Critique of research article: ‘Associations between objectively measured physical activity and academic attainment in adolescents from a UK cohort’ (Booth *et al*, 2014)

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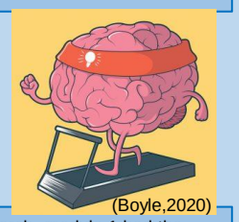
1. Introduction

Educational achievement has slowly increased in Wales and the United Kingdom (UK) throughout the previous decade; however, the attainment gap continues to be prominent at key stage 2 and key stage 3 especially (Welsh Government, 2021). Therefore, new methods and research ought to be conducted to enhance academic standards in children and young people. Furthermore, the Department for Digital, Culture, Media, and Sport (2022) stated around 40% of the population in the UK were classed as physically inactive, completing less than thirty minutes of exercise in a week. Alternative health adversities may increase, such as mental health disorders or cardiorespiratory issues. Therefore, increasing physical activity in schools may benefit the UK physically and cognitively.

Accordingly, Booth *et al* (2014) conducted a research study unearthing the correlation between physical activity (PA) and educational achievement within children and young people aged 11-16. This investigation aimed to uncover new evidence that could reveal the importance PA has on improving children’s academic performance and develop new curriculum to drive standards in primary and secondary schools. Within this post-positivism designed study, the quantitative methods used may provide sufficient evidence to researchers that ensure beneficial results of incorporating PA further into education in the UK. Panhwar, Ansari and Shah (2017) state a post positivism study is an effective research paradigm in context of education as it evaluates the statistical and scientific approaches of education to expand learner’s knowledge. Critical analysis of this article will be developed throughout this poster, considering the reliability and credibility of the authors, ethics, methodology, data analysis and findings.



(Boyle,2020)

2. Methodology

Methodology is considered the foundations of research as it provides the key components that allow the researcher to design their study in a systematic procedure. Methodology within research consists of adequate and reliable research methods (qualitative, quantitative), a representative sample and the consideration of ethical implications. Providing the methodology is designed precisely, the outcome of the research is more likely to be reliable and conclusive of the researcher’s hypothesis (Robert-Holmes, 2018).

Sample.

The study sample was derived by inviting children from age eleven to sixteen that took part in the Avon Longitudinal Study of Parents and Children (ALSPAC) which lasted eleven years, from 11,952 invited, 4755 participants (55% were female) provided correct data needed to perform the research (Booth *et al*, 2014). Many variables were taken into consideration including the age, weight, ethnicity, socioeconomic status, and many exclusions were made for children with additional learning needs, mental disorders, or behavioural difficulties. Within the article, a non-probability sample technique was used to select participants that had useful accelerometer data and incorporating excluding measures for certain participants. Berndt (2020) opposes non-probability sampling due to the increase probability of selection bias which in turn may produce deceptive results. A probability sample within various primary and secondary schools may have been more representative of students in the study and could provide more insight to daily PA and educational outcomes. Alternatively, the sample invited in this study is large and diverse in terms of individual participants. Using a large sample size improves the validity of the research as it is representative of the wider society, also it means the research can be reproduced further using similar methods which can universalise the data to other studies (Delice, 2010). The sample includes a variety of diverse participants which strengthens the study as it may show minor differences PA has on individuals with different academic abilities.

Research Methods

Participants within this study were observed by Booth *et al* (2014) over a seven-day period, an Actigraph accelerometer was given to each participant to wear for the entirety of each day. The observation monitored the average amount of moderate-vigorous PA individuals completed (Booth et al, 2014). An external company would use the data from the observation alongside a regression analysis of the participants scores that were attained from their nationally administered tests at key stage 2, 3 and GCSE, to further create links from the average PA to educational achievement. Shipway, Jago and Deery (2020) state the gathering of quantitative data paired with participant observation throughout this study provides a reliable and objective overview of the effects PA could have on academic performance. Furthermore, Troiano *et al* (2014) justify the use of an accelerometer as an analytical tool to accurately measure PA, stating accelerometers have been used previously in many studies producing high validity within results. Although, accelerometers lack the ability to distinguish non-movement related activities such as cycling, this may hinder the accuracy of PA measurements as it does not account for all activities. On the other hand, the lack of qualitative data collected throughout this study reduces the depth of the research as there is no real-life experiences or human interactions explaining their feelings towards the issue (Hall, 2020). A mixed-method approach may benefit the research as it would provide reasoning and discover participant’s beliefs towards using PA to improve educational achievement.

