

**Analysis of Dyscalculia, Attention Deficit Hyperactive Disorder and Gender Differences of junior secondary school students in Rivers State.**

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**Abstract**

The study explored the link between Dyscalculia, Attention Deficit Hyperactive Disorder and gender differences of junior secondary school students in Rivers State Nigeria. It employed the correlational and descriptive research designs. The population was junior secondary school students in 16 secondary schools in Obio-Akpor LGA of Rivers State. A multi-stage sampling procedure that employed simple random, stratified and purposive was used to draw a sample size of 127 students. Two instruments, the Dyscalculia Test and Conners' Rating Scales-Revised (CRS-R) for assessment of Attention Deficit Hyperactive Disorder was used in obtaining data. Face, content and construct validities were established for the instruments using expert judgement and factorial evidence of factor analysis. The reliabilities estimated for the Dyscalculia ranged from 0.88 to 0.93 when Kuder-Richardson and split half was used in establishing reliability. Using Cronbach alpha, a reliability coefficient of .84 was obtained for the second instrument. The data were analyzed r, beta values, simple regressions, t-test associated with simple regression mean, standard deviation and one-way multivariate analyses of variance. Result showed a significant prediction and positive relationship between ADHD and dyscalculia, it showed as well that gender had no significant influence independently and jointly on ADHD and dyscalculia. It was recommended amongst others that there should be collaborations between psychometricians, psychologists, educators and teachers to ensure that assessment tools are reliable, valid and available for accurate measure and identification of students at risk for ADHD and dyscalculia at routines times for targeted interventions.

**Key words: Dyscalculia, Attention Deficit Hyperactive Disorder and Gender**

## **Introduction**

Secondary school mathematics), with its intricate formulas and abstract concepts, can be a daunting challenge for many students. However, some face an even steeper climb rooted in specific learning difficulties like dyscalculia. The World Health Organization (2010) described dyscalculia as a specific impairment in arithmetical skills, which is not solely explicable on the basis of general mental retardation or of grossly inadequate schooling. Dyscalculia is a specific learning disorder that affects the acquisition and understanding of arithmetic and mathematical concepts and skills that are not solely attributable to intellectual disabilities, inadequate educational opportunities, or environmental factors. It is a specific learning difficulty that affects a student's ability to process and understand mathematical concepts. According to Eteng-Uket and Amaechi-Udogu (2023), Dyscalculia is a math disorder that makes it challenging to understand mathematical concepts and perform calculations. According to Eteng-Uket (2023), it is characterized majorly by impairment in number sense (an intuitive feel for numbers and a commonsense approach to using them; like subitising and numerizing which is the ability to instantaneously recognize the number of objects in a small group without the need to count them), difficulty in arithmetic operation (four basic arithmetic operations of addition, subtraction, multiplication and division) and working memory (holding information in short-term memory and manipulating the information). Other scholars has further posited that it is characterized by difficulties in recalling arithmetic facts, inaccurate calculations, struggles in understanding mathematical terms, operations and concepts, prolonged solution times and inability to follow the sequence of steps involved in various mathematical operations, and difficulty in retaining information (Jordan et al. 2003; Dowker 2004; Geary 2004a, 2004b; Landerl et al. 2004; Trott 2010; American Psychiatric Association 2013; Zerafa 2015; Pandey & Agarwal 2015; Zygouris et al. 2017; Ogbogo & Opara 2021; Ogbogo & Orluwene 2021).

These difficulties can significantly impact academic achievement in mathematics and related subjects, as well as everyday tasks requiring numerical proficiency. This has been collaborated with views from scholars on how dyscalculia can impact on a person's academic and professional success limiting their advancement careers in science and technology as well as exposing them to psychological issues like, low self-esteem, anxiety, frustration and high levels of psychological distress (Buttersworth, 2003; Eteng-Uket 2023; Eteng-Uket & Ameachi 2023; Ogbogo & Opara 2021; Ogbogo & Orluwene 2021; Shalev & Von Aster 2008).

