in control of the child's diet, whether they walk or get a lift to and from school, how much time they spend indoors playing computer games and whether the child is involved in extracurricular sports or not. These and various other environmental factors will have an influence, positively or negatively on the fitness of a child along with their genetics according to Ortega et al (2008).

2.2 Academic Achievement

In school there is no question that children develop far more than simply their understanding of the curricular areas. Children develop as individuals socially, morally and also physically, providing them with the skill set to enable them to fulfil their full potential during their adult life. Within the classroom environment each child will have their own set of interests and hobbies, influenced by their personality as well as a number of other external factors such as their family. The same can be said for the manner in which children learn in the classroom. Therefore it is the responsibility of the class teacher to provide a wide range of experiences to cater for the needs of every child. CCEA (2007) in the Northern Ireland

Primary Curriculum outlines that in order for teachers to meet the needs of all their pupils when planning they need to consider implementing a varied set of teaching styles which will appeal to the spectrum of learning styles within the classroom. Ensuring that the children are engaged in active learning for the entire lesson is fundamental as the pupils should be given the chance to use a range of different organisational approaches.

Although developing children socially and morally during school is important to their development as well-rounded individuals, success is ultimately judged by how children achieve academically through in class and statutory assessments, therefore a great deal of emphasis is placed on a child's ability to complete tasks to a high standard within a restricted time frame.

With regard to the Northern Ireland Primary Curriculum (2007) children's learning is separated into a number of different thematic units which incorporate all of the traditional subjects that children learn in school. The idea behind grouping certain subjects together in thematic units such as World Around Us which combines the subjects of history, geography and science is that there are strong connections between areas of learning within each of these subjects. Through effective teaching these subjects can be integrated together to give children a much better appreciation of how each subject relates to each other rather than teaching them in isolation. This interconnected system of learning reflects the reality of the adult workplace in terms of how skills learnt in one area can be effectively applied to other areas.

Assessing how a child is performing academically is fundamentally important to schools and this is reflected by the depth and variety of assessments that schools utilise in order to attain an accurate set of results. Statutory assessment targets were set out by CCEA as a means of measuring the 5 levels of attainment for children working within Key Stage 1 and Key Stage 2. Every child is assessed against these levels, including those with statements of special educational needs. They are used by teachers to monitor progress, measure achievement, award levels and target set for each child individually and the class as a whole. Bartlett (2003) agrees that assessment of children allows teachers to accurately see where the strengths and weaknesses of each child lie and therefore provides them with a platform on which they can tailor their teaching style to address the issues that are presented. Throughout the academic year these targets are used as a constant point of reference for teachers. Each child is formally assessed at the end of Key Stage 1 and also at the end of Key Stage 2 against statutory levels of attainment for communication and using mathematics. The expectation is

that the average child in Key Stage 1 will attain level 2 and the average child in Key Stage 2 will attain level 4 (DENI, 2009).

NRIT is a non-reading intelligence test to measure a child's innate ability. It is usually used during both Key Stage 1 and 2 and helps to give a context to the standardised test scores, allowing schools to target set more effectively. NFER tests are then used to assess progress in literacy and numeracy and have always been used by the vast majority of schools. If a child achieves a high score in their NRIT but then obtains a low score on their NFER test then this is a clear indicator that the child is underachieving as they have a high level of innate ability but are not progressing well in literacy and numeracy.

A child's ability to achieve academically may be affected by a number of external factors. Furrer et al (2003) states that "Children's sense of relatedness is vital to their academic motivation" which taken to its literal meaning in the classroom suggests that it is a child's ability to feel connected to their learning, which can be achieved through the effective use of varied teaching styles, but also their ability to connect and relate to their peer group and the class teacher which will impact on their academic achievement.

A negative self- image is often one of the symptoms that children suffer from as a result of factors like those outlined by Swale (2007) as social disadvantage, gender, ethnicity and school processes. Montgomery (2009) explains that children who suffer from a poor self-image do not feel as though they are capable of being successful in class and therefore underachieve. This often comes as a result of an unsupportive learning environment where the school sets only low aspirations for their own pupils because the school as a whole is underachieving.

Outside of the school environment children gain a large depth of knowledge through observing and imitating their parents according to Bandura's Social Learning Theory (1982). If the child's parents had a bad experience of education and felt that they were unfairly treated by their school or particular teachers due to their socio-economic class then this sense of disconnection with education will undoubtedly filter down to the child. The result of this is that the child is then less likely to enjoy being in school and therefore more likely to be absent. This disconnection from education often leads children to associate themselves with individuals and groups of children who are from similar backgrounds, isolating themselves further from the rest of their peers. As Estell et al (2008) detail this can result in children who have a high level of innate ability following the often anti-social behaviour set out by other

more influential friends within their group with the child eventually falling out of education entirely at an older age.

2.3 The possible correlation between fitness levels and academic achievement

Coe et al (2006) stated that "Numerous studies have shown positive relationships between academic achievement and both physical activity and sports participation". Furthermore as a result of engaging in an increased level of physical activity through physical education individuals may experience an increased level of arousal, coinciding with a reduction in boredom. This in turn may result in an increased level of concentration which can be crucial when children are engaging in class work, especially on new concepts (Coe et al, 2006).

Castelli et al (2007) put forward the point that professionals within the fields of education and health have intuitively believed that there was a positive correlation between a high level of fitness and a corresponding high level of academic performance in school. These individuals would have first-hand experience of how children with a variety of fitness levels perform differently in the classroom as well as the relevant expertise to make educated assumptions on this issue.

In 2001 CDE carried out a research study to investigate the relationship between physical fitness and academic achievement. In this study, reading and mathematics scores were matched with the fitness scores of over 900,000 fifth to ninth graders. A positive relationship was observed between physical fitness and the Academic Achievement Test across all three grade levels, indicating that there was a positive correlation between higher fitness levels and higher academic achievement (Castelli et al, 2007). The CDE (2001) study sets a context for the latter research study that CDE carried out in 2006. This study extended the findings to conclude that there was also a positive relationship between vigorous physical activity and higher grades.

"Educators have suggested that movement, particularly in very young children, stimulates cognitive development" (Castelli et al, 2007). This implies that it is the movement involved in physical activity rather than the physical exertion which helps in the cognitive development of children. Therefore assessing the relationship between the time spent participating in physical activity and academic achievement rather than the influence of

fitness levels might produce a more accurate set of results. This will then take account of children who might not have a high level of cardiovascular fitness due to external factors such as poor diet but because they participate in a lot of physical activity such as dance their cognitive development is stimulated, enabling them to perform better academically. Castelli et al (2007) citing the work of Piaget appears to offer further evidence that it is through a child engaging in physical activity rather than their level of physical fitness that equips them with a set of transferrable skills which are applicable to an academic setting. "According to Piaget, skills and relationships learned during physical activity carry over to the learning of other relationships and concepts."

