# Evaluating Physical Fitness in College Students with and without ADHD

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December 20, 2021

**Abstract**

The current study examined differences in the cardiorespiratory fitness and muscular strength components of physical fitness among college students with and without ADHD. We hypothesized that college students with ADHD would be less physically fit in these domains than their peers without ADHD. Students with ADHD were expected (a) to have significantly lower VO2 max as an indicator of cardiorespiratory fitness following a 3-minute step test and (b) to demonstrate less strength in a handgrip dynamometry test compared to their peers. There were 63 participants in this study between the ages of 18 and 25, both male and female. Approximately half of the participants were in the ADHD group ($n$ = 31), and half were in the non-ADHD group ($n$ = 32). To test cardiorespiratory fitness, a 3-minute step test was completed with a 15-second heart rate taken after. Information including heart rate, age, and sex was then used in a validated step test equation to estimate VO2 max. To test muscular strength, participants completed three trials of a handgrip strength test using a dynamometer, and the highest of the three trials was recorded. Descriptive results of independent sample $t$ tests indicated that estimated V02 max in the ADHD group ($M$ = 38.62, $SD$ = 6.96) was lower compared to the non-ADHD group ($M$ = 40.34, $SD$ = 7.05). Results for handgrip strength also showed less strength in the ADHD group ($M$ = 79.75, $SD$ = 26.74) compared to the non-ADHD group ($M$ = 83.80, $SD$ = 27.29). However, these differences failed to meet statistical significance ($p$ = .334 , $p$ = .554, respectively). These findings do not support that college students with ADHD are less physically fit in the cardiorespiratory and muscular strength domains of physical fitness than their peers. However, the effect sizes were small ($d$ = .25, $d$ = .15, respectively), and the study was not powered to detect small effects (only large), suggesting that results should be reevaluated when a larger sample size is attained.

**Evaluating Physical Fitness in College Students with and without ADHD**

As defined by the American College of Sports Medicine (2000), physical fitness consists of a set of attributes that people possess or attain over time that impact their ability to perform physical activity. Physical activity is defined as any movement of the body through skeletal muscle contraction that increases overall energy expenditure. According to the American College of Sports Medicine (2000), there are four components that make up physical fitness. The components include cardiorespiratory endurance, body composition, muscular fitness, and flexibility. Cardiorespiratory endurance refers to a person's ability to perform dynamic, moderate-to-high intensity exercise using large muscle groups for an extended period of time. Body composition is the comparison of the percent of a person's overall weight that is from fat and fat-free tissue. Muscular fitness includes both muscular strength and muscular endurance. Muscular strength refers to the max amount of force that a muscle or muscle group can produce at a certain velocity. Muscular endurance refers to the ability of a muscle or muscle group to repetitively contract over an extended period of time. Lastly, flexibility is the ability for one to move a joint through its full range of motion.

These components of physical fitness are related to several positive life outcomes. Some of the positive health outcomes that have been found to be associated with physical fitness and regular physical activity include improvement in respiratory and cardiovascular function, reduction of risk for coronary artery disease, decreased mortality and morbidity, decreased anxiety and depression, enhanced feelings of well-being, and enhanced performance in daily activities (American College of Sports Medicine, 2000). However, research indicates that during college years, students may be less physically active and, therefore, likely less physically fit. In evaluation of college student physical activity, previous findings show that most college students do not meet guidelines given for aerobic exercise (Downes, 2015). These guidelines for aerobic exercise provided by the American College of Sports Medicine and the Centers for Disease Control and Prevention state that adults should participate in a minimum of 150 minutes of moderate-intensity or 75 minutes of vigorous activity every week. In a study done by Downes (2015), findings evaluating adherence to these guidelines indicate that a very small percentage of college students meet them, possibly less than 9.4%