Eteng-Uket & Ameachi Udogu (2023) asserted in their study that researchers have revealed that dyscalculia is prevalent, affecting approximately 4-13% of the population depending on the country of study and criteria of diagnosis. They further viewed that the implication of this is there are millions of people worldwide who struggle with math and may not even know they have dyscalculia. Dyscalculia according to literature does not occur alone, it co- occurs with some conditions like dysgraphia, dyslexia and attention deficit hyperactivity disorder (ADHD). When dyscalculia coexists with other conditions such as dyslexia, dysgraphia, attention deficit disorder (ADD) and attention deficit hyperactivity disorder (ADHD) these are known as co-morbid or co-occurring conditions (Emerson & Babtie, 2008). Research has shown that ADHD co-occur with dyscalculia. For example, Gross-Tsur et al.(1996) reported that 26% of children with dyscalculia showed symptoms of ADHD, whereas Shalev, Auerbach, and Gross-Tsur (1995) reported a figure of 32%. A recent review by DuPaul, et al, (2013) stated that about 45% of children with ADHD have a learning disability, although specific estimates for reading, writing, and maths problems were not provided. This is also in collaboration with the findings of Kaufmann & Nuerk, 2008). However research that shows that there is a relationship between ADHD and dyscalculia in rivers state Nigeria is almost non-existent to the best of the researchers knowledge.

#### **Attention Deficit Hyperactivity Disorder (ADHD)**

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by symptoms of inattention, hyperactivity, and impulsivity. ADHD is a developmental condition of lack of attention and distraction tendency resulting from hyperactivity (Soreff & Xiong, 2022). It is characterized by inability to sit still, as difficulties with attending to instruction, focusing on schoolwork, keeping up with assignments, following instructions, completing tasks, social interaction, just to mention a few. It is essentially characterized in children, teens and adults by inattentiveness, impulsivity and hyperactivity (American Psychiatric Association 2013). Attention-deficit/hyperactivity disorder (ADHD) is perceived to be a consistent fashion of inattention arising from hyperactivity-impulsivity that interferes with normal functioning of an individual that can impact negatively on social and academic activities (APA, 2013). ADHD is one of the most common neurodevelopmental disorders, typically diagnosed in childhood but often persisting into adulthood especially if there are no interventions. Individuals with ADHD may struggle with sustaining attention on tasks, controlling impulses, and managing hyperactive

behaviors. These difficulties can interfere with various aspects of daily functioning, including academic performance, social interactions, and emotional regulation. While ADHD is primarily associated with attentional difficulties, it can also manifest in executive function deficits, such as working memory impairments and difficulties in organization and planning. Approximately one in 20 children are affected by attention deficit hyperactivity disorder (ADHD). Students often suffer from not only ADHD symptoms but also poor school achievement, impaired health, low quality of life, low self-esteem and negative family interactions (Huss et al 2008; Kim 2011; Polancy et al 2007, Tripp 2007). As earlier mentioned, literature has shown that both ADHD and dyscalculia co-occur.

### **ADHD and Dyscalculia**

Research suggests a potential association between ADHD and Dyscalculia, as both disorders neurodevelopmental in nature involves some forms of impairments in executive functions and attentional processes amongst others. Individuals with ADHD may exhibit difficulties in maintaining attention and focus during mathematical tasks, leading to errors and inefficiencies in mathematical reasoning and problem-solving. Additionally, the impulsivity and distractibility associated with ADHD may further exacerbate difficulties in learning and applying mathematical concepts. Similarly, individuals with Dyscalculia may experience attentional difficulties that contribute to their mathematical challenges, although these difficulties may manifest differently from those observed in ADHD. While ADHD is characterized by attentional difficulties, impulsivity, and hyperactivity, Dyscalculia specifically affects mathematical reasoning and computation. However, the extent to which ADHD serves as a correlate or exacerbating factor for Dyscalculia remains unclear.

However, these two factors can significantly impact an individual's academic performance especially in mathematics. These difficulties can significantly impact academic achievement in mathematics and related subjects, as well as everyday tasks requiring numerical proficiency and overall quality of life. While ADHD is characterized by attentional difficulties, impulsivity, and hyperactivity, Dyscalculia specifically affects mathematical reasoning and computation. Research has shown that ADHD and dyscalculia has a positive relationship. (Sarma & Padmavathy 2022) However, the extent to which ADHD serves as a correlate or exacerbating factor for Dyscalculia remains unclear. Furthermore, another factor that may likely moderate this influence is gender.