Castelli et al (2007) raise the point that due to the large number of external variables that children are confronted with that further research is required to investigate to what extent these impact on both academic performance and fitness levels in young people, rather than examining the correlation between fitness levels and academic achievement without giving consideration to potential socio-economic factors. Grissom (2005) provides further evidence that supports the position held by Castelli et al (2007) when reflecting on the findings of the study held to compare fitness levels with academic achievement in reading and mathematics. Grissom (2005) stated that the "Results need to be interpreted with caution. First, it is possible that the relationship between fitness and achievement was mediated by variable(s) not included in this study."

This suggests that external variables such as the socio-economic class of the child or the level of parental education may have an influence on the child's ability to achieve academically or indeed to be physically fit. If parents do not place a high level of importance on education because possibly they left school at an early age and got a job then this will devalue education for the child as their focus will be on getting a job, not sitting in school. This will adversely affect the child's ability to achieve academically regardless of their fitness level.

2.4 Conclusion

The full extent to which a child's fitness level affects their academic performance remains unclear due to the potential influence of other external variables on them. It is clear however according to Castelli et al (2007) that engaging in physical activity helps to

stimulate cognitive development and also aid concentration levels for children. This may not directly affect the academic achievement experienced by the child but enabling them to focus more in class is therefore providing them with a platform on which to learn and achieve as they are likely to retain more information. Also for children that struggle with classwork physical activity often provides them with the opportunity to experience success. This increases the level of self-esteem that a child has, giving them newfound confidence to take on their academic work with a renewed sense of optimism. Children are also able to develop life skills as well as developing their behavioural and social attributes through physical education lessons, all of which are easily transferred to a school context (Weiss, 2011).

Methodology

3.1 Research Design

This study has two main focus areas, the physical fitness and level of academic attainment that children have. The primary objective is to investigate how these two areas interact and to assess whether a higher fitness level corresponds with a higher level of academic achievement. Fundamental to the success of this study are the testing methods used to gather the required data and therefore extensive research is essential to ensure that the most appropriate tests are used and then collated in an efficient manner. The investigation will take account of fitness components that are either skill or health related which will help to give a more balanced set of results that reflect the overall fitness of the children. The elements that are under examination are speed, agility, strength, flexibility and endurance.

Due to the nature of the investigation that is being carried out the most appropriate research design to implement is quantitative as according to Hibberts and Johnson (2012) this will be necessary to take account of all the raw data that will be collected from the large group of children. This statistics based research method is more appropriate and beneficial than carrying out a subjective qualitative study where interviews, questionnaires and surveys form the basis of the data that is collected for this reason.

3.2 Subjects

The subjects in this study all attend primary schools in Northern Ireland in both rural and urban settings. There are a combined total of 295 pupils across 15 different schools involved in the investigation with 138 females and 157 males making up that number. All of the children sampled are currently in Key Stage Two and in either Primary Six or Seven.

3.3 Procedures

In order to ensure that the investigation is carried out in an appropriate and professional manner it is essential that certain protocol is followed. As the school and their pupils are fundamental to the investigation it is important that consent is obtained from both the school principal and also the parent/guardian of the children involved. Consent is also essential in order to ensure that the data that is collected can be utilised in the research study. The letter of consent that is sent to both the principal and parents will outline the purpose and requirements of the investigation as well as the exact information about what the process will

involve. It will stress that all information collected will remain entirely anonymous and that everything will be conducted in a professional manner. Accompanying the informative letter will be a consent form that upon completion will confirm the participation of each affiliated child.

Once consent has been given by the concerned parties it is then important that the children are informed about the specifics of each test. Each test is demonstrated to the children as this will help to reduce any confusion regarding what each involves, therefore reducing the likelihood of mistakes. The children are also told that the purpose behind the tests is investigative and not competitive although they are still encouraged to perform to the best of their ability in each test.

Employing an effective organisational approach to displaying the data will help to allow for easy interpretation and comparison between the fitness tests and academic test results. With this in mind a spread-sheet format is appropriate and will therefore be setup prior to testing to allow for an easy transfer of results as each test is completed, again helping to reduce the chance of mistakes.

3.4 Test

The investigation will be based around the data collected from 7 tests, 5 of which are fitness tests, while the other 2 are the Academic Attainment Tests for literacy and numeracy.

3.4.1 Testing Physical Fitness

Fitness tests will be used to assess the elements of cardiovascular endurance, agility, flexibility, muscular endurance and also speed. Cale and Harris (2005) explain in great depth the various testing options that are appropriate to assess each of the concerned fitness components as well as outlining the perfect model for setting up and executing each test. It is essential to ensure that the most appropriate testing method is used for the age and experience of the subjects in order to ensure the reliability and validity of the data gathered.

The bleep test is an effective and simple method of testing the cardiovascular endurance levels of the children. Flexibility will be assessed by the sit and reach test while speed will be tested by a timed short sprint over a 20 metre stretch. The handgrip dynamometer is an appropriate method of testing muscular strength while the “T” test is

going to be utilised to test agility. Appendix C covers each of these fitness tests in greater detail, explaining the procedure of each test as well as the equipment required in order to run them.

3.4.2 Testing Academic Achievement

INCAS (Interactive Computerised Assessment System) is utilised by teachers as a means of assessing children in literacy and numeracy each year. It is an appropriate method of academic assessment for this study as its results also generate a corresponding reading and numeracy age for each child, allowing for easy comparisons to be made against their actual age. This is very useful as it allows the teacher to assess whether each child's literacy and numeracy competency is developing in line with their actual age, highlighting any children that are having difficulties. As with any type of formal assessment the results of INCAS need to take account of a child's general class work and other assessment scores as a number of external socioeconomic factors could impact on a child's ability to perform to their full ability.

3.5 Statistical Analysis

The Spearman Rank Test will be used to assess any possible correlation between the variables of physical fitness and academic achievement.

Results and Discussion

4.1 Introduction

Within this chapter, the results of the tests that were carried out by 297 Primary 6 and 7 pupils are presented in a variety of graphic formats. These graphs will help to highlight specific trends and therefore better inform the discussions that follow them. The aim of the study was to investigate the possible correlation that exists between physical fitness and academic achievement in children. In order to investigate this it was important that a sample group of children were used to undertake a series of tests specific to each component of physical fitness under investigation. The components used were cardiovascular endurance, muscular strength, flexibility, agility and speed. INCAS scores for literacy and numeracy were used to form the basis of the data collected to determine academic achievement for the children.

4.2 Subjects

A total of 295 pupils participated in the various tests involved in the investigation with 136 females and 159 males making up that number. The average age of the children was 124 months which equates to a child that is 10 years and 3 months old. The oldest child to be used in the study was 136 months old while the youngest child was only 108 months old.

4.3 Physical Fitness

The children were assessed on 5 fitness tests specific to a combination of components that would give an overall general fitness level of each child. The components under investigation were cardiovascular endurance, muscular strength, flexibility, agility and speed. The tests were chosen because they were deemed to be an appropriate method of assessment that children of all fitness levels could participate in.

