FITNESS

Comparison of Physical Fitness Performance Between Elementary-Aged Students With and Without Attention Deficit Hyperactivity Disorder

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Abstract

The purpose of this investigation was to analyze the possible differences of the physical fitness performance of elementary-aged students with and without attention deficit hyperactivity disorder (ADHD). Little research has been produced in the area of youth with ADHD and motor development; this research paper further investigates the effects of ADHD and motor development within elementary-aged students. The participants included 51 elementary-aged students between ages 7 and 10. These participants included eight with ADHD (three females, five males; age, M = 7.75) and 43 without ADHD (21 females, 22 males; age, M = 8.23). They received measures on seven test items selected from The President's Challenge physical fitness program, including curl-up, push-up, pull-up, flexed-arm hang, sit and reach, endurance run, and shuttle run. A simple multivariable analysis (MANOVA) and one variable analysis (ANOVA) were used to analyze the differences between students with and without ADHD. Results showed little difference between the two groups. Follow-up tests again showed little variance, even when compared against gender and age. These findings revealed

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that young adults with ADHD are on par and/or show performance similar to their peers on fitness performance assessments.

Attention deficit hyperactivity disorder (ADHD) is one of the most common childhood disorders and can continue through adolescence and adulthood (National Institute of Mental Health, 2008). Behaviors associated with this disorder include difficulty waiting for one's turn, inability to pay attention, higher rates of classroom interruption, day dreaminess, difficulty sitting still, excessive talking, and difficulty developing appropriate motor behavior (Johnson & Rosen, 2000). Children with this disorder are often more aggressive, more negative, and more socially awkward and are perceived as more annoying (Lopez-Williams et al., 2005). Studies have also linked ADHD with poor basic motor skill development, poor coordination, and low levels of athletic skill. These same studies have shown ADHD is associated with a variety of different motor deficits, such as poor balance, decreased fine motor ability, decreased gross motor ability, and impaired motor response resulting in slow reaction times (Licari & Larkin, 2008). With low motor ability and decreased motor response, it could be hypothesized that these children also have low fitness levels. However, few authors have described fitness levels in children with ADHD (Verret, Gardiner, & Beliveau, 2010).

Much of fitness assessment data has been related to the adult population and less to children in the general population. However, muscular, aerobic, flexibility, and body composition are universally core to assessing fitness abilities. Given the importance of motor skills for the level of physical activity in the child population, it has also been suggested these skills be included within the fitness assessments (Verret et al., 2010). This idea is extremely important when researching fitness ability in children with ADHD considering the links are strong toward poor motor ability and motor reaction.

This emerging evidence of links between children with ADHD and difficulty performing motor tasks leaves one wondering why this is so. Why do children, who are overactive, have difficulty with gross and fine motor movements, which are the basics of major fitness assessments? None have been able to find a definitive answer. One study suggested that children with ADHD may lack the ability to regulate their skill performances in different movement contexts, further suggesting that these children have difficulties in self-regulation, more specifically, experience and inability to

proceduralize (e.g., perform) their declarative knowledge (e.g., personal facts and knowledge acquired about performance; Harvey, Reid, Bloom, & Staples, 2009). This previous declarative knowledge is essential in the performance of common and new tasks. This lack of knowledge could be linked to lack of inclusion and desire for individualistic activities (Harvey et al., 2009).

Other researchers have attempted to link ADHD with other developmental disorders, such as developmental coordination disorder (DCD), oppositional defiant disorder (ODD), conduct disorder (CD), and reading disorder (RD; Martin, Piek, Bayman, Levy, & Hay, 2010). Through the other developmental disorder studies, researchers focused on increased associated movements. With all new motor tasks or activities, children often display excessive/unnecessary movements, which reduce biomechanical efficiency and increase the energy cost of movement; these extra movements are labeled as associated movements (Licari, Larkin, & Miyahara, 2006). Much of the research demonstrated children with movement disorders display more associated movements than children without movement difficulties (Licari & Larkin, 2008); however, motor problems are not universally linked to ADHD unless another disorder(s) is also present (Martin et al., 2010). Still, the questions of why children with ADHD have motor performance difficulties and why they are perceived as less physically fit than children without ADHD are left unanswered.