### **ADHD, dyscalculia and Gender Differences**

Attention Deficit Hyperactivity Disorder (ADHD) and Dyscalculia are two neurodevelopmental disorders that can significantly impact the academic performance and overall well-being of secondary school students as earlier mentioned. Recent research has begun to explore how gender may influence the manifestation and severity of these disorders among secondary school students. Gender is the set of social, cultural, and psychological characteristics associated with being male or female. Eteng-Uket & Iruloh (2023). It refers to a set of social and psychological characteristics associated with being male or female. It is also one factor that can influence a lot of variables. Studies have indicated potential gender influence and differences in the prevalence and presentation of dyscalculia symptoms among students. Generally, the most common finding reported in the literature regarding the influence of gender generally on dyscalculia is that of no dyscalculia gender difference (Eteng-Uket & Amaechi-Udogu 2023 Hein et al., 2000; Koumoulaet al., 2004; Mazzocco & Myers, 2003 Sarma & Padmavathy 2022). Nevertheless, some studies did report gender differences, (Dirks, et al., 2008; Landerl & Moll, 2010; Moll et al., 2014; Barbaresiet al., 2005; Reigosa-Crespoet al., 2011). Similarly, research has suggested gender differences in the prevalence and manifestation of ADHD, particularly in how ADHD are expressed and identified among male and female students. (Gerhon 2005; Koermer et al 2021; Vogley 2019) However, some studies reported no gender difference (Sarma & Padmavathy 2022) The intersection of ADHD and Dyscalculia with gender adds another layer of complexity to understanding these neurodevelopmental disorders among secondary school students. Research suggests that gender differences in ADHD and Dyscalculia may or may not interact or compound each other, leading to unique challenges and support needs for male and female students. For instance, some studies reported no gender difference of ADHD and dyscalculia (Capano et al 2008; Silva et al 2020) while other studies reported gender difference (Czamara et al 2013; Koermer et al 2021; Youshimasu et al 2010; Youshimasu et al 2011). These studies of gender differences in the influence and association between ADHD and specific learning disorders are scarce and the few results available are heterogeneous.

Exploring the influence of gender on ADHD and Dyscalculia can provide insights into effective identification, tailored assessment tools and intervention strategies that consider gender differences in symptom presentation and help-seeking behaviors as well as support strategies for all students ultimately promoting academic success and well-being for all. As earlier stated, the

debate as to whether male and female differ with regards to dyscalculia and ADHD jointly is still on-going in the research community and is unclear, providing research gaps that needs to be closed. Thus, more research is needed to establish more conclusive positions especially from areas and regions of the world where evidence of gender difference on dyscalculia and ADHD is scarce.

The following research questions guided the study

1. To what extent does ADHD relate with Dyscalculia amongst secondary school students?
2. What is the influence of gender on dyscalculia and ADHD amongst secondary school students?

The Following null hypothesis was tested at 0.05 significant level

1. ADHD does not have any significant relationship and prediction on dyscalculia of secondary school students
2. There is no significant influence of gender on dyscalculia and ADHD amongst secondary school students

### **Methodology**

The correlation and descriptive design(s) were used as the research designs for the study. According to Kpolovie (2010), correlation research is a method used to determine the strength and direction (positive or negative) of a relationship between a dependent variable (also known as a criterion variable- dyscalculia) and one or more independent variables (predictor variable-ADHD). The descriptive design was employed to describe the influence of gender on dyscalculia and ADHD of students. This design is also suitable when comparisons are to be made between various strata of a sample for the variables that are being studied. (Nwankwo, 2013). The population of the study were junior secondary school students in 16 secondary schools in Obio-Akpor LGA of Rivers State. A sample of 127 secondary school students was drawn using disproportionate stratified random sampling based on gender. The sample consists of 127 students (56 female and 71 males) who have been diagnosed with dyscalculia and ADHD. This sample was randomly drawn using a multistage sampling procedure that applied simple random, cluster, stratified, and purposive sampling techniques. At the first stage, from Obio-Akpor local government, random sampling technique by balloting without replacement was used to draw three (3) public junior secondary schools. At the second stage stratified random sampling technique based on gender was used to draw 250 students. At the third stage of