4.3.1 Speed

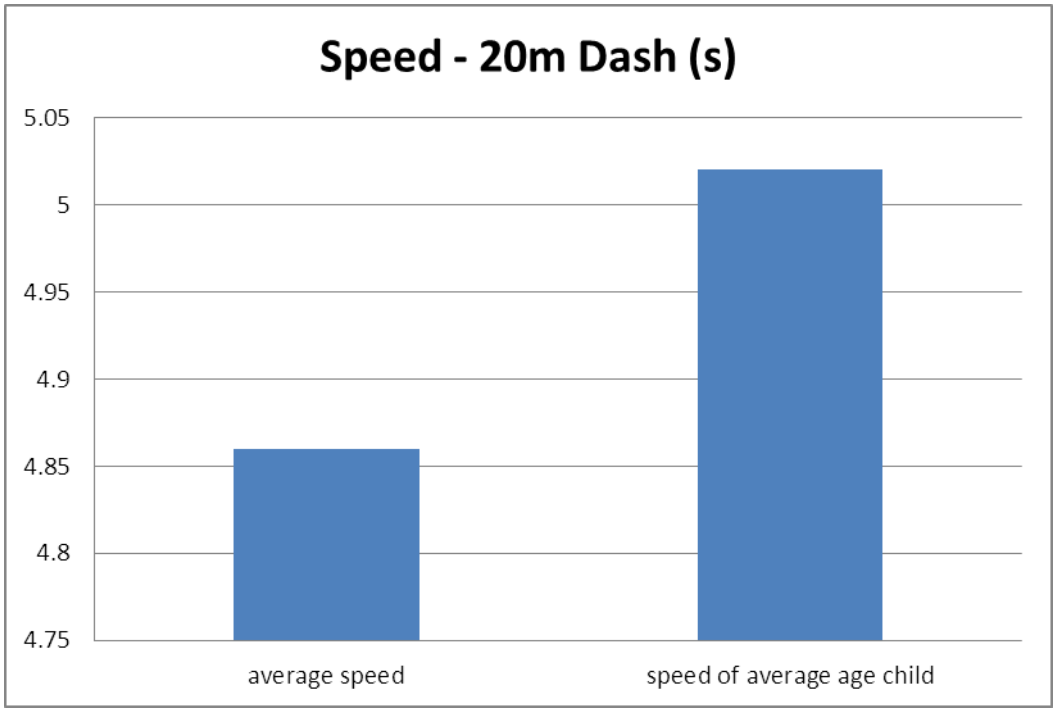

Figure 4.1 – 20m Dash – Average Speed and Speed of Average Age Child

This is the graphical representation of the timed results in seconds for the 20m dash of both the average time attained by the whole group and also the time attained by the average aged child within the sample group. The fastest time recorded during the test was 2.03 seconds by a female participant while the slowest time was 8.6 seconds by a female participant as well. The average time attained was 4.86 seconds ± 1.52 highlighting that on average children attained times closer to the fastest score of 2.03 seconds than they did to the slowest time of 8.6 seconds. This may indicate that the child who attained a time of 8.6 seconds possibly has external factors influencing their ability to perform, such as poor diet or that they have a low level of physical fitness due to high levels of inactivity. This observation corresponds with the views held by Ortega et al (2008) as they place a great weight of influence on environmental factors with regard to a child's ability to be physically fit. The time attained by the average aged child (123 months) of 5.02 seconds is 0.16 seconds slower than the average time attained by the whole group. Although a few children attained results that were considerably faster or slower than the average child, with a standard deviation of 1.52 seconds it is a clear indication that generally the children attained times that were relatively close together.

4.3.2 Agility

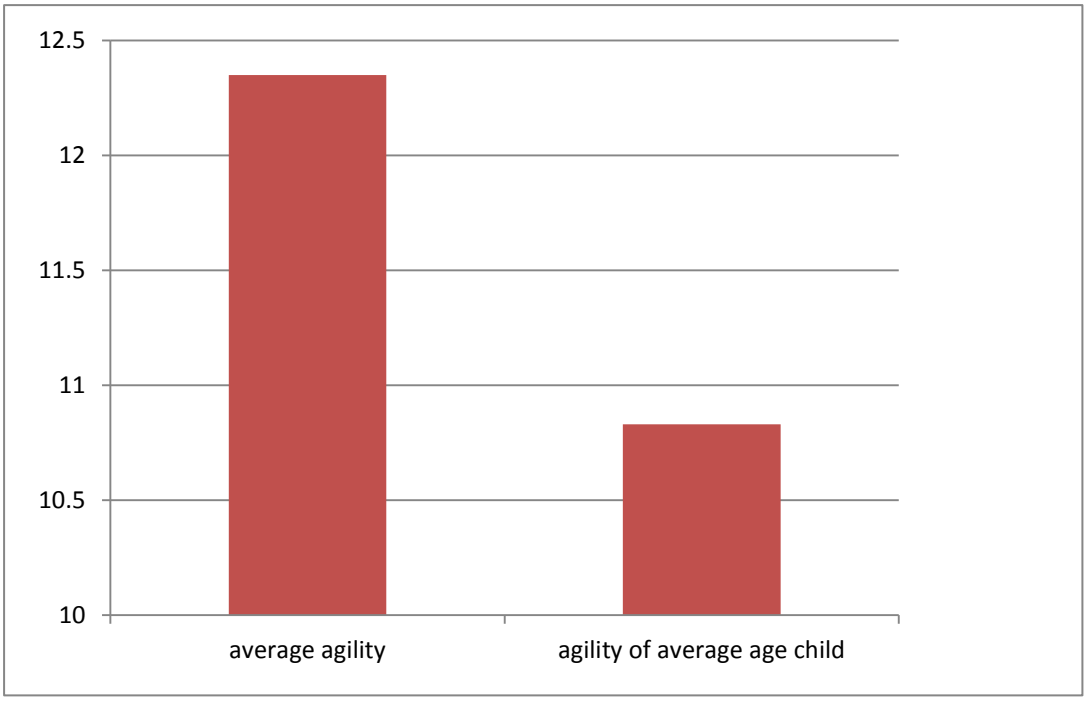

Figure 4.2 – Agility – Average Agility and Agility of Average Age Child

This graph illustrates both the average agility time attained for the whole group of children as well as the average time attained by the average aged child (123 months). With the average agility time of the entire group being 12.35 ± 2.77 seconds and the average aged agility time at 10.83 seconds it is clear that those children at 123 months of age were more agile than the average child within the entire sample. The fastest time for the test was attained by a male of 132 months who completed the test in 7.58 seconds. The slowest score was attained by a female of 133 months with a time of 21.92 seconds. 35% of the children that engaged in the test attained a time which was slower than the average time set with the remaining 65% attaining times that were faster than the average. This is an indication that some of the children, for example the female that set a time of 21.92 seconds, displayed agility levels that were not in keeping with almost two thirds of their peers. It is this group of children that are seen by the WHO as well as many other health organisations as the primary concern with regard to childhood obesity, especially as this group is on the increase in young children. Therefore it is fundamentally important that the core reasons behind the issue, such as lack of opportunity are addressed quickly. Weiler et al (2013) make the case that the health of children in the UK has lagged behind many of its European counterparts for many years but despite numerous initiatives only the wealthy and more advantaged families have

benefited. This highlights a much wider issue of opportunity across all social classes as the lack of opportunity for some children is reflected in not only the agility test but across all of them.