Ethics

Within the article, Booth *et al* (2014) “obtained ethical approval from the ALSPAC Law and Ethics Committee and the Local Research Ethics Committee” ensuring that their study remained ethically sound, in turn allowing their results to be valid and reproducible. All participants were invited to take part and confidentiality was apparent throughout the entire study due to participants being anonymous. Researchers had unrestricted access to the ALSPAC data where participants were also kept anonymous to the researchers. Firstly, informed consent was apparent due to the age of the participants (11-16), however using invitations to gather the cohort shows assent and willingness from the participants to take part in the study. Oulton *et al* (2016) ensure the importance of acquiring assent from children or young people that are deemed competent in making their own decisions, this develops trust and understanding between the researchers and participants. Moreover, Coffelt (2017) confirms the confidentiality and anonymity within the article protects the participant’s privacy and reduces any harm the research may cause. Adversely, limited ethical procedures are stated within the article raising questions around disclosure and transparency towards the participants, this may cause harm to the participants as they may feel deceived by the study (Alderson and Morrow, 2020). Also, lack of anonymity of the setting (ALSPAC) may arise more issues of protection. Although previous work from the authors is credible the lack of ethical considerations in this article may discredit the study.

3. Data Analysis

Booth *et al* (2014) completed five repeated models for the research, module 1 had the lowest adjustments with tests for PA in counts per minute (cpm) and the age of participants, further models assessed for the other confounding variables that may have caused bias or inaccuracies due to human error. Upon gathering the fully adjusted model where all confounding variables were accounted for, participants that appeared in model 1-5 had their model 1 repeated to ensure the results were accurate. Finally, a control group of the participants were requested to wear the Actigraph accelerometer at four periods throughout the year to discover any changes between seasons or if any irregularities occurred (Booth *et al*, 2014, p. 2). A Regression Analysis of the correlation between national tests and PA in final adjusted models predicted improvement of academic attainment in Maths, English and Science within all ages.

Booth *et al* (2014) used standard deviation (SD) to represent their descriptive statistics from the participants national test scores. Cooksey (2020) describes standard deviation as an excellent tool to display a cluster of quantitative information, the SD scores in the article were low, therefore ensuring the data is more precise and accurate as it is closer to the mean. Additionally, Inferential statistics were heavily used throughout the article to explore any correlations and predict the association between PA and educational achievement. Using these inferential statistics from the observations, a regression analysis was conducted to find the correlation and predict whether PA will improve academia within children and young people. Arkes (2019) identifies using a regression analysis model to discover direct correlations between variables allows researchers to be more accurate when making predications, this process verifies the aims and enhances the validity of the research. It is a reliable method and has been used widely within quantitative research in the past.

Although the research design has been structured very competently, a thematic analysis parallel to the quantitative regression analysis would add depth to the article and provide more validity to future research in this field. Clarke and Braun (2017) discuss Thematic analysis as a means of unravelling themes or patterns within research to link with other research or theoretical frameworks. The inclusion of thematic analysis and qualitative data in the post-positivism paradigm research study would increase the richness and potentially alter the impact it may have on society. Healy (2019) further criticises the article due to lacking visual quantitative data, using data like graphs or charts may strengthen the article because it broadens the accessible information to wider audiences. Individuals that observe this article may lack understanding of inferential statistics, therefore with linear graphs to represent regression analysis, the study may reach a larger audience creating more influence on the topic of PA on academic achievement in primary and secondary aged children.

Ultimately, the research design Booth *et al* (2014) conducted was proficient in securing data to meet their aims of uncovering whether physical activity can affect educational performance. Wisker (2018) suggests a strong research design allows results of the study to be generalised more effectively and provide a foundation for the hypothesis of the research to be further studied.

4. Findings and Discussion

Booth *et al* (2014) found a direct correlation between 60 minutes of daily moderate-vigorous physical activity and the improvement of educational performance in English, Mathematics and Science with both males and females at ages eleven, thirteen and sixteen. All totally adjusted models of confounding variables doubled or increased their coefficients by 0.10 minimum (all data in figure 1.). In context, this is broken down to an increase of one whole GCSE grade per fifteen minutes of extra PA, therefore providing children meet daily PA recommendations, these increases will be evident over a longitudinal course of the school year. However, the role of sedentary behaviour was not accounted for within the study, further research should be conducted to record the effect it may have on academic attainment.

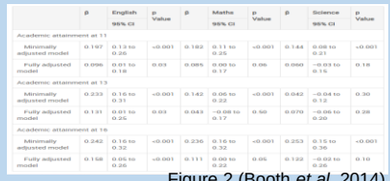
Quantitative data within this study provides highly designed evidence to meet the authors aims, Have *et al* (2018) and Mavilidi *et al* (2020) corroborate this hypothesis within their own studies to promote the benefits of physical activity within the education sector and improve performance in children. Meeting the daily recommendations for physical activity will improve academic attainment, but there are no boundaries suggesting the more physical activity individuals partake in, the greater or less of an impact it will have, meaning endless potential for improvement. Research in this field is extremely relevant in the modern era with rising stereotypes stating less women finding careers in Science, Technology, Engineering and Mathematics (STEM), Government Equalities Office (2013) stated less than 16% of individuals working in STEM careers in the UK are female. This raises the need for more involvement of physical activity within education, with existing research presenting data that male and female students are improving their academic attainment. Incorporation of PA in education may lead to a universal way of life, relieving gender stereotypes and decreasing the pay gap between genders. Furthermore, National Health Service Digital (2021) state that nearly 40% of children are overweight or obese within the UK. Therefore, introducing a physical activity based curriculum has many health benefits that may decrease obesity, improve cardiorespiratory illness, and improve mental health within children and young people.