sampling the 250 students were administered the Dyscalculia Test by Eteng-Uket (2023) and the Conners' Rating Scales-Revised (CRS-R) for assessment of Attention Deficit Hyperactive Disorder. They were administered this instrument to screen for those with dyscalculia and ADHD using the Dyscalculia Test manual, what this meant was that the 250 students were administered the Dyscalculia test and only those with scores from 43 below formed the sample. Also from the ADHD scale, only students that had ADHD based on their scores (scores above 60) formed the final sample size as well. After administration and scoring, from the 250 only 127 students beat the cut off. And had completely filled instruments formed the final sample. At the fourth stage therefore, purposive sampling was employed to draw the sample size of 127. Thus, purposive sampling technique was employed to draw final sample size of 127. Two instruments were used for data collection. The first is a standardized instrument the Dyscalculia Test by Eteng-Uket (2023) was used for data collection. The Dyscalculia Test is an instrument developed to diagnose and identify persons with specific learning difficulty in arithmetic. The Dyscalculia test items comprised of three broad dimensions on which multiple choice test items was on. The domains are Number Sense, Arithmetic Operations and Working Memory. The Dyscalculia Test is a 45-minute timed test containing demographic details like age, gender and so on and 85 items in an item booklet. It was designed using the multiple-choice question format with four options lettered A, B, C, and D, which has a key (correct response) and three distracters (incorrect response), and test takers are expected to provide the answer in a separate answer. A total of 85 items gives a raw score of 85 from the three domains. The total score index from the three core domains of the Dyscalculia Test is summed up to give a score representing an individual's dyscalculia score. The highest possible score from the scale is 85, and the lowest score is 0. Based on the DSM-5 recommendation on how specific learning difficulties like dyscalculia are to be categorized, scores from Dyscalculia Test are classified as follows. No Dyscalculia (total scores from 64 and above, that is an individual performed significantly above average in the three subsets of the test). Mild Dyscalculia (total scores between 43–63 that is an individual performed around average in the three subsets of the test). Moderate Dyscalculia (total scores between 23–42, that is an individual performed below average in the three subsets of the test) and Severe Dyscalculia (total scores between 0–22, that is an individual performed significantly low in the three subsets of the test). The second instrument is an adapted Conners' Rating Scales-Revised (CRS-R) for assessment of Attention Deficit Hyperactive Disorder,

developed by Conners, 2000. The Conners' Rating Scales-Revised (CRS-R) is a paper and pencil screening questionnaire consisting of 28 items with three response options. The scale is designed with response options of If Not true at all (never seldom) = 0, Just a little true (occasionally) = 1, Pretty much true (often, Quite a bit) =2 and Very much true (very often, very frequent) = 3. The Conners' Rating Scales-Revised (CRS-R) short form contains the subscales/indices of Oppositional, Cognitive Problems, Hyperactivity, and the ADHD Index. The higher the score the greater (or more severe) the problem. A standardized score called a T-score helps to compare results. When a pupil's T-score is less than 60, it usually means one does not have ADHD. A score higher than 60 may indicate ADHD, that is scores above 60 are signs of academic, behavioral, or social issue. T-score higher than 70 means ADHD Symptoms are more serious or severe.

Face and content validities of the Dyscalculia Test was ensured by seeking expert (four experts; test and measurement, counseling psychologist, Mathematics subject specialist and Language experts) opinions. critically analyzed the items for the content, language, correct ambiguities, usefulness, thoroughness, clarity, and literacy requirements. The construct validity of Dyscalculia Test was estimated using the multivariate factor analysis and the first factor loading for all items was significantly greater than 1. The principal component analysis was used for processing the data. The varimax Kaiser Normalization extraction method and the rotated factor loading matrix were used to estimate the construct validity. For instance, for the Number Sense dimension, rotated factor loadings ranged between 0.31 to 0.755. For the Arithmetic Operations dimension, it ranged between 0.30 to 0.54, while for the Working Memory dimension it ranged between 0.30 to 0.50. The eigenvalues of one above were used to select items that measure the similar construct. Construct validity was further established through hypothesis testing evidence. Also, face and content validity was ensured by seeking expert judgements for the Conners' Rating Scales-Revised (CRS-R) for ADHD. These experts critically analyzed the items for the content, language, correct ambiguities, usefulness, thoroughness, clarity, and literacy requirements. The Kuder-Richardson,  $KR_{20}$  internal consistency reliability of the Dyscalculia Test of .93, .91, .88 and .91 was obtained for the three dimensions and the Dyscalculia test as a whole. The Split-half reliability analysis for Dyscalculia Test shows reliability estimate of the first half of the test to be .90 and that of the second part of the test to be .92. To estimate the reliability of the full test, Spearman-Brown yielded a coefficient of .88. Therefore, a split half coefficient of .88 was

obtained. Using Cronbach alpha, a reliability coefficient of .84 was obtained for Conners' Rating Scales-Revised (CRS-R) for ADHD. The data were analyzed r, beta values, simple regressions, t-test associated with simple regression mean, standard deviation and one-way multivariate analyses of variance (MANOVA). At 0.05 level of significance, each hypothesis was tested

**Results**

**Research Question One:** To what extent does ADHD relate with Dyscalculia amongst secondary school students?

**Table 1:** Simple Regression Analysis of the extent to which ADHD relates with Dyscalculia amongst secondary school students