4.3.3 Strength

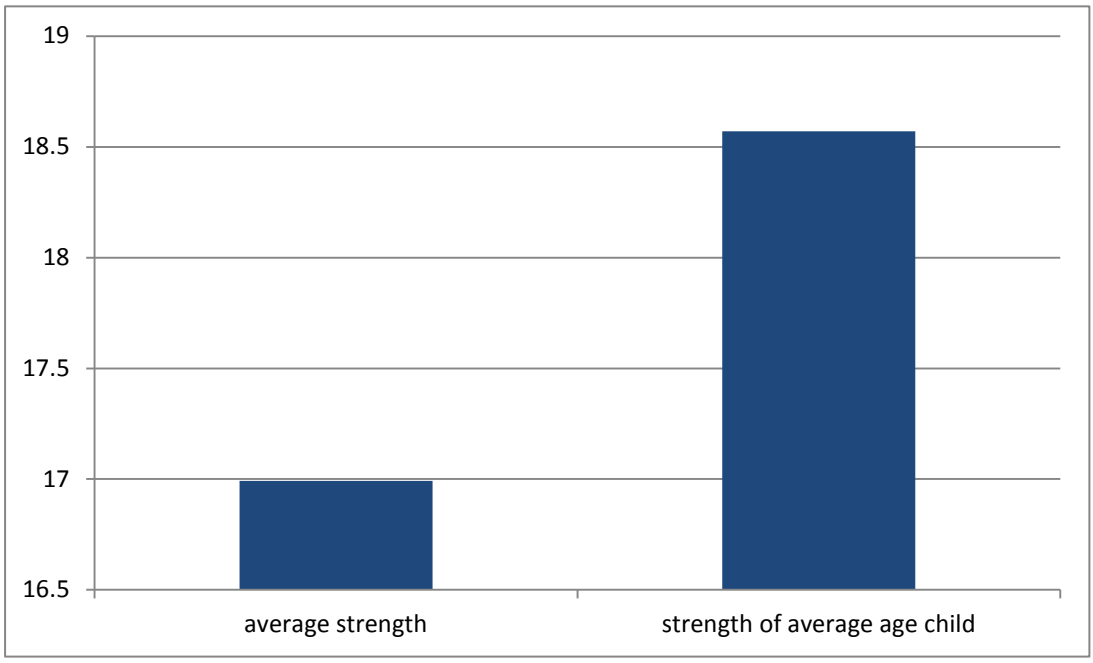

Figure 4.3 – Strength – Average Strength and Strength of Average Age Child

The test that was chosen to measure the muscular strength of the children participating in the study was the Handgrip Dynamometer test. The highest score was recorded by a female with a score of 31 Newton while the lowest score of 8 Newton was attained by one female and two male participants. It is interesting to note that both the female who attained the highest score and the two males that attained the lowest score were all 127 months old, while the other female that attained 8 Newton was only 116 months old. This seems to indicate that at this age that muscular strength is more developed in females as the top and bottom scores are from children of the same age but different genders and a 23 Newton difference in attainment. However, Wind et al (2010) dispute this stating that boys outperform their female peers across all age, weight and height groups which may be due, in part, to hormonal changes during puberty which increase levels of testosterone, a known factor to increase muscular strength. The average strength in the group as a whole was 16.99±4.92 Newton while the strength of the average age child (123 months) was considerably higher at a score of 18.57 Newton. The average muscular strength score attained

by children who were 110 months or younger was 16.86 Newton which when compared against the average score of children aged 123 months indicates that with regard to this component of fitness age plays an important role, with older children displaying higher levels of muscular development which is reflected in their higher strength test results.

4.3.4 Flexibility

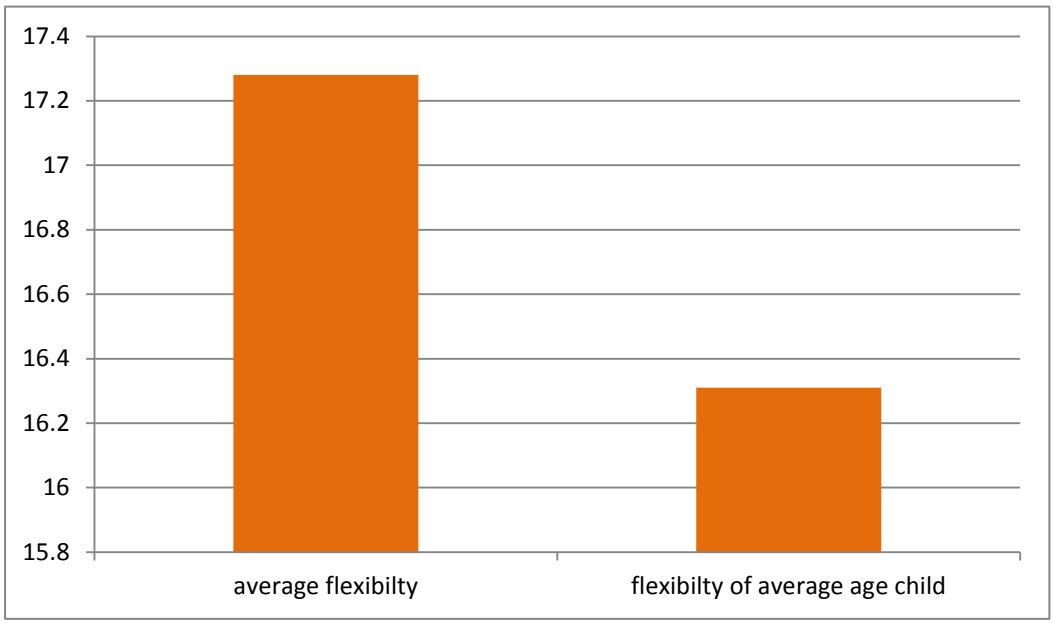

Figure 4.4 – Flexibility – Average Flexibility and Flexibility of Average Age Child

In order to assess the flexibility of the children the "Sit and Reach" test was used and the graph displays both the average level of flexibility for the whole group and also the flexibility score for the average aged child (123 months). The flexibility score for the entire group was 17.28±8cm while it was 16.31cm for the average age child. The highest score recorded was 42cm by a female of 122 months while the lowest score was recorded by a male of 124 months with a score of -9cm. It is interesting to note that 16 of the top 20 scores were attained by females while 15 of the bottom 20 scores were attained by males. The graph below highlights this trend as it clearly indicates that with an average score of 19.4cm females outperformed their male peers who attained a lower average score of 15.4cm in the test. The assumption can therefore be made that girls at this age are more likely to be flexible than boys, there are of course exceptions to this. Rodríguez et al (2008) emphasise the importance of flexibility as a component of fitness, stressing its role in protecting the spine from potential risk. This would therefore put the males involved in the study at a higher risk of injuring their spine or back than the females due to their poor hamstring flexibility.