## Attention-Deficit/Hyperactivity Disorder

As defined by the American Psychological Association (2013), attention-deficit/hyperactivity disorder (ADHD) is a behavioral disorder in which six or more symptoms in children under 17, and five or more symptoms in children 17 and older, of either inattention or impulsivity/hyperactivity are present prior to age 12 and persist for at least six months in two or more settings. These symptoms must be negatively impacting daily function (social, educational, and occupational). Symptoms of inattention may include poor listening skills, misplacing items, forgetting daily activities, diminished attention span, inability to complete schoolwork, avoiding tasks that require concentration, and lacking attention to detail. Symptoms of hyperactivity may include squirming or fidgeting, restlessness that is difficult to control, being often “on the go,” inability to engage in leisure activities quietly, inability to stay seated, and being over-talkative. Symptoms of impulsivity may include difficulty waiting a turn, interrupting conversations or activities, and impulsively blurting out. With that, there are three classifications of ADHD related to these symptoms. First is predominantly hyperactive/impulsive (HI) type in which the patient only meets the hyperactive/impulsive criteria. Second, predominantly inattentive (IA) type in which the patient only meets the inattentive criteria. Third, combined type (C), where the patient meets the inattentive and hyperactive/impulsive criteria (APA, 2013).

**ADHD and Physical Fitness**

Previous studies that have examined the correlation between ADHD and health have suggested that ADHD is related to poorer physical fitness. For example, in a systematic review by Harvey and Reid (2003), they found that children with ADHD are at greater risk than those without ADHD for poorer levels of physical fitness. Discussed in this review, a study done by Boileau, et al. (1977) found elevated heart rates both at rest and during a 5-minute submaximal treadmill walk in 20 children with ADHD compared to a control group. Another study discussed in this review done by Harvey and Reid (1997) found that compared to a control group, those with ADHD (19 children) showed higher levels of adipose tissue, specifically in the 75th percentile. A third study explained in this review, done by Leger, et al. (1994), indicated that performance on a VO2 max field test for children with ADHD was below the 25th percentile, and a study done by Fitness Canada (1985) also showed that performance for children in the ADHD group was below the $25^{th}$ percentile for a sit-up test (Harvey & Reid, 2003). Other findings indicate that a higher occurrence of obesity across the lifespan is associated with ADHD due to things like impulsive eating, eating foods with higher fat content and less nutrient density, and less physical exercise than their peers (Nigg, 2013). Finally, a study examining differences in physical fitness between children with and without ADHD found that those with ADHD displayed lower performance of aerobic capacity that was estimated using a field shuttle test (Verret et al., 2010).

**ADHD and Adverse Health Outcomes**

Physical fitness is inherently tied to overall health, and research has shown that ADHD is associated with poorer health outcomes. One study found that ADHD-C in young adulthood is associated with reduced estimated life expectancy (Barkley & Fischer, 2019). Another study done to examine associations between ADHD and disease in adulthood found that ADHD is linked to higher risk for certain respiratory, musculoskeletal, gastrointestinal, metabolic, and nervous system diseases in adults. Specifically, associations between ADHD and 34 diseases were found. Those among the most strongly associated included alcohol-related liver disease, chronic obstructive pulmonary disease, sleep disorders, fatty liver disease, and obesity (Du Rietz et al., 2021). Because of this association between ADHD and poorer health outcomes, it is important to understand the physical fitness (or behavioral and health-related life choices) of these individuals.

**ADHD and Physical Fitness in the Context of Emerging Adulthood and College**

Emerging adulthood (EA), from age 18 to 25, is a unique developmental period between adolescence and young adulthood. It is an important foundational time that presents instability along with many changes and challenges. During these years, most leave their childhood homes to live independently, many of which go off to college. This gain of independence comes with a great amount of responsibility and a new ability to start making personal decisions regarding health and daily habits such as exercise, diet, sleep, and more (Arnett, 2000). This means that EA is a time that requires high levels of self-regulation, or at least more than has been required when caregivers were structuring the environment. This is an interesting time to study ADHD, which itself is a disorder of self-regulation. ADHD is often characterized by deficits in the executive functioning system of cognition such as difficulty with time management, organization, planning, and behavioral inhibition (Willcutt et al., 2005). With that, there might be a further and greater impact on engagement in physical activity and, as a result, on physical fitness in college students with ADHD. However, there is very limited research on this topic.