This deficit in motor ability, although contradictive, needs to be considered when looking at physical fitness performance. All standardized fitness tests have a certain degree of fine and gross motor performance. The proper development of these skills will certainly have an effect on the outcome of the overall fitness assessment. The variance in the former testing of motor problems in children with ADHD can be linked to differences in methodologies; most tasks assessed in recent studies regarding motor ability are far different from those completed in a physical activity context (Verret et al., 2010). In a literature review looking specifically at gross motor skills in children with ADHD, authors concluded cautiously that children with ADHD could be more at risk for movement skill problems than age-matched peers without ADHD (Verret et al., 2010). With the great convergence of information regarding the motor ability of children with ADHD, little is known of the link between motor ability and physical fitness performance to make a conclusive determination of the relation of the two skill sets.

With little research done on the fitness profiles of children with ADHD, and with the overwhelming stigmatization of children with ADHD being lazy/unfit, the aim of this study was to compare the physical fitness performances of elementary-aged students with and without ADHD using The President's Challenge program as the vehicle for testing fitness performance.

Method

Participants

Participants recruited for this study were 51 elementary-aged children, including eight children with ADHD (three females, five males; age, $M = 7.75$) and 43 without ADHD (21 females, 22 males; age, $M = 8.23$). All participants were sampled from two elementary schools within the Lapeer Community Schools District. Students identified as having ADHD were categorized as such by the parent through diagnosis of their own (e.g., personal doctor); no specific assessments were administered to determine the accuracy of said identifications. Of the eight children with ADHD, none were codiagnosed with any other learning development disorder; only one participant without ADHD had been diagnosed with type 1 diabetes. All participants were measured in seven test items for evaluating the level of physical fitness.

Test Items

The seven test items used were selected from The President's Challenge physical fitness program. These test items include an endurance run, shuttle run, curl-up, push-up, flexed-arm hang, pull-up, and sit and reach tests. A body mass index or skinfold measurement was not taken from the individuals due to concerns from the administration at each school. The endurance run and shuttle run were employed to test the aerobic functioning and endurance capabilities. The curl-up, push-up, flexed-arm hang, and pull-up tests were used to test muscular endurance and strength. The sit and reach test was selected to test the flexibility of each student as stated in the *President's Challenge Program Guide* (President's Council on Fitness, Sport, and Nutrition, 2010).

The endurance run and shuttle run were used to measure aerobic functioning and endurance (President's Council on Fitness, Sport, and Nutrition, 2010). With these testing items, the children's aim was to complete the task as quickly as possible. For the endurance

run, a quarter-mile track was measured and marked. Children were prepped on the track and given a chance to walk the track, in order to be exposed to the track before running. Children aged 10 and up ran 1 mile, 8 to 9 ran a half mile, and 6 to 7 ran a quarter mile. For the shuttle run, tape was set up 20 m apart and two 1 in. x 1 in. x 4 in. wooden blocks were placed on the line opposite the children. On the start signal, children ran to the opposite line, grabbing one block and bringing it back to the start, and setting it down on the line. They then went back to get the other block and raced back to the finish. These test items have been documented to be valid and reliable for assessing aerobic capacity (Franks & Safrit, 1999; Keating & Silverman, 2004; Verret et al., 2010).

The curl-up, push-up, flexed-arm hang, and pull-up tests were used to measure muscle strength and endurance (President's Council on Fitness, Sport, and Nutrition, 2010). For the curl-up test, children lay flat on their back with their knees bent and arms across their chest. Children were instructed to sit up until their elbows touched their knees and to do their maximum in a 60-s window. For the push-up test, children were shown proper push-up form. A 6-in. diameter gator ball was used to ensure students reach the 90° angle in the arms; the gator ball was held directly underneath the child's chest. Children aimed to reach their maximum number, with no time limit. For the flexed-arm hang and pull-up tests, a standard pull-up bar was used. To complete the pull-ups, children were instructed to pull up their body, without using their legs, so their chin reached above the bar and to do as many as possible. In the flexed-arm hang test, children held their chin above the bar using an underhand grip. This was done for as long as they could. These test items have been documented to be valid and reliable for assessing muscular strength and endurance (Keating & Silverman, 2004; Franks & Safrit, 1999; Verret et al., 2010).

