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Exercise to increase engagement of children with attention-deficit/hyperactivity disorder in physical education: Method development

| Research

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Abstract: There is evidence that physical exercise has positive effects on the mental health of children. For those diagnosed with attention deficit/hyperactivity disorder (ADHD) moderate to high intensity exercise has been associated with a reduction in symptoms. However, these children can have difficulty maintaining attention in physical education (PE) lessons. The aim of this preliminary study was to work with children with ADHD in developing exercise sessions of moderate to high intensity to fully engage them in PE lessons. The exercise sessions were developed through a prospective study involving a single cohort of children with ADHD in one primary school. The Borg rating of perceived exertion, the AD/HD Rating Scale-IV scores, and child-friendly hand signals were used to evaluate exercise intensity, symptom level, and the children's enjoyment of the exercises respectively. The intervention was ten 40-minute sessions over five weeks. The results showed the children were fully engaged, working at moderate to high intensity in each session. There was a trend towards lower hyperactivity and inattentive symptom scores. In addition, teachers observed an increase in engagement in classroom lessons. In conclusion, key elements of the design are short periods of each activity and a variety of different exercises. Feedback from the children also indicated the importance to them of the ability to choose activities from an approved list and the opportunity to take turns leading part of the session.

Keywords: Physical education; attention deficit hyperactivity disorder; physical activity; symptom-reduction.

1. Introduction

Physical exercise can be an enjoyable part of the school week for children. In addition to the physical benefits of exercise, there is research indicating it has positive effects on mental health, including cognitive and social function for children with and without special educational needs [1]. For children with ADHD, acute and extended interventions up to four weeks long have been found to improve motor skills and executive function after exercise [2]. With regard to the symptoms of ADHD, interventions of six to ten weeks of aerobic exercise have been associated with a reduction in many of the symptoms [3]. A systematic review of 30 studies examined interventions ranging from single bouts of moderate to intense exercise to a series of sessions over four months [4]. Ng and co-workers [4] found that exercise at this intensity was acceptable to the children and adolescents aged six to seventeen years with

symptoms of ADHD, and there was evidence indicating improvement in motor skills, attention, behaviour and cognitive performance. However, differences in methodology in the studies reviewed leave further work necessary to discover the optimum exercise intensity and frequency.

Most children willingly engage in physical activity. However, physical education (PE) classes in school can fail to maintain the engagement of children with ADHD. In seated classroom lessons some innovative adjustments and strategies have been used to help children with ADHD manage symptoms, for example simple physical activities such as stretching at intervals during the lesson [5]. Another strategy developed was to use multiple short-duration tasks in a lesson, enabling choice for the children, and close supervision with immediate feedback by the teacher [6]. Currently educators are advised by organisations dedicated to the wellbeing of people with ADHD that the children should not miss PE lessons or break-times [7,8]. However, these organisations have not yet produced specific advice regarding adjustment to the PE lessons for the children, indicating the need for research in this area. Therefore, the aim of this preliminary study was to develop exercise sessions of moderate to high intensity to engage children with ADHD in PE lessons. The primary objective was to collaborate with children with ADHD in the evaluation and selection of multiple short-duration activities for PE lessons. The second objective was to pilot a method for future research into the long-term effects of PE lessons with exercise sessions for children with ADHD on their behaviour in school.

2. Method

The exercise sessions were developed through a prospective study involving a single cohort of four children with ADHD in one primary school. Ethical permission was granted by the University of West London.

2.1. Participants and procedure

Eligible prospective participants and their families were invited to take part in the study by the school staff. Inclusion criteria were: children aged 9 to 11 years, a diagnosis of ADHD or currently undergoing assessment for ADHD and parental permission. Four children meeting the criteria for the study volunteered to take part and were granted permission by their parents. The children were Caucasian boys aged 10 and 11. Informed consent was obtained from the children and their parents.

Ten 40-minute sessions were undertaken twice per week in the morning over five weeks. Different activities in seven to ten-minute blocks were provided in each session. The session started with a warm-up before the first activity. It also included short breaks of approximately 20 seconds between activities and finally a cool-down. Outdoor activities and indoor gym-based activities were used. An example session and other activities are provided in Figure 1. Each activity was evaluated on a 3-point Likert scale by the children using child-friendly hand signals. Progress was checked by the exercise leader every two or three minutes. The enjoyment was recorded during each activity by the exercise leader at the same time, so each exercise was evaluated at least twice per session. The final session was selected by the children, who chose from amongst their favourites, while still including appropriate warm-up and cool-down. For each child, the class teachers recorded the number of ADHD symptoms observed in one week before and then one week after the intervention.

2.2. Measures

The AD/HD Rating Scale-IV has 18 items derived from the Diagnostic and Statistical Manual of Mental Disorders [9]. There are two subscales, one representing inattentive symptoms and the other hyperactivity symptoms. Each item is scored on a four-point Likert scale: never or rarely (0), sometimes (1), often (2) and very often (3).