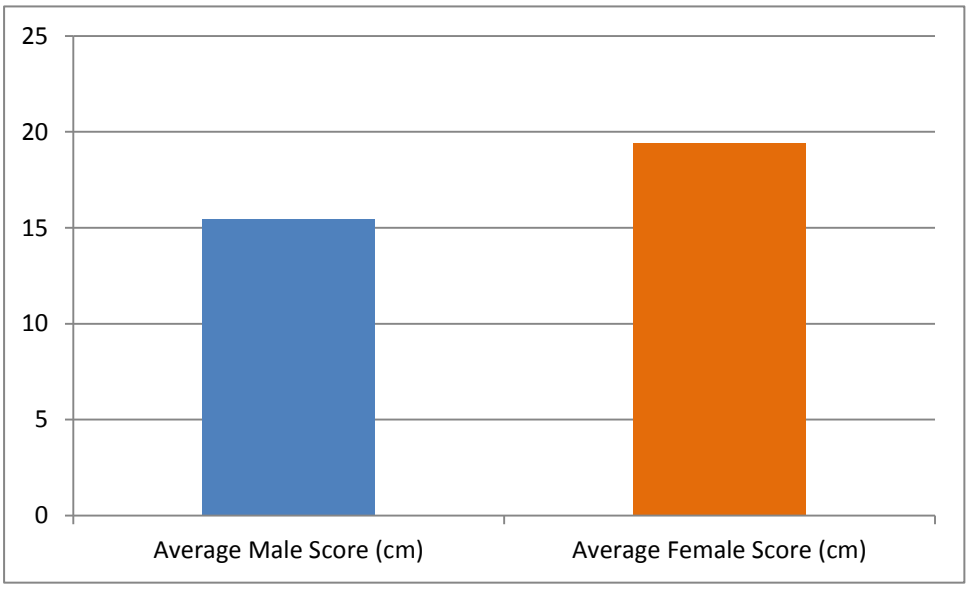

Figure 4.5 – Flexibility – Average Female Agility and Average Male Agility

Stretching could play a valuable role in helping to improve this component for the male participants, with studies showing that engaging in static stretching for 30 seconds, three days per week for six weeks significantly improves hamstring flexibility Rodríguez et al (2008). It is also interesting to note that the child who attained a flexibility score of 35cm, ranking 4th among her peers was also ranked 1st in the INCAS math assessment.

4.3.5 Endurance

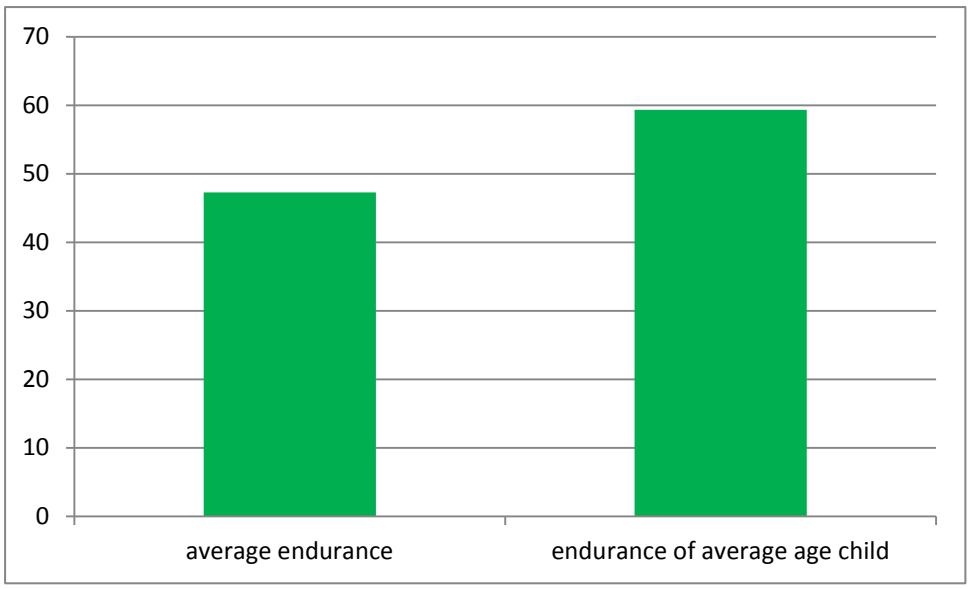

Figure 4.6 – Endurance – Average Endurance and Endurance of Average Age Child

This graph is displaying both the average endurance score attained by the group and also the average score attained from the average age child (123 months) that participated in the study. The "20m Shuttle Run" was used to assess this component of fitness as it was

deemed to be an effective test which was appropriate for the age of the subjects. Within the group there was a very large spectrum of results attained with the lowest score being level 12 from a female who was 132 months old while the highest level attained was 108 by a male aged 125 months. Generally speaking however the participants attained between level 20 and 50 as this accounted for almost half of the 295 students with 49.2% falling into this category. The average for the entire group was level 47.27±20.77. This standard deviation of 20.77 levels simply reinforces the wide range of results attained by the children. The average level attained by the average age child was 59.31, 12.4 levels higher than the average endurance level attained by the group as whole. With regard to how the genders performed against each other in this test it is interesting to note that females made up the majority of those who attained level 20 or lower with 19 females and 11 males making up that category. At the other end of the results 16 males and 4 females made up those who attained level 80 or above. These statistics indicate strongly that the males generally had a higher level of cardiovascular fitness which may be influenced by a number of factors, such as levels of participation in extracurricular sports. This corresponds with the findings of Klomsten (2006) who found that males outperformed their female peers in this particular component of fitness.

4.4 Academic Achievement

In school children engage in informal assessments every year within the curricular areas of numeracy and literacy. At the end of each Key Stage children formally sit the INCAS assessments in order to assess how they are progressing in maths and reading. After children have sat the INCAS the results produce the child's maths age and reading age based on the scores that they should be attaining for their particular age. This is extremely useful to both parents and teachers as it clearly highlights how each individual child is progressing in months which then can be compared off their actual chronological age. With this information teachers are then able to evaluate how and why the child may have a reading age which is lower than their actual age, adjust their teaching strategies or possibly offer more support in order to correct the issue. With regard to the indicators of academic achievement used for this study the INCAS scores for both reading and maths were used. These assessments offered both current data and also a means of comparing their progression against their actual age because of the manner in which INCAS results are presented.