The sit and reach test was used to measure flexibility within the students (President's Council on Fitness, Sport, and Nutrition, 2010). A commercially built testing apparatus was used to test flexibility. The children began the test by removing their shoes and sitting down next to the apparatus. The children then placed both feet firmly against the flex-tester; with both arms fully extended, the children reached as far as they could, extending their hands, palms down, over the measuring scale of the apparatus. This test item has been documented to be a valid and reliable test for assessing

flexibility within elementary-aged children (Keating & Silverman, 2004; Verret et al., 2010).

Because understanding, preparedness, and motivation are important to the success of each of these tasks (Harris & Cale, 2006), several measures were taken to ensure that the children were well prepared and confident when beginning each assessment. The children were given a thorough explanation of each task, shown a proper demonstration, and allowed to conduct several practice trials, allowing them ample time to understand how to perform each task properly. Each of the tests was completed twice over an 8-month period; the children completed each test during the fall and then again in the spring, thus allowing for demonstration of progression and allowing for additional trials. All norms for each test were provided through the President's Council on Fitness, Sports, and Nutrition (2010).

Data Collection and Analysis

Data were collected for the seven test items over the course of the school year. Students were tested twice on each item throughout the year: once in the fall and once in the spring. This allowed for multiple trial attempts, as well as a larger sample of data to compare one group to another. A simple multivariable analysis (MANOVA) was used to check for differences on the fitness test items, first between male and female participants to see whether they could be included in the same data analysis group. Because no significant differences could be found between male and female participants, a MANOVA was then employed to analyze the overall differences on all test items of participants with and without ADHD. The significant differences resulting from the MANOVA test were then followed by additional tests in order to analyze the difference(s) on each of the seven test items.

Results

Data for each test item were taken over the course of the school year and entered into a simple ANOVA, to compare the relationship between male and female participants. Table 1 shows the descriptive statistics, means, and standard deviations based on all fitness test items by gender. The results of the ANOVA indicated that the overall differences of the test items between male and female participants were not statistically significant in all except the endurance run test (time in seconds) and the push-up test (see Table 2). Scores involving

muscular strength and endurance favored the boys (curl-up, M = 29.32; push-up, M = 18.93; pull-up, M = 1.97) to the girls (curl-up, M = 27.19; push-up, M = 18.21; pull-up, M = .73). As expected the girls did better than the boys during the flexibility test (sit and reach), although differences were not statistically significant enough to separate the genders during calculations (girls, M = 29.28; boys, M = 27.06). Means are shown in Figure 1.

Table 1

Means and Standard Deviations Based on All the Test Items Between Male (1) and Female (2) Participants

Fitness Test	Number	Mean	Standard Deviation
Curl-Up Test 1 (1)	27	29.26	7.502
(2)	24	25.79	7.483
Total	51	27.63	7.621
Curl-Up Test 2 (1)	27	29.37	10.478
(2)	24	28.58	8.801
Total	51	29.00	9.640
Push-Up Test 1 (1)	27	21.04	22.514
(2)	24	19.79	10.867
Total	51	20.45	17.841
Push-Up Test 2 (1)	27	16.81	13.278
(2)	24	16.63	9.385
Total	51	16.73	11.498
Pull-Up Test 1 (1)	27	2.04	3.192
(2)	24	.83	1.129
Total	51	1.47	2.501
Pull-Up Test 2 (1)	27	1.89	2.991
(2)	24	.63	.970
Total	51	1.29	2.343
Flexed-Arm Hang 1 (1)	27	8.963	5.2294
(2)	24	6.696	3.1724
Total	51	7.896	4.4895
Flexed-Arm Hang 2 (1)	27	10.363	8.3478
(2)	24	6.500	3.8943
Total	51	8.545	6.8560

Table 1 (cont.)