One study was done to examine differences, specifically in physical activity, between college students with ADHD and their peers without ADHD. The findings of this study showed that there was no indication of a difference in physical activity. That is, college students with ADHD were not found to be less physically active than their peers (Valis and Gonzalez, 2017). In a recent study done to examine differences in handgrip strength in young adults 18-25 with and without ADHD, findings indicated that there were no observable differences in handgrip strength between adults with and without ADHD (Fietsam et al., 2021). Another study by Jeoung (2014) explored the association between self-reported ADHD symptoms and several components of physical fitness in male college students. To test muscular strength, participants completed a handgrip strength test in which the highest of two trials was recorded. Findings from this test indicated that ADHD symptoms, specifically in the categories of inattention and memory, are significantly related to lower levels of muscular strength. Second, to test muscular endurance, participants completed max sit-up and push-up tests. Findings showed that less push-ups were associated with problems in the categories of self-concept, impulsivity/emotional lability, hyperactivity/restlessness, and inattention/memory. Third, to measure flexibility, a sit-and-reach test was performed by the participants. Findings regarding flexibility indicated that there is no correlation between ADHD symptoms and flexibility. Fourth, to measure body composition, the Inbody 720 body composition test was used to determine abdominal fat percentage. Researchers found that abdominal fat percentage was related to ADHD symptoms in the categories of impulsivity/emotional lability, hyperactivity/restlessness, irritability, and inattention/memory. Finally, to test differences in cardiorespiratory endurance, participants completed a 20 m pacer test. Findings from this test indicated that there was no correlation between ADHD symptoms and cardiorespiratory endurance (Jeoung, 2014). Opposingly, findings in a study done by Fritz and O'Connor (2018) examining differences in cardiorespiratory fitness in male college students with and without ADHD indicated that ADHD is associated with lower cardiorespiratory fitness. Specifically, those who screened positive for ADHD demonstrated significantly lower VO2 max readings on a graded maximal cycle exercise test than those without ADHD (Fritz and O'Connor, 2018).

## Current Study

An active lifestyle is very important across the life span because of the positive health outcomes that result from it. Previous research suggests that ADHD is associated with poorer physical health (Nigg, 2013) and overall poorer health outcomes. Additionally, previous research indicates that emerging adulthood is associated with a more sedentary lifestyle and decreased level of physical activity due to its unique challenges (Downes, 2015). However, there have been very few studies done that examine the association between these variables: physical fitness and ADHD among college students. The studies that have been completed are limited in general, have conflicting results, and are not fully representative of the college population. We were interested in the cardiorespiratory fitness and muscular strength components of physical fitness. Specifically, three empirical studies have evaluated these domains among college students with ADHD (Fietsam et al., 2021; Jeoung, 2014; Fritz and O'Connor, 2018). Of these, two (Jeoung, 2014; Fritz and O'Connor, 2018) included only male participants. Therefore, the purpose of this study was to examine the differences among college students with and without ADHD in the cardiorespiratory and muscular strength domains of physical fitness. We hypothesized that college students with ADHD would be less physically fit in these domains than their peers without ADHD. That is, students in the ADHD group were expected (a) to have significantly lower VO2 max as an indicator of cardiorespiratory fitness following a 3-minute step test and (b) to demonstrate less strength in a handgrip dynamometry test compared to their peers.