In Contrary, Wassenaar *et al* (2021) completed a yearlong study on the effect of cardiorespiratory fitness and possible links to academic achievement. However, no significant correlations were made between improved cardiorespiratory fitness and educational performance, this raises concerns to alternative audiences as to how much physical activity Is beneficial to children in education. In addition, Public Health England (2019) provide evidence that shows adolescents aged eleven to sixteen are not meeting the daily physical activity guidelines (60 minutes), with less than a 25% of boys and 15% of girls meeting the target. This is important as Booth *et al* (2014) conducted their study in the presumption that their cohort were meeting the recommendations. Therefore, the impact of PA in the UK would be less prominent as not every child is hitting the criteria, further damaging the reliability of their research. Although the diversity in the sample is great, Lee and Zhang (2021) discuss children’s social and emotional development using theoretical framework to visualise the different experiences individuals have within the population. Children have different environmental stimulations which could result in lack of social interaction causing the child to be uninterested in physical activity. Booth *et al* (2014) fail to recognise the limitations social and biological differences may have on a child’s beliefs towards participating in physical activity, even considering the many benefits of PA, a child may prefer introverted activities for enjoyment. Therefore, more ethical implications arise as the children may have felt they had to complete more physical activity at the time they were being monitored and potentially leading to bias results.

In Wales, play is used as a tool for enhancing children and young people’s social, physical, and emotional development. Play relates to physical activity as children learn though being active and having freedom to explore the world through their own eyes. Activities may include visits to the beach or park, games on the playground or sports (The Welsh Government, 2014). Accordingly, physical activity can be used more within the curriculum to develop these factors but also develop their attitudes and behaviours in class and promote positive learning environments which may increase educational performance and reinforce the findings from Booth *et al* (2014). Vygotsky and other sociocultural theories would promote inclusion of PA in education as children use the social aspect of PA to learn and scaffold off their peers and develop their own cognition (Blunden, 2021) Adversely, Dunn and Kennedy (2019) believe the impact of modern technology benefits children’s pedagogical experience, reducing the need for physical activity as a tool to improve educational performance. The use of technology provides children with a new opportunity to further develop their literacy, numeracy, and digital literacy skills through easily accessible and more available resources. This may divide viewpoints on the research conducted by Booth *et al* (2014) as there are many alternative methods that could improve academic attainment within children.

5. Conclusion

To conclude, the research conducted by Booth *et al* (2014) was significant in the education field as it contained a large sample size, strong research design and conclusive findings. This ensures the study is representative of the UK population whilst providing accurate and reliable results for other researchers to further reproduce evidence and strengthen the validity of the findings. Alternatively, ethical limitations reduced the credibility of the study as there was limited reference to the ethical considerations they conducted. Further qualitative research would be recommended to provide more insight from the participants and add depth to their study, allowing the results to be repeated. Overall, I believe this post positivist study was successful in producing valid results to counteract the issues of educational performance and the lack of physical activity children and young people participate in within schools. However, with some limitations, the research could be strengthened with deeper ethical considerations and evidence, more recent statistics, and incorporation of qualitative research methods.



	β	English 95% CI	p Value	β	Maths 95% CI	p Value	β	Science 95% CI	p Value
Academic attainment at 11									
Minimally adjusted model	0.197	0.13 to 0.26	<0.001	0.182	0.11 to 0.25	<0.001	0.144	0.08 to 0.21	<0.001
Fully adjusted model	0.096	0.01 to 0.18	0.03	0.085	0.00 to 0.17	0.06	0.060	−0.03 to 0.15	0.18
Academic attainment at 13									
Minimally adjusted model	0.233	0.16 to 0.31	<0.001	0.142	0.06 to 0.22	<0.001	0.042	−0.04 to 0.13	0.30
Fully adjusted model	0.131	0.01 to 0.25	0.03	0.043	−0.08 to 0.17	0.50	0.070	−0.06 to 0.20	0.28
Academic attainment at 16									
Minimally adjusted model	0.242	0.16 to 0.32	<0.001	0.236	0.16 to 0.32	<0.001	0.253	0.15 to 0.36	<0.001
Fully adjusted model	0.158	0.05 to 0.26	<0.001	0.111	0.00 to 0.22	0.05	0.122	−0.02 to 0.26	0.10

Figure 2 (Booth *et al*, 2014)

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