Fitness Test	Number	Mean	Standard Deviation
Sit & Reach Test 1 (1)	27	26.926	4.7448
(2)	24	30.146	4.7077
Total	51	28.441	4.9534
Sit & Reach Test 2 (1)	27	27.185	5.0823
(2)	24	28.417	6.1036
Total	51	27.765	5.5636
Time in Seconds 1 (1)	27	278.30	132.481
(2)	24	232.08	108.625
Total	51	256.55	122.870
Time in Seconds 2 (1)	27	340.22	216.118
(2)	24	384.67	265.148
Total	51	361.14	239.017
Shuttle Run 1 (1)	27	13.337	1.2506
(2)	24	13.914	1.1898
Total	51	13.608	1.2446
Shuttle Run 2 (1)	27	12.504	1.1054
(2)	24	13.229	1.1215
Total	51	12.845	1.1609

Note. 1 denotes the first trial and 2 denotes the second trial.

Table 2

Results of ANOVA Tests on Each of the Test Items Between Male and Female Participants

Fitness Test	Sum of Squares	*df*	Mean Square	*F*	Sig.
Curl-Up Test 1 Between Groups	152.778	1	152.778	2.721	.105
Within Groups	2751.144	49	56.146		
Total	2903.922	50			
Curl-Up Test 2 Between Groups	7.870	1	7.7870	.083	.774
Within Groups	4638.130	49	94.656		
Total	4646.000	50			

Table 2 (cont.)

Fitness Test	Sum of Squares	*df*	Mean Square	*F*	Sig.
Push-Up Test 1 Between Groups	19.706	1	19.706	.061	.806
Within Groups	15894.921	49	324.386		
Total	15914.627	50			
Push-Up Test 2 Between Groups	.458	1	.458	.003	.954
Within Groups	6609.699	49	134.892		
Total	6620.257	50			
Pull-Up Test 1 Between Groups	18.410	1	18.410	3.065	.086
Within Groups	294.296	49	6.006		
Total	312.706	50			
Pull-Up Test 2 Between Groups	20.297	1	20.297	3.911	.054
Within Groups	254.292	49	5.190		
Total	274.588	50			
Flexed-Arm Hang 1 Between Groups	65.307	1	65.307	3.395	.071
Within Groups	942.473	49	44.095		
Total	1007.779	50			
Flexed-Arm Hang 2 Between Groups	189.603	1	189.603	4.300	.043
Within Groups	2169.643	49	44.095		
Total	2350.246	50			
Sit & Reach Test 1 Between Groups	131.732	1	131.732	5.894	.019
Within Groups	1095.091	49	22.349		
Total	1226.824	50			
Sit & Reach Test 2 Between Groups	19.269	1	19.269	.618	.436
Within Groups	1528.407	49	31.192		
Total	1547.676	50			
Time in Seconds 1 Between Groups	27135.164	1	27135.164	1.827	.183
Within Groups	727719.463	49	14.851.418		
Total	754854.627	50			

Table 2 (cont.)

Fitness Test	Sum of Squares	*df*	Mean Square	*F*	Sig.
Time in Seconds 2 Between Groups	25098.039	1	25098.039	.434	.513
Within Groups	2831358.000	49	57782.816		
Total	2856456.039	50			
Shuttle Run 1 Between Groups	4.226	1	4.226	2.828	.099
Within Groups	73.221	49	1.494		
Total	77.447	50			
Shuttle Run 2 Between Groups	6.687	1	6.687	5.398	.024
Within Groups	60.699	49	1.239		
Total	67.386	50			

Note. 1 denotes the first trial and 2 denotes the second trial.