## Method

### Participants

A power analysis conducted using G-Power 3.1.9.7 (Faul et al., 2007) indicated that 52 total participants would be necessary to achieve adequate power (0.80) to detect a large effect size ($d = 0.8$). Participants in this study ($N = 63$) were undergraduate students attending either a 2-year or 4-year college. During their participation, they were enrolled in classes either part-time or full-time. Participants were between the ages of 18 and 25 (at the start of the first session). The average age of the participants was 20.60, and the standard deviation from this mean was 1.84. Inclusion criteria for participants included being a native English speaker, reporting more than four hours of sleep on most nights, and not being pregnant, attempting to become pregnant, or currently breastfeeding. Participants were excluded from the study if they were stratified as moderate- to high-risk for adverse effects associated with physical exercise. Exclusion from the study also occurred if there was any concern with blood pressure or safety during the study. Both men and women were included in the study. Of the 63 participants, 27 were male (42.9%), and 36 were female (57.1%). The majority of the participants were white ($n = 50$, 79.4%), and 13 participants were of a non-white ethnicity (20.6%). Participants were fully informed about the study and provided both verbal and written consent before participation.

There were two groups of participants in the study, a non-ADHD group and an ADHD group. Approximately half of the participants were in the ADHD group ($n = 31$, 49.2%), and the other half were in the non-ADHD group ($n = 32$, 50.8%). Attempt to match members from each group with the opposite based on biological sex and age was made. The criteria for participants to be included in the non-ADHD group included denial of a previous ADHD diagnosis, in addition to three or fewer symptoms reported in both the IA and HI categories on the *DSM-5* ADHD Symptom Checklist completed in the pre-screener. Participants who denied a previous ADHD diagnosis but reported four or more symptoms in either IA or HI categories were excluded from the study. The criteria for participants to be included in the ADHD group included a report of a previous ADHD diagnosis and report of four or more IA symptoms on the *DSM-5* ADHD Symptom Checklist completed during the pre-screener. Confirmation of this assignment to the ADHD group was completed after a structured clinical interview with a clinical psychology graduate student. Those who reported being diagnosed with ADHD but reported three or fewer IA symptoms during the pre-screener were excluded from the study.

**Procedure**

Recruitment of participants was completed in six ways: online (advertisements) or via email, through a pool of students enrolled in psychology courses who complete the departmental pre-screener via the SONA system, posting flyers, University Disability Support Services distributing flyers, contacting participants from previous studies who indicated that they wanted to be informed about future study opportunities, and by word of mouth. After recruitment, prospective participants completed a pre-screener online. The pre-screener included electronic informed consent and information regarding biological sex, gender identity, sexual orientation, race and ethnicity, subjective socioeconomic status (SES), academic information (current and past attendance), if they are a native English speaker, prior ADHD diagnosis, and how many hours of sleep they typically get. Additionally, prospective participants completed the *DSM-5*

ADHD Symptoms Checklist, the University of Wyoming Health History Screening Questionnaire, and additional health history items.

Once participants were approved to begin the study after the pre-screener, they participated in a study session with two tests to measure the cardiorespiratory fitness and muscular strength components of physical fitness. Prior to participating in these tests, a research team member conducted a pre-session check to ensure the participants were safe to participate in the study session. This check included confirmation of refraining from (for at least 12 hours prior to the appointment) exercise, alcohol, nicotine, and caffeine, and confirmation of refraining from taking their stimulant medication (if applicable) the entire day prior to and the day of the scheduled appointment. Participants were also asked about their health and prior night's sleep. Including if there had been any changes to their medication use or any other recent health issues. Participants were reminded before the session to wear athletic clothing, to eat a light breakfast within 90 minutes of the start of the appointment, to have something to drink within 90 minutes of the start of the appointment, and to bring a snack to eat within 60 minutes or prior to leaving the lab after completing exercise. Snacks and bottled water were available to participants who did not adhere to these instructions. Finally, blood pressure and heart rate were taken. First, after five minutes of rest, seated in a comfortable position with feet flat on the floor and in a temperature-controlled room. Second after another 2-minute rest period. If any blood pressure reading exceeded 130/80, researchers waited for another 5-minute rest period and measured blood pressure for a third time to verify. If there were concerns about heart rate, a pulse oximeter was used to help make any safety risk decisions. If participants were approved to continue, they then completed the two tests. These tests included a step test for cardiorespiratory fitness and a handgrip dynamometry test for muscular strength. The procedure for these tasks are detailed further below.