The Borg rating of perceived exertion (RPE) scale was used to record the children's perception of exertion for each exercise [10]. The RPE scale has been calibrated for exercise intensity against oxygen use [11]. The 20-point scale is linked to seven verbal descriptors: very, very light (7), very light (9), fairly light (11), somewhat hard (13), hard (15), very hard (17) and very, very hard (19). Exercise between 13−14 is moderate intensity, 15−16 vigorous, 17−18 very vigorous to intense exertion and 19−20 maximum effort. Each session was designed by a sports psychologist and an exercise leader to enable children to reach a work rate between moderate and intense exertion.

Child-friendly hand signals were used to follow progress and determine the child's enjoyment of the exercise. The hand with the thumb up, the thumb horizontal or the thumb down were used to represent positive (+1), neutral (0) and negative responses (-1), respectively.

3. Results

All the children engaged fully in the physical exercise sessions and evaluation of each activity. The RPE data (Table 1) showed that the children perceived themselves to be working at moderate intensity for the warm-up and the basket-ball shooting game called Hot Seat. For more complex exercises the children reported working vigorously to intensely, with some reporting maximum effort. The children's responses to each activity expressed as the enjoyment rating are shown in Table 1.

Table 1. Example exercise session and alternative activities: physical activities used in the sessions rated for perceived exertion (RPE) and enjoyment.

		RPE: Mean (range)	Enjoyment rating: highest 4, lowest 1
Example session	Session specific warm up in school gym, children take in turns to lead (5−10 minutes)	14 (13−15)	2
	Outdoors challenge course using the school playing field and outdoor equipment for climbing and balance (10 minutes)	18 (17−19)	4
	Hot Seat: basketball and shuttle sprint game (10 minutes)	14 (13−15)	3
	Cool down (5−10 minutes)	9 (9)	1
Alternative activities	Two x circuits in school gym using the ropes and climbing frames (10 minutes)	18 (17−19)	4
	Sprint and pass rugby no-contact session in the gym (10 minutes)	14 (13−15)	2
	Pick up Tens: circuit outside short sprint to stations for 10 repetitions of an exercise, e.g. push-ups (10 minutes)	17 (17)	3
	Circuit training including pad-work outside (15 minutes due to safe technique being taught)	19 (19)	4
	Outdoors 3 option circuit with short sprint to stations for burpees, star jumps or squat thrusts (10 minutes)	17 (17)	3

The exercise leader observed the children were very keen to engage in every aspect of the study, for example they took great pride in the responsibility of leading the warm-up when it was their turn. The children also showed enthusiasm for the shared task of choosing their favourite optional activities for the final session. The options chosen were Hot Seat, then the circuit-training with pad-work and finally the outdoor challenge course each for ten minutes. When asked what they had enjoyed most about the exercise sessions the children themselves commented on the chance to choose activities and to get turns leading.

There was a reduction in teacher-rated AD/HD rating scale scores for inattentive and hyperactive symptoms (Figure 1). The reduction could not be tested for statistical significance due to the very small number of participants. The teachers also informed the research team that there had been a general increase in engagement and effort by all the children during their regular classroom-based lessons.

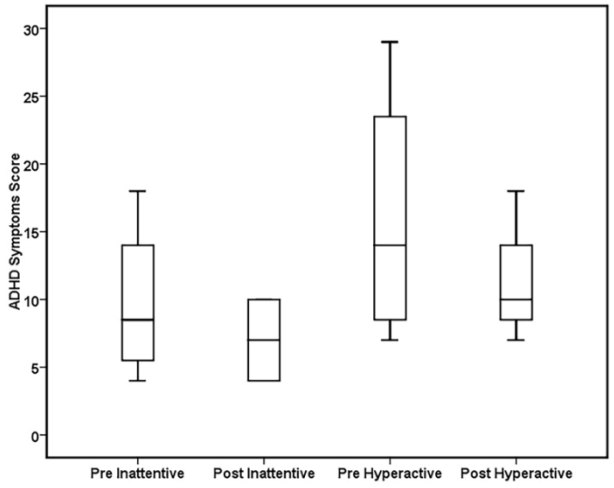

Figure 1. Median and range of the teacher-rated AD/HD Rating Scale-IV [9] scores for inattentive and hyperactive symptoms for four participants measured on the week before (Pre Inattentive; Pre Hyperactive) and then after five weeks of exercise intervention for children with ADHD (Post Inattentive; Post Hyperactive).

4. Discussion

The results show that the aim of this study has been successfully addressed through collaborative method development with a group of the target children. It is interesting that these children had all previously experienced extreme difficulty maintaining attention during PE lessons. In contrast, during the sessions specifically developed to enable swift changes of activity and variety, they were fully engaged throughout. Moreover, the children were very keen to contribute to the evaluation of each activity, both in terms of exercise intensity and how much they enjoyed doing them. The successful collaboration between the children and the researchers was the primary objective. This culminated in the final selection of enjoyable activities which enabled exercise in every session to reach moderate to high intensity: thus, achieving the exercise level that has been previously associated with ADHD symptom reduction [4].