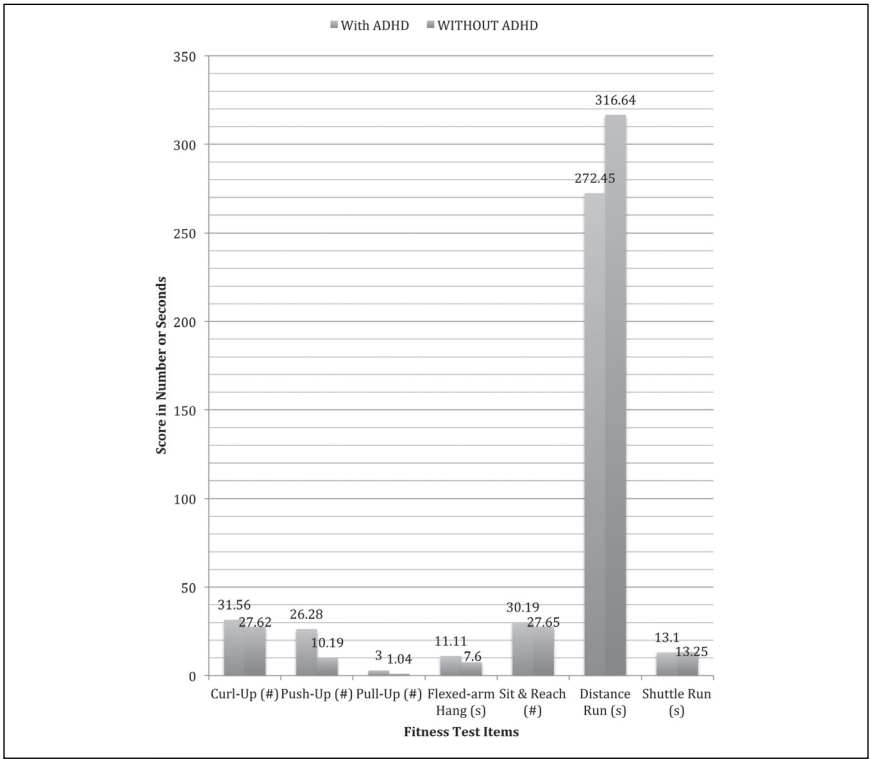

Figure 1. Comparison of Fitness Scores Between Children With and Without ADHD

The differences between the endurance run and push-up test were then run in a separate ANOVA considering age (see Table 3) and then again in a MANOVA considering age and gender (see Table 4). These results showed few differences between gender and the run test based on age. Because there was little difference in male and female participants, the test items were run between participants with and without ADHD.

Table 3

Results of ANOVA Test on the Endurance Run Test Items Between Male and Female Participants

Fitness Test	Sum of Squares	*df*	Mean Square	*F*	Sig.
Time in Seconds 1 Between Groups	325464.250	3	108488.083	11.875	.000
Within Groups	429390.377	47	9135.965		
Total	754854.627	50			
Time in Seconds 2 Between Groups	1059835.262	3	353278.421	9.242	.000
Within Groups	1796620.777	47	38225.974		
Total	2856456.039	50			

Note. 1 denotes the first trial and 2 denotes the second trial.

Table 4

Results of MANOVA Test on the Endurance Run Test Items Between Male and Female Participants, Based on Age

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Corrected Model	27.085	3	9.028	16.537	.000
Intercept	394.836	1	394.836	723.201	.000
Run 1	6.310	1	**6.310**	11.557	.001
Run 2	4.882	1	4.882	8.942	.004
Gender	.173	1	.173	.316	.577
Error	25.660	47	.546		
Total	3446.000	51			
Corrected Total	52.745	50			

Note. 1 denotes the first trial and 2 denotes the second trial.

Table 5 shows the descriptive statistics, means, and standard deviations based on all fitness test items analyzed against ADHD. The results of this ANOVA showed a significant difference between those with ADHD and those without, regardless of age or gender (see Table 6). Participants with ADHD scored significantly better on every test item (shown in Figure 2).