## Measures

### ***Step Test***

The step test used for this study was adapted from the Queens College Step Test or the McArdle Step Test (American College of Sports Medicine, 2014). The step used for this test measured 16.25 inches or 41.25 centimeters in height. Participants were required to step up and down this step for 3 minutes at a specific rate based on biological sex. For men, the step rate was 24 steps per minute, and for women, the rate was 22 steps per minute. This rate was set for participants and observed by researchers with an electronic metronome. One “step” or cycle associated with the electronic metronome involves a step up with one leg, step up with the other leg, step down with the first leg, and step down with the second leg. However, this metronome was set at four times this rate to associate each individual leg movement with a sound. During this test, all participants were continuously monitored by a heart rate monitor chest strap. Participants were allowed to reach their maximum heart rate (220 – age) during the test. After the 3 minutes, participants’ 15-second heart rate was taken. Information including heart rate, age, and sex was then used to estimate cardiorespiratory fitness using validated step-test equations. For men, the equation used to find VO2 max was 111.33 minus the product of 0.42 times the post step test heart rate. For women, the equation used was 65.81 minus the product of 0.1847 times the post step test heart rate. A systematic review evaluating the reliability and validity of various submaximal step tests indicated that these tests provide a safe, simple, and ecologically valid way of determining VO2 max. Additionally, findings in this review showed that the Queen’s College Step Test specifically demonstrated a significant correlation between measured and predicted VO2 max values indicating that this is a valid way to predict VO2 max through calculation (Bennett et al., 2016).

***Hand Grip Dynamometry***

To begin, researchers helped set up the dynamometer (Jamar Plus electronic hand dynamometer) in the participants' dominant hand. This required adjustment of the handle for proper grip, a 90-degree bend in the elbow, and contact of the elbow with the participant's side. From there, three trials were taken with a 60-second rest between each. Of those three trials, the highest reading was recorded for evaluation of overall muscular strength. In a review done to evaluate the accuracy and reliability of different measures of handgrip strength, the Jamar handgrip dynamometer was found to be a reliable measure based on inter-rater reliability and test-retest reliability (Innes, 1999). Handgrip strength has been found to be associated with or predictive of several aspects of health and life outcomes in adults. Specifically, handgrip strength has been found to be associated with or predictive of overall muscular strength, upper limb function, nutrition, cognition, diabetes, depression, bone mineral density, bone fractures, falls, sleep problems, multimorbidity, all-cause/disease-specific mortality, problems associated with hospitalization, future function, and overall quality of life (Bohannon, 2019).

## Results

The data was screened for adherence to the statistical assumptions of the bivariate analyses (i.e., independent samples *t* test). The cardiorespiratory fitness levels and the muscular strength levels of college students with ADHD were compared to those without ADHD. Regarding cardiorespiratory fitness, as measured via the estimated V02 max following a step test, the college students with ADHD ($M$ = 38.62, $SD$ = 6.96) were lower compared to their peers ($M$ = 40.34, $SD$ = 7.05). The difference failed to meet statistical significance ($t(61) = .97$, $p$ =

.334). However, the estimated effect size was small with a Cohen's *d* of .25. A post-hoc power analysis confirmed that we were not adequately powered (power = 17% two tailed, 25% one tailed) to detect the effect.

Regarding muscular strength, the differences in handgrip strength were examined. Students with ADHD (*M* = 79.75, *SD* = 26.74) demonstrated less strength compared to their peers (*M* = 83.80, *SD* = 27.29). The difference failed to meet statistical significance ($t(61) = .60$, $p = .554$). The estimated effect size was small ($d = .15$). The post-hoc power analysis determined that we were not adequately powered (power = 9% two tailed, 15% one tailed) to detect the effect.