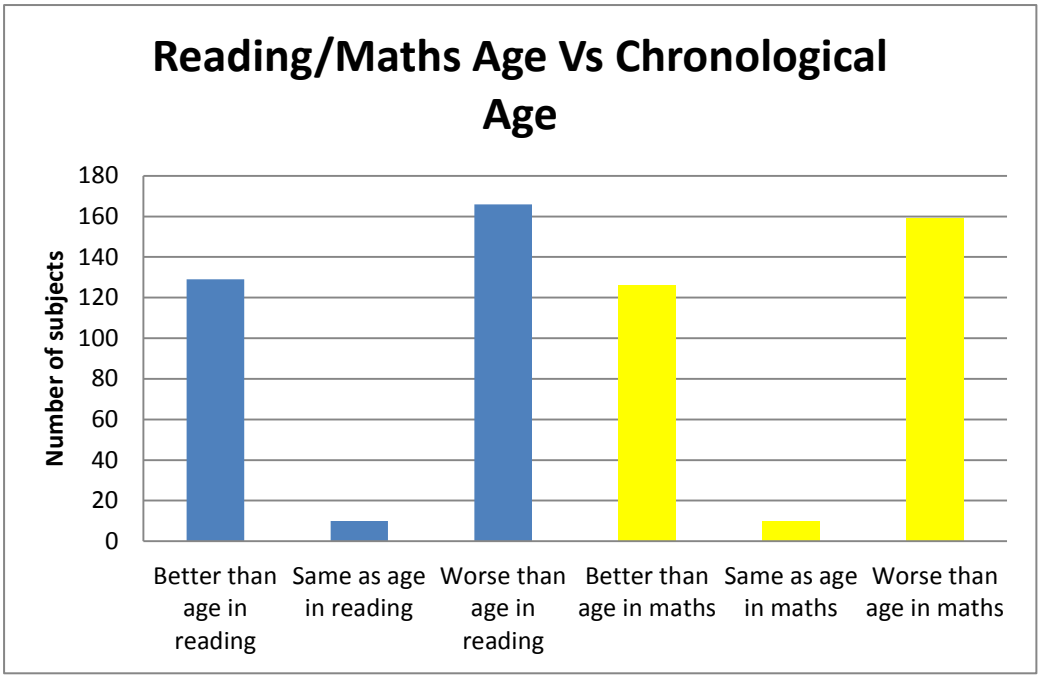

Figure 4.7 – Reading/Maths – Reading/Maths Age Vs Chronological Age

The above graph details how many of the subjects attained reading and maths ages from their INCAS assessments that were better, the same or worse than their chronological age. This effectively illustrates how the subjects are progressing in each of the areas and highlights that only 10 subjects for both maths and reading had a score which represented the same age for them in maths and reading as their actual age. The child that attained the highest score in the reading assessment was a female that was 112 months old but had a reading age of a 154 month old child. She was also ranked 4th with regard to the maths scores attaining a maths age of 142 months. The highest maths score was attained by a male who was 124 months old but had a maths age of 163 months old. It is interesting to note that 60% of females in the study attained a reading age which was lower than their actual age, compared with 47% of males involved in the study. The case is the same with regard to the maths scores, this time 64% of females achieved a score which was lower than their actual age while only 45% of males were deemed to be underachieving. 50% of males attained scores in both maths and reading that gave them an age which was older than their actual chronological age. The same could not be said for females with only 35% in maths and 37% in reading falling into this category. The remaining 3% in reading and 5% in maths of the male subjects attained ages that were the same as their actual age while 1% in maths and 3% in reading of the female subjects attained the same result. These statistics highlight that the subjects attained very similar results as a whole group in both maths and reading with the females attaining results that suggest they struggled more than their male peers in both reading and maths. These findings are in stark contrast to the findings of Montgomery (2009) who found

that girls across all the Key Stages perform better than boys, especially in reading and literacy. This is an area of potential concern for the class teacher as the results would appear to indicate that there is quite a large percentage of the females in the class that are struggling in both reading and maths. The difficulties could be a result of numerous socio-economic factors, difficulties with the teaching style of the teacher or quite simply a situation where additional support is required to help encourage progression.

4.5 Physical Fitness and Academic Achievement

The graph below displays both the academic and fitness rank for every child that participated in the study. The results suggest that contrary to the large depth of literature from authors such as Coe et al (2006) that in fact there is little or no correlation between fitness levels and academic achievement. There are a few examples of children who ranked high in both their academic INCAS assessments and also their fitness tests, these children are highlighted in red. With the exception of these students the rest of the children's results indicate that a child could be ranked in the top 5 for their fitness level but find themselves in the high hundreds with regard to their academic rank. An example of this is the child that ranked 2nd for their academics but found themselves ranked 258 for their fitness level. The same situation can be said for the child ranked 1st for their fitness level but 288 for their academics. The results would appear to suggest that although there were a small number of cases were children performed to a high standard in both their academic and fitness assessments, generally speaking there is no evidence to substantiate the suggestion that there is a positive correlation between fitness levels and academic achievement.

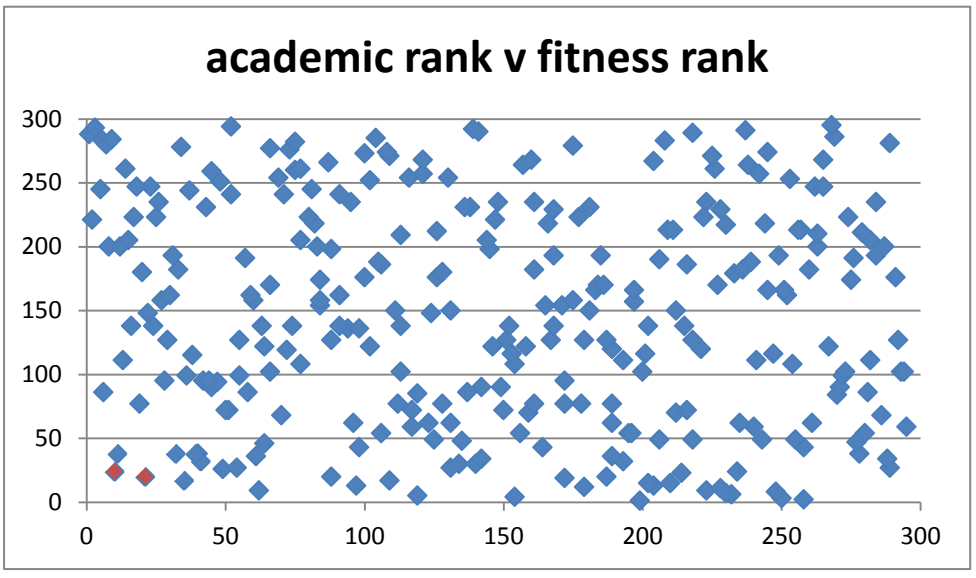

Figure 4.8 –Fitness and Academic Achievement – Fitness Rank and Academic Rank

When the results are examined from the viewpoint of those children that attained an academic age which was older than their actual age, 15% of them also featured in the top 50 ranked children for their fitness level. 18% of those children that are deemed to be behind their chronological age academically featured in the top 50 for fitness levels. This is a clear indication that children who are both underachieving and overachieving academically are still attaining a similar percentage of the fittest children in the study.