Table 5

Means and Standard Deviations Based on All the Test Items Between Participants With (1) and Without (2) ADHD

Fitness Test	Number	Mean	Standard Deviation
Curl-Up Test 1 (1)	9	30.56	10.199
(2)	42	27.00	6.946
Total	51	27.63	7.621
Curl-Up Test 2 (1)	9	32.56	10.933
(2)	42	28.24	9.307
Total	51	29.00	9.640
Push-Up Test 1 (1)	9	34.476	11.492
(2)	42	10.954	1.690
Total	51	17.841	2.498
Push-Up Test 2 (1)	9	18.084	6.028
(2)	42	9.418	1.453
Total	51	11.498	1.610
Pull-Up Test 1 (1)	9	3.33	4.637
(2)	42	1.07	1.583
Total	51	1.47	2.501
Pull-Up Test 2 (1)	9	2.67	4.272
(2)	42	1.00	1.623
Total	51	1.29	2.343
Flexed-Arm Hang 1 (1)	9	10.056	6.3549
(2)	42	7.433	3.9315
Total	51	7.896	4.4895
Flexed-Arm Hang 2 (1)	9	12.167	12.2642
(2)	42	7.769	4.9476
Total	51	8.545	6.8560

Table 5 (cont.)

Sit & Reach Test 1 (1)	9	30.00	4.3804
(2)	42	28.107	5.0528
Total	51	28.441	4.9534
Sit & Reach Test 2 (1)	9	30.389	5.5271
(2)	42	27.202	5.4728
Total	51	27.765	5.5636
Time in Seconds 1 (1)	9	235.67	107.964
(2)	42	261.02	126.572
Total	51	256.55	122.870
Time in Seconds 2 (1)	9	309.22	190.435
(2)	42	372.26	248.747
Total	51	361.14	239.017
Shuttle Run 1 (1)	9	13.556	1.2300
(2)	42	13.620	1.2622
Total	51	13.608	1.2446
Shuttle Run 2 (1)	9	12.722	1.2194
(2)	42	12.871	1.1616
Total	51	12.845	1.1609

Note. 1 denotes the first trial and 2 denotes the second trial.

Table 6

Results of ANOVA Tests on Each of the Test Items Between Participants With and Without ADHD

Fitness Test	Sum of Squares	*df*	Mean Square	*F*	Sig.
Curl-Up Test 1 Between Groups	93.699	1	93.699	1.634	.207
Within Groups	2810.222	49	57.351		
Total	2903.922	50			
Curl-Up Test 2 Between Groups	138.159	1	138.159	1.502	.226
Within Groups	4507.841	49	91.997		
Total	4646.000	50			

Table 6 (cont.)

Fitness Test	Sum of Squares	*df*	Mean Square	*F*	Sig.
Push-Up Test 1 Between Groups	1485.834	1	1485.834	5.046	.029
Within Groups	14428.794	49	294.465		
Total	15914.627	50			
Push-Up Test 2 Between Groups	357.435	1	357.435	2.801	.101
Within Groups	6252.722	49	127.607		
Total	6610.157	50			
Pull-Up Test 1 Between Groups	37.920	1	37.920	6.762	.012
Within Groups	274.786	49	5.608		
Total	312.706	50			
Pull-Up Test 2 Between Groups	20.588	1	20.588	3.972	.052
Within Groups	254.000	49	5.184		
Total	274.588	50			
Flexed-Arm Hang 1 Between Groups	50.964	1	50.964	2.610	.113
Within Groups	956.816	49	19.527		
Total	1007.779	50			
Flexed-Arm Hang 2 Between Groups	143.337	1	143.337	3.182	.081
Within Groups	2206.910	49	45.039		
Total	2350.246	50			
Sit & Reach Test 1 Between Groups	26.556	1	26.556	1.084	.303
Within Groups	1200.268	49	24.495		
Total	1226.824	50			
Sit & Reach Test 2 Between Groups	75.258	1	75.258	2.504	.120
Within Groups	1472.419	49	30.049		
Total	1547.676	50			
Time in Seconds 1 Between Groups	4765.651	1	4765.651	.311	.579
Within Groups	750088.976	49	15307.938		
Total	754854.627	50			

Table 6 (cont.)