## Discussion

Although the current study was powered to detect large effects, it was not adequately powered to detect small or moderate differences in physical fitness by ADHD diagnosis. The expected differences in cardiorespiratory fitness and muscular strength are likely small to moderate, given the size of the differences in the limited existing literature (i.e., Fietsam et al., 2021; Jeoung, 2014; Fritz and O'Connor, 2018). However, the findings were in the hypothesized direction and yielded small effect sizes. The lack of significance may be due to the small sample size or may indicate that differences in physical fitness in the categories of cardiorespiratory fitness and muscular strength between college students with and without ADHD do not exist. Accordingly, the following information is presented as occurring in the current group of college students, and no attempt to generalize these findings is made.

When comparing cardiorespiratory fitness, as measured by estimated VO2 max following a step test, the college students with ADHD showed a lower average VO2 max than their peers without ADHD. The average VO2 max of the ADHD group was 1.72 mL/kg/min lower than the average VO2 max of the non-ADHD group. However, this difference was not statistically significant. When looking at differences in muscular strength between the two groups, the ADHD group demonstrated less muscular strength compared to the non-ADHD group. Specifically, the average handgrip strength reading for those with ADHD was 4.05 lbs less than the average of those without ADHD. Again, this difference was not statistically significant. These findings follow the direction of our hypotheses that college students with ADHD are less physically fit in both domains than their peers without ADHD. However, because differences between the two groups in each category were not statistically significant, we can not be certain that these results did not occur by chance and that they would be shown again.

**Cardiorespiratory Fitness In Emerging Adults**

In line with our null findings, the study done by Jeoung (2014) that explored the association between self-reported ADHD symptoms and several components of physical fitness in college students, findings indicated that there are no differences in VO2 max in those with ADHD and without, supporting that there might be no differences in cardiorespiratory fitness. However, opposing findings were discovered in the study done by Fritz and O'Connor (2018). Findings in this study indicated that those with ADHD are less physically fit in the domain of cardiorespiratory fitness. Specifically, they demonstrated lower VO2 max readings. This opposing finding might be due to differences in sample size, participant demographics, and methods for determining VO2 max. The participants in this study included 32 male college students versus a total of 63 college students in the current study that included both males and females. Further, in the study done by Fritz and O'Connor (2018) VO2 max was estimated through a graded maximal cycle exercise test, whereas we estimated VO2 max through a 3-minute step test. A graded maximal cycle test is completed on a cycle ergometer, and during this test, participants pedal at a certain set rate with resistance increasing every two minutes until participants can no longer keep up with the pedaling rate. The changing resistance and allowance for participants to continue the test with no set time limit may be factors that contributed to differences in VO2 max results.

**Muscular Strength In Emerging Adults**

In line with our findings, Fietsam et al., (2021) did not find significant differences in handgrip strength in young adults 18-25 with and without ADHD. Contrary to our findings and Fietsam et al. (2021), the study done by Jeoung (2014) reported that poorer muscular strength was associated with symptoms of ADHD. One possible reason for the discrepancy in findings is the manner of assessing or conceptualizing ADHD. Our study and Fietsam et al., (2021) classified the individuals as being diagnosed with ADHD via clinical interviews or past diagnoses. Jeoung (2014) did not have a sample of individuals with confirmed ADHD diagnoses and evaluated the association of self-reported symptoms with demonstrated muscular strength. The discrepancy in findings could also have to do with differences in sample size and characteristics. The study done by Jeoung (2014) had a larger sample size ($N = 86$) which might have allowed them to detect small effects we were unable to with a smaller sample size ($N = 63$). Additionally, participants in this study were only male, whereas our study included both male and female participants.