The full engagement by the children and successful collection of symptom data in the classroom indicate that the second objective has been achieved. Therefore, it appears that it could be possible to test the utility of this method in regular PE lessons at school. In addition, the work of DuPaul, Weyandt and Janusis [6] demonstrated that teachers and parents could have more effect when applying positive behaviour change strategies for ADHD in the school and home at the same time. This suggests that school teachers and parents working together might increase or extend the positive effect of exercise on symptom reduction if exercise opportunities at home could be increased simultaneously.

The measurement of the ADHD symptoms was not the primary purpose of this stage of the method development, so no control group was included. However, it was interesting to observe that just ten sessions over five weeks were associated with a reduction in hyperactivity and inattentive symptoms. It appears that with sufficient power this change could be statistically significant. Arguably, the most important measure of the change is already indicated by the teachers' reports of a general increase in engagement and effort in classroom-based lessons as well as the specific ADHD symptom reduction. Other very interesting and unexpected observations include the children's positive response to making choices and taking turns leading some activities. Future work might provide useful insight by determining whether these observations are replicated or not.

The study has limitations that could not be avoided in the setting of a single primary school. These should be addressed in future study design. The sample of children must be increased in size and range to include girls as well as boys and different ethnic groups. The school had nine boys and girls who met the criteria, but only four were free to undertake the study during PE lesson time. Incorporating the exercise sessions into regular PE lessons for all the class could overcome this problem. Carrying out the study in multiple primary schools would also be necessary to increase the number of participants with ADHD and appropriate non-ADHD control group when testing the effect of the intervention. These proposals could cause new difficulties, including potential confounding factors due to using different schools and increased costs of running the study in different locations. However, the positive response by the children and changes in their behaviour suggest that this low-cost intervention might be a useful tool for schools and merits rigorous testing.

In conclusion, the results from this preliminary method development study suggest that specifically designed exercise sessions can stimulate and maintain engagement by children with ADHD. Further, the results indicate that key elements are the short period for each activity and a variety of different exercises. Two other elements appear to be helpful in engaging the children. These are the ability to choose activities from an approved list and the opportunity to lead part of the session. Finally, this study has provided some indication

that this method might reduce ADHD symptom level and merits further research.

Author contributions

Dr Alyx Taylor and Dr David Foreman conceived and designed the study. Dr Taylor analysed and interpreted the data. Dr Taylor drafted the article and Dr Foreman critically revised it for important intellectual content. Both authors approved the final version.

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Conflict of Interest

The authors declare no conflict of interest.

References

1 Ahn S, Fedewa AL. A meta-analysis of the relationship between children's physical activity and mental health. J Pediatr Psychol 2011; 36: 385−397.

2 Vysniauske R, Verburgh L, Oosterlaan J, Molendijk ML. The effects of physical exercise on functional outcomes in the treatment of ADHD: a meta-analysis. J Atten Disord 2016; pii: 1087054715627489.

3 Cerrillo-Urbina AJ, García-Hermoso A, Sánchez-López M, Pardo-Guijarro MJ, Santos Gómez JL, Martínez-Vizcaíno V. The effects of physical exercise in children with attention deficit hyperactivity disorder: a systematic review and meta-analysis of randomized control trials. Child Care Health Dev 2015; 41: 779−788.

4 Ng QX, Ho CYX, Chan HW, Yong BZJ, Yeo WS. Managing childhood and adolescent attention-deficit/hyperactivity disorder (ADHD) with exercise: a systematic review. Complement Ther Med 2017; 34: 123−128.

5 Mulrine CF, Prater MA, Jenkins A. The active classroom: supporting students with attention deficit hyperactivity disorder through exercise. Teach Except Child 2008; 40: 16−22.

6 DuPaul GJ, Weyandt LL, Janusis GM. ADHD in the classroom: effective intervention strategies. Theor Pract 2011; 50: 35−42.

7 ADDitude. Quiet Ways for Fidgety Kids to Release Energy at School. Additudemag.com. Available: https://www.additudemag.com/fidgeting/ Accessed February 5, 2019.

8 ADHD Foundation. Primary school classroom strategies. Available: https://www.adhdfoundation.org.uk/information/schools/ Accessed February 5, 2019.

9 DuPaul G, Stoner G. ADHD in the schools: assessment and intervention strategies (3rd ed). New York, NY: The Guildford Press, 2014.

10 Borg, G. Borg's perceived exertion and pain scales. Champaign, IL: Human Kinetics, 1998.

11 Coquart JB, Garcin M, Parfitt G, Tourny-Chollet C, Eston RG. Prediction of maximal or peak oxygen uptake from ratings of perceived exertion. Sports Med 2014; 44: 563−578.