Fitness Test	Sum of Squares	*df*	Mean Square	*F*	Sig.
Time in Seconds 2 Between Groups	29454.365	1	29454.365	.511	.478
Within Groups	2827001.675	49	57693.912		
Total	2856456.039	50			
Shuttle Run 1 Between Groups	.031	1	.031	.019	.890
Within Groups	77.417	49	1.580		
Total	77.447	50			
Shuttle Run 2 Between Groups	.165	1	.165	.120	.730
Within Groups	67.221	49	1.372		
Total	67.386	50			

Note. 1 denotes the first trial and 2 denotes the second trial.

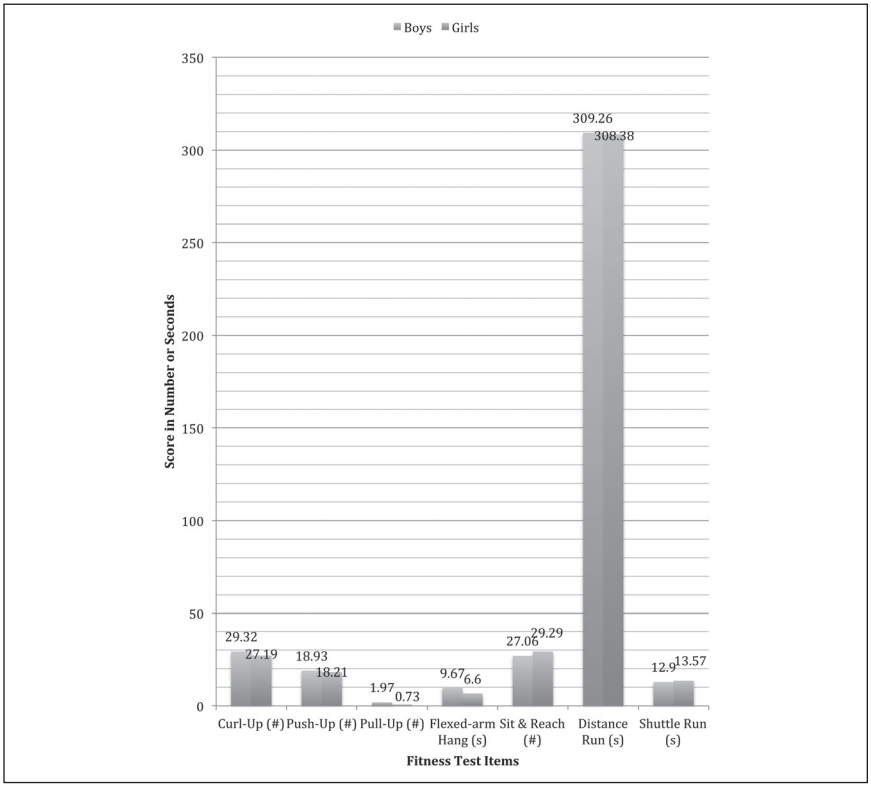

Figure 2. Comparison of Fitness Scores Between Boys and Girls

To further test the differences of students with and without ADHD, a MANOVA was run analyzing differences between gender and participants with and without ADHD; these results (Table 7) demonstrated relative differences, but were not significant enough to warrant great concern. Data reflected that which was demonstrated in previous examinations.