**Cardiorespiratory Fitness and Muscular Strength In Youth**

Our results are in opposition to several studies that have found children with ADHD to be less physically fit in the domain of cardiorespiratory fitness. First, the study done by Boileau, et al. (1977) found elevated heart rates both at rest and during a 5-minute submaximal treadmill walk in 20 children with ADHD compared to a control group. Second, the study done by Leger, et al. (1994) indicated that performance on a VO2 max field test for children with ADHD was below the 25th percentile. Finally, a study examining differences in physical fitness between children with and without ADHD found that those with ADHD displayed lower performance of aerobic capacity that was estimated using a field shuttle test (Verret et al., 2010). These findings indicating that children with ADHD are less physically fit in the domain of cardiorespiratory fitness than their peers, in comparison to those from the current study indicating that adults with ADHD are not less physically fit in the domain of cardiorespiratory fitness than their peers, might suggest that the gap in physical fitness between those with ADHD and those without narrows as age increases. Indeed, the same pattern emerges regarding muscular strength. Findings in youth have suggested that muscular strength differences do exist such that those with ADHD show less strength (Harvey & Reid, 2003); but again, our results support that these differences may disappear as the individuals with ADHD "catch up" developmentally.

**Limitations and Future Directions**

When interpreting the findings of this study, there are limitations that should be considered. One limitation of this study is a self-selection bias. That is, during recruitment for this study, participants were informed that physical health metrics would be taken. Therefore, participants who decided to sign up for the study did so knowing they would participate in tests that involve physical activity. This might mean that those who chose to participate were comfortable with physical activity, possibly due to experience or regular participation in physical activity. Whereas, some might have chosen not to sign up because of reluctance to participate in physical activity, possibly due to lack of experience or little participation in physical activity. This could mean that those who participated and represented this population were more physically fit overall than their peers who chose not to participate. A second limitation of this study was ethnic diversity. Specifically, 79.4% of the participants were white and only 20.6% were of a non-white ethnicity. This means that the findings of this study might not be representative of the entire college population. Rather, they might only be representative of white college students. A third limitation of this study is the sample size. With a total of 63 participants in this study, the sample size might have been too small to detect true differences in this population. Although we included both biological sexes in our study, we were not powered to analyze the ADHD and comparison groups by sex, a factor that we would expect to impact physical fitness. Future directions for research on this topic might include a study involving participants with greater ethnic diversity to better represent the entire college population. Additionally, a study with a larger sample size, as it would allow for the ability to analyze differences by sex and be powered to detect small differences in these populations (women with ADHD, men with ADHD, comparison women, comparison men).

## Conclusion

ADHD is associated with poor health outcomes. The components of physical fitness (cardiorespiratory endurance, body composition, muscular fitness, and flexibility) are inherently associated with health. However, limited research has explored the differences in physical fitness that may be associated with ADHD. The current study explored the cardiorespiratory fitness and muscular strength of college students with and without ADHD. Although the differences did not reach statistical significance, students with ADHD demonstrated poorer cardiorespiratory fitness and muscular strength compared to their peers. More research is needed to determine if reliable differences exist. Understanding the physical fitness of individuals with ADHD may be helpful in identifying risk factors related to poorer health and creating interventions to improve their health outcomes.

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Table 1: Sample Characteristics (*N* = 63)

| | *n* | % |
|---|---|---|
| Biological sex | | |
| Female | 36 | 57.1 |
| Male | 27 | 42.9 |
| Race/Ethnicity | | |
| White | 50 | 79.4 |
| Hispanic/Latino | 5 | 7.9 |
| African American | 2 | 3.2 |
| Asian/Asian-American | 2 | 3.2 |
| Multiracial | 4 | 6.3 |
| Age | | |
| 18 | 7 | 11.1 |
| 19 | 15 | 23.8 |
| 20 | 10 | 15.9 |
| 21 | 11 | 17.5 |
| 22 | 11 | 17.5 |
| 23 | 4 | 6.3 |
| 24 | 3 | 4.8 |
| 25 | 2 | 3.2 |

Table 2: Differences in VO2 max and handgrip strength by ADHD status

| | Non-ADHD<br>*M* (*SD*) | ADHD<br>*M* (*SD*) | *t* | 2-tailed | *d* |
|---|---|---|---|---|---|
| VO2 max | 40.34 (7.05) | 38.62 (6.96) | .97 | .334 | .25 |
| Hand grip strength | 83.80 (27.29) | 79.75 (26.74) | .60 | .554 | .15 |