<b>R</b>	<b>R Square</b>	<b>Adjusted R Square</b>
.193	.037	.030

According to the result shown in Table 1, a simple linear regression R-value .193 was obtained with a R<sup>2</sup> value of .037 and an adjusted R<sup>2</sup> of .030 gotten when ADHD was used to correlate and predict its relationship and influence on dyscalculia of secondary school students. The table shows an R of .193 which shows that there is a positive relationship between ADHD and dyscalculia of secondary school students. This implies that increase in ADHD is associated with increase in dyscalculia. An R<sup>2</sup> change of .037 was obtained as well which means that 3.7% of the proportion of variation in dyscalculia can be explained, accounted or attributed to ADHD.

**Hypothesis One:** ADHD does not have any significant relationship and prediction on dyscalculia of secondary school students

**Table 2: T- test associated with** Simple regression analysis of the relationship and prediction of ADHD on dyscalculia of secondary school students

<b>Model</b>	<b>Unstandardized Coefficients</b>		<b>Standardized Coefficients</b>		
	<b>B</b>	<b>Std. Error</b>	<b>Beta</b>	<b>T</b>	<b>Sig.</b>
ADHD	.104	.047	.193	2.204	.029

The table 2, shows a beta of .193, t-value of .2.204 and a sig of. 029. B = .193, t = 2.204 which was significant at 0.05 alpha level, t= .2.204, p=.029 (p < .005). The null hypothesis of ADHD does not have any significant relationship and prediction on dyscalculia of secondary school

students is therefore rejected and the alternate accepted. This result indicates that ADHD does have a significant relationship, influence and prediction on the dyscalculia amongst secondary school students.

Research Question 2: What is the influence of gender on dyscalculia and ADHD amongst secondary school students?

Hypothesis 2: There is no significant influence of gender on dyscalculia and ADHD amongst secondary school students

Table 3. Mean, SD and One-Way MANOVA of influence of gender on dyscalculia and ADHD amongst secondary school students

<b>Variables</b>	<b>Gender</b>	<b>Mean</b>	<b>Std. Dev</b>	<b>N</b>	<b>Univariate test (F)</b>	<b>Sig</b>	<b>Multivariate test (f)</b>	<b>Sig</b>
<b>Dyscalculia</b>	male	27.16	10.53	71	.821	.367	.990	.544
	female	25.57	8.950	56				
<b>ADHD</b>	male	64.18	17.61	71	.642	.424		
	female	66.82	19.40	56				

The table 3 reveals that the mean score for the dyscalculia was higher for males (M=27.16, SD=10.53) than females (M=25.57, SD=8.95). The univariate test revealed a no significant difference between genders (F=.821, p=.367). ADHD, the mean score was higher for females (M=66.82, SD=19.40) than males (M=64.18, SD=17.61), but the difference was not statistically significant (F=.642, p=.424).

The multivariate test examines the overall effect of gender on dyscalculia and ADHD taken together. The results show no significant influence of gender on dyscalculia and ADHD combined (f=.990, p=0.544). That is students with dyscalculia and ADHD, male and female students does not differ significantly as seen by the Wilk's  $\Lambda$  = .642, p = .544. >.05. This simply connotes that that gender (whether one is male or female) does not have a significant influence on their dyscalculia and ADHD characteristics.

The results suggest that gender may have a small influence on dyscalculia and ADHD of students, but this influence is not statistically significant. Therefore, the hypothesis that there is no significant influence of gender on dyscalculia and ADHD amongst secondary school students is accepted and the alternate rejected.

### **Discussion of Findings**

The result indicating a significant positive relationship between ADHD and dyscalculia among secondary school students. This is in alignment specifically with the research findings of Sarma & Padmavathy (2022) whose results revealed a significant positive relationship between ADHD and dyscalculia among secondary school students. This is also in collaboration with the findings of Kaufmann & Nuerk, (2008).