Table 7

Results of MANOVA Tests on Each of the Test Items Between Participants With and Without ADHD, Considering Gender

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.
Corrected Model	5.954	15	.397	2.058	.039
Intercept	.199	1	.199	1.032	.317
Curl-Up 1	.378	1	.378	1.960	.170
Curl-Up 2	.455	1	.455	2.360	.133
Push-Up 1	.038	1	.038	.199	.659
Push-Up 2	.109	1	.109	.564	.458
Pull-Up 1	.015	1	.015	.076	.784
Pull-Up 2	.063	1	.063	.328	.570
Flexed-Arm 1	.070	1	.070	.363	.551
Flexed-Arm 2	.349	1	.349	1.808	.187
Sit & Reach 1	1.628	1	1.628	8.440	.006
Sit & Reach 2	.375	1	.375	1.943	.172
Run 1	.034	1	.034	.177	.677
Run 2	.280	1	.280	1.454	.236
Shuttle Run 1	.011	1	.011	.058	.811
Shuttle Run 2	.745	1	.745	3.862	.057
ADHD	.143	1	.143	.741	.395
Error	6.752	35	.193		
Total	123.00	51			

Note. 1 denotes the first trial and 2 denotes the second trial. The dependent variable is gender.

Discussion

There are three valid discussion points that derive themselves from the ANOVA and MANOVA analysis. First, the lack of significant differences between the physical fitness performance does

not support the claims that elementary-aged children with ADHD are more likely to be lower or behind in motor development (Licari & Larkin, 2008; Licari et al., 2006; Verret et al., 2010). Assessments using large motor groups, such as the endurance run, push-up test, and curl-up test, showed extreme similarities and/or tended to favor students with ADHD (ADHD: curl-up, M = 31.56; push-up, M = 26.28; endurance run, M = 4:54; non-ADHD: curl-up, M = 27.62; push-up, M =16.73; endurance run, M = 5:27). This possibly shows the opposite of the claim of previous research that has demonstrated children with ADHD are developmentally behind their normal peers in the area of gross motor movement and leans toward the idea that children with ADHD could possibly, because of their hyperactivity, hold higher endurance rates and muscular strength.

The second area of concern during analysis was the shuttle run assessment. Within this test, unlike other assessments, participants must complete a more complex task using not only motor function, but also eye–hand coordination while multitasking. The shuttle run assessment was thought to show a great difference between children with ADHD and children without, favoring students without ADHD, because of children with ADHD's inability to multitask and focus long enough to complete the tasks at hand. However, to the surprise of the researchers, again, participants with ADHD were on par with their normal developing peers (ADHD, M = 13.1 s; non-ADHD, M = 13.24 s). Such a slight difference between means lends to the idea that children with ADHD can focus, when needed, and complete multiple tasks at once, but because little research has been done in this area, this can only be deemed as a hypothesis. More research must be completed testing physical fitness performance of elementary-aged children with ADHD before proving any conclusions.

Third, in many of the studies linking children with ADHD to motor development issues, the participants were diagnosed with another form of learning disability. Within this study, no participants showed any other form of learning disability other than ADHD, possibly leading to the similarities between participants with and without ADHD. It was mentioned that motor developments can be linked more closely to reading issues (Martin et al., 2010); perhaps this study furthers that finding by showing children with ADHD and no learning disabilities or reading issues perform at similar levels as their peers without ADHD.

Concerns for Further Research

This study has shown that children with ADHD can perform at the same level as their normal developing peers and that little evidence leans toward motor development issues within the children with ADHD. However, because the focus of this study was so small, it is a stretch to link this study to the general population. If further research were to be done, researchers would need to broaden the spectrum and attempt to include a large quantity of children with ADHD. Also, great consideration should be placed on the fitness assessments being used. For this study, The President's Challenge physical fitness program was used. Perhaps it would be more prudent to use a more criterion-based fitness assessment, such as the Brockport Fitness Assessment.

Conclusion

The participants within this study with ADHD demonstrated their abilities to perform as well as their peers without ADHD during all physical fitness assessments. This analysis led the researcher to hypothesize further that children with ADHD can perform as well as or at higher rates because of their hyperactivity and show no signs of gross motor development problems. Without other similar research to which to compare this study, no concrete statement can be made. More research must be completed in the area of elementary-aged children with ADHD to completely answer the question of whether children with ADHD have better performance rates due to their disability or whether having ADHD leads toward motor development issues because of the inability to focus on more than one task.

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