In relation to how children ranked specifically in one component of fitness such as cardiovascular endurance, comparing that against their academic rank can sometimes give a better insight into trends than looking at their overall fitness rank. An example of this is that the child ranked 1st for endurance and the child ranked 269th are separated by only 3 ranks in their academic rank, ranking 274th and 271st respectively. This is another indicator that although a child may excel or struggle within an aspect of fitness such as endurance that when placed in an academic setting that they are of a very similar level, supporting the work of Kirk (2006) who found there to be a slight negative relationship between the two variables under investigation. However the same trend could not be said when the component of strength is looked at in the same way. The child that ranked 1st for strength also ranked 99th for their academic scores while the child that ranked last in 293rd for their strength test only managed 251st rank for their academics. These statistics when looked at in isolation appear to suggest that the child with the higher level of strength also has a much higher academic achievement level, indicating that there is a positive correlation between fitness levels and academic achievement.

4.6 Spearman Rank Test

In order to enhance the validity and also reliability of the data obtained from this study it was essential that an appropriate test was utilised in an attempt to discover whether there was a positive relationship between the two variables in question, fitness levels and academic achievement. The test that was chosen was the Spearman rank test and it appears to indicate a slight negative correlation with an R = -0.1001 (P<0.J). This suggests that there is no correlation between the two variables.

4.7 Conclusion

There has been a great depth of literature supporting the suggestion that there is a positive relationship between the variables of fitness levels and academic achievement but the results of this study have displayed no positive correlation that would suggest that it is the case. It appears to be the case that there is a slight positive correlation between specific components of fitness such as strength where the child ranked 1st massively outperformed the child ranked 293rd in the academic assessments. Although the study indicates that there is no correlation between the variables there is no doubting the value that sport and being physically fit plays for young people in their physiological, psychological and social development. With child obesity levels on the increase as the British Heart Foundation (2010) indicates it is essential that children are encouraged to participate in physical activity as much as possible in order to stay healthy. The social skills learnt through physical activity are invaluable in ensuring that children develop as well-rounded socially comfortable individuals as these skills are fundamental in any adult workplace.

Conclusion

5.1 Conclusion

After analysing the data obtained from both the fitness and INCAS assessment scores from the 295 children it seems that the concerns raised by Grissom (2005) regarding the possibility of other factors affecting academic attainment rather than solely physical fitness were correct as the results indicated little correlation between the two components. Although on a whole sample scale the results displayed no correlation, on an individual level there were cases of children excelling both academically and in a particular component of fitness. The child that ranked 1st for strength also ranked 99th overall for their academics while the child that ranked 4th for flexibility also ranked 1st in their INCAS maths. When the top 20 ranked children for their overall academic scores were compared against their corresponding ranks in each component of fitness it highlighted an encouraging set of results. In both agility and speed they generally performed well while these children appeared to struggle quite a lot in endurance, which in itself is concerning.

Once the data had been organised into various graphic formats and the overall fitness and academic ranks compared of the sample group it was quite apparent that there was no positive correlation presentation between the two components as expected. The numerous benefits that can be attained as a result of being physically fit both physiologically in terms of prevention of obesity and chronic diseases as well as social and cognitive development (Cale and Harris, 2005) appeared to suggest that physical fitness would have an influence on academic achievement as well, but this is not the case. Therefore the conclusion can be made that although there were a few examples of children that excelled in a particular component of fitness and academically, overall the two components share no positive correlation.

5.2 Recommendations

After completing this study it is clear that sufficient time needs to be given to fully investigate and select the most appropriate processes and methods for any future work carried out on this area as they are essential in ensuring that the study is carried out in an effective and focussed manner. Utilising INCAS scores for literacy and numeracy proved to be an extremely clear and effective manner of assessing academic achievement as scores had a corresponding age, allowing for comparisons to be made with little difficulty. With regard to the fitness tests used to assess the children the only issue that rose was their unfamiliarity with the processes involved. Therefore familiarising the children with the various fitness

assessments prior to testing may have helped to eradicate any anomalies and would possibly have given a better reflection of the children's actual ability levels. Having a large sample group of 295 pupils to attain data from was extremely beneficial to the validity of the investigation as it gave a more accurate reflection of each component under assessment.

5.3 Limitations

The main limitation or difficulty that the study faced was the children's lack of familiarity with the fitness testing procedures. As the testing was occurring within a confined period of time it wasn't possible to spend sufficient time in order to ensure all children fully understood each test. This undoubtedly affected a certain percentage of the children's ability to perform to their full potential as a few appeared quite anxious and unsure on occasion during testing. When working with a large group of children it is also to be expected that some children will be unable to take part in the testing due to illness and some children may be absent that day, these are outside of the control of the study but are still limiting to a certain extent. Due to the large number of subjects the data collection was not completed by the same person, although the same protocol was followed. This may have an effect on the validity of the data collected.

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Appendices

Appendix A

Dear Principal,

My name is Paul Smart and I am currently a 4th year Physical Education student at St Mary's University College, Belfast. The focus of my Capstones Dissertation is the examination of fitness levels of children and the possible impact that it has on their academic attainment in Primary School. In order to ensure that the research I conduct is based on current data I am required to assess a sample group of children on their level of fitness as well as their current academic attainment in the classroom. With your permission I would like to use a sample group of children working in Key Stage Two from your school to help me gather information for the research study.

This part of the investigation will involve me speaking with the sample group of children for around 10 minutes to explain to them about fitness testing and why it is used before then showing them the procedures that will be involved in each of the 5 fitness tests. The elements of fitness under investigation are endurance, strength, flexibility, agility and speed. I hope to complete the testing at a time which suits the school and also where the sports hall is available as it would provide a fantastic setting in which to do the testing because the children will be required to run and move around during testing.

In order to assess the children academically it is hoped that I would utilise their INCAS scores for literacy and numeracy. For both fitness and academic scores each child will be given an anonymous code that will take the place of their name on all record sheets. I fully appreciate the sensitivity of this type of information and it will therefore be dealt with in the highest degree of confidentiality and professionalism. All information gathered will be destroyed when the research has been completed.

I would be extremely grateful for your support and the support of your school in helping me to gather the necessary information for the study.

Yours Sincerely,

Paul Smart

Appendix B

Dear Parent/Guardian,

My name is Paul Smart and I am currently a 4th year Physical Education student at St Mary's University College, Belfast. The focus of my Capstones Dissertation is the examination of fitness levels of children and the possible impact that it has on their academic attainment in Primary School. In order to ensure that the research I conduct is based on current data I am required to assess a sample group of children on their level of fitness as well as their current academic attainment in the classroom. With your consent I would like to include your child in the sample group that I am going to use in my investigation, therefore your consent would be greatly appreciated as without a sample group of child to assess the research study can't be completed.

Children that are involved in the study will firstly be given a short talk during which the testing procedure for the five fitness tests will be explained. The elements of fitness under investigation are endurance, strength, flexibility, agility and speed.

In order to assess the children academically it is hoped that I would utilise their INCAS scores for literacy and numeracy. For both fitness and academic scores each child will be given an anonymous code that will take the place of their name on all record sheets. I fully appreciate the sensitivity of this type of information and it will therefore be dealt with in the highest degree of confidentiality and professionalism.

I would be extremely grateful for your support in helping me to gather the necessary information for the study. Please complete and return the permission slip below.

Yours Sincerely,

Paul Smart

I do/do not give consent for _____ to take part in this research study.

Signed _____ Date _____

Appendix C

Fitness Tests

Within this investigation it was deemed essential to test 5 components of fitness in order to assess the overall fitness level of the sample group of children. The elements under investigation were endurance, agility, flexibility, muscular strength and speed. Below are descriptions and images to explain each test.

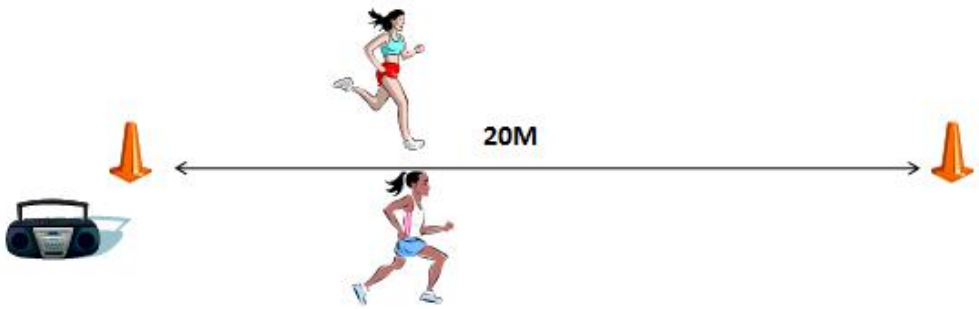
Endurance – 20m Multistage Fitness Test (The Bleep Test)

This test is a maximal test commonly used to assess the cardiovascular endurance levels of participants.

Equipment: Cones, tape measure (20m), bleep test CD, CD player, 20m flat surface and record sheets.

Procedure: Participants are required to run from one end of the 20m to the other within the time between two bleeps. The subjects begin behind one line and run on hearing the first bleep and run back down the grid on hearing the next bleep. The bleeps are initially quite slow but become progressively faster requiring the participants to increase the speed at which they are running in order to continue beating the bleeps. If the subject does not cross the line before the next bleep they have to cross the line and make it down to the far line before the next bleep in order to stay in the test. If the subject makes it to the line before the bleep, they wait there until the bleep sounds. The test ends when the subject is unable to reach the line for two consecutive times.

Scoring: The participants score is the level (number of minutes) and number of 20m shuttles they completed before they fell behind the bleep. The number of completed runs is recorded.



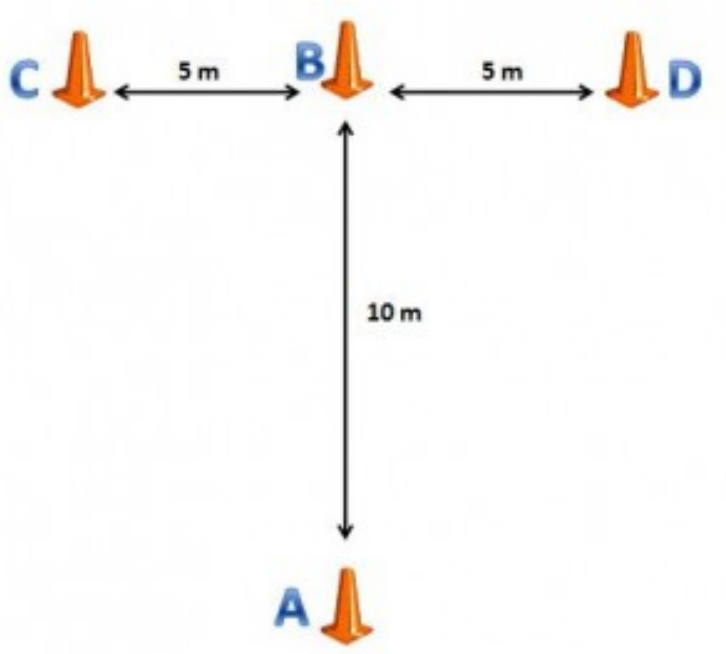
Agility – The "T" Test

This test is used to assess the agility levels of participants as it requires them to make forward, backward and sideway movements at speed.

Equipment: Tape measure, cones, stop clock.

Procedure: Set out four cones in a "T" shape as illustrated in the diagram below. The participant is required to sprint from cone A to cone B, tapping it with either hand before then shuffling sideways to cone C where they are required to touch it with their left hand. They then have to shuffle back across the grid to cone D where they have to touch it with their left hand before shuffling back to cone B, touching it with their hand and then running backwards to cone A.

Scoring: The stopwatch starts as they begin at cone A and stops when they pass cone A at the end.



<u>Flexibility – Sit and Reach Test</u>

This test is commonly used to assess the flexibility levels of participants, focusing on lower back and hamstring muscles.

Equipment: "Sit and reach" box, ruler.

Procedure: This requires participants to sit on the floor with their legs flat to the ground in front of them. Shoes should be removed and participants should then lean forward as far as they can, pushing the ruler with their hands up the scale which is on the "sit and reach" box. It is essential that participants keep their knees down as this will alter the validity of the scores attained otherwise. In order for a participant to register a distance they have to ensure that both hands are flat on the box and at the same level, with no hand further up the box than the other. The participant also needs to hold the ruler at the position they are at for a second or two and cannot push the ruler forward in a jerking movement.

Scoring: The score is recorded to the nearest centimetre.

Muscular Strength – The Handgrip Dynamometer

This test is used to assess the isometric strength of the hand and forearm muscles. This form of strength is essential for completing some of the fundamental movements of any sport, being catching, throwing or lifting.

Equipment: Handgrip dynamometer.

Procedure: The participant is required to hold the dynamometer in their hand, with their arm at a right angle and their elbow tight to the side of their body. The handle should be placed equally across the four fingers while the base of the dynamometer should be rested against the palm of the hand. When the participant feels comfortable they are required to squeeze the dynamometer with maximal isometric force for a period of 3-5 seconds. In order for the test

to be completed fairly participants are told to keep the rest of their body still while performing the test.

Scoring: The best score attained after a number of turns on each hand is recorded. A short period of rest is allowed within each attempt.

Speed – The 20m Dash

The 20m dash is used to assess the acceleration and maximal running speed of the participant.

Equipment: Stop clock, tape measure, cones.

Procedure: This test requires participants to run a single maximal sprint over a distance of 20m. The position that each athlete starts at should be standardised to ensure that each is being tested under the same conditions. Athletes should start from a static position behind the line with both feet placed behind the line. As this is a short burst of maximal intensity it is important that participants are engaged in a short warm-up prior to testing in an attempt to prevent any injuries during testing.

Scoring: The score will be timed for their 20m run to the nearest 0.1 second. Each participant will be given the opportunity to complete the run twice.