Both ADHD and dyscalculia are associated with deficits in executive functioning, such as working memory, attentional control, and cognitive flexibility. Students with ADHD may struggle with sustaining attention and inhibiting impulsive responses, which can impede their ability to comprehend and apply mathematical concepts effectively. These executive functioning difficulties may exacerbate the challenges associated with dyscalculia, leading to a stronger association between the two conditions. Similarly, students with ADHD often exhibit difficulties in maintaining sustained attention and processing information efficiently. These attentional and processing speed differences can interfere with their ability to accurately and fluently perform mathematical calculations, exacerbating the symptoms of dyscalculia. Consequently, individuals with ADHD may be more susceptible to experiencing difficulties with numerical processing and mathematical reasoning, contributing to the observed positive relationship with dyscalculia. Furthermore, ADHD and dyscalculia may share common underlying neurobiological mechanisms, such as abnormalities in brain regions involved in attention, working memory, and numerical processing. Dysfunction in these neural circuits could contribute to the co-occurrence of ADHD and dyscalculia, as disruptions in these systems may manifest as symptoms characteristic of both conditions. In addition, environmental factors, such as educational experiences and instructional methods, may also contribute to the relationship between ADHD and dyscalculia. Students with ADHD may face challenges in accessing appropriate educational support and accommodations for their learning needs, exacerbating their difficulties with mathematical concepts. Additionally, ineffective teaching methods or insufficient support for

students with learning differences may further exacerbate the symptoms of dyscalculia in individuals with ADHD.

The result reveals that there is no significant influence of gender on dyscalculia amongst secondary school students. This is in alignment with the research findings that no gender difference was found for dyscalculia (difference (Eteng-Uket & Amaechi-Udogu 2023 Hein et al., 2000; Koumoulaet al., 2004; Mazzocco & Myers, 2003 Sarma & Padmavathy 2022) It is however not in line with some studies that did report gender differences, (Dirks, et al., 2008; Landerl & Moll, 2010; Mollet al., 2014; Barbaresiet al., 2005; Reigosa-Crespoet al., 2011). Possible explanations for this divergence could be these studies used varying criteria to identify dyscalculia,

The result reveals that there is no significant influence of gender on ADHD amongst secondary school students. This is in alignment with the research findings that gender difference was found for ADHD (Gerhon 2005; Koermer et al 2021; Vogley 2019) However, it is not in consonant with some studies reported no gender difference (Sarma & Padmavathy 2022). Possible explanations for this could be these studies used varying instrument to identify ADHD and location of the research.

Also, the result reveals that there is no significant influence of gender on dyscalculia and ADHD amongst secondary school students. This is in alignment with the research findings that no gender difference was found for dyscalculia and ADHD (Capano et al 2008; Silva et al 2020) while it is not in agreement with some studies reported no gender difference (Czamara et al 2013; Koermer et al 2021; Youshimasu et al 2010; Youshimasu et al 2011). Possible explanations for this could be these studies used varying criteria to identify dyscalculia and ADHD, location of study and varying demographics which could account for some of the differences in the results This result suggests that, the lack of a significant gender influence on these conditions may reflect comparable rates of occurrence among male and female students, leading to similar patterns of association between ADHD and dyscalculia across genders. The lack of a significant gender effect may suggest that other factors, such as cognitive profiles or comorbid conditions, genetic predispositions, neurobiological differences, environmental influences, and societal expectations exert a stronger influence on the manifestation of ADHD and dyscalculia than gender alone. In other words, gender differences in ADHD and dyscalculia may be overshadowed by heterogeneity within gender groups. Individual differences in symptom

severity, cognitive profiles, comorbidities, and educational experiences may contribute to variability in the presentation and impact of ADHD and dyscalculia, making it challenging to detect significant gender effects across the entire sample.

### **Recommendations**

Based on findings, the following recommendations are made.

1. It is recommended that there should be collaborations between psychometricians, psychologists, educators and teachers to ensure that assessment tools are reliable, valid and available for accurate measure and identification of students at risk for ADHD and dyscalculia at routines times. Particularly for those exhibiting difficulties with attention, working memory, and mathematical
2. It is recommended that teachers and educators should develop individualized education plans (IEPs) or support plans tailored to students' specific needs and learning profiles that are gender neutral. They should provide accommodations and modifications, such as extended time for tasks, preferential seating, multisensory approaches and assistive technology,
3. It is recommended that ongoing training and professional development opportunities should be provided by for teachers to enhance their understanding of ADHD and dyscalculia and develop effective instructional strategies and assessment tools.
4. Schools and teachers should involve and collaborate with parents and caregivers to create a supportive home-learning environment and reinforce skills learned in school.
5. Educational psychologist and school counsellors should raise awareness among school staff, students, and families about ADHD and dyscalculia to reduce stigma and foster empathy and understanding.
6. Educational Psychologist and school counsellors should offer counseling and support services to students with ADHD and dyscalculia to address emotional and behavioral challenges, build self-esteem, and enhance coping skills in academic and social settings.
7. Educators, teachers, school administrators and parents should provide supportive and inclusive classroom environment by promoting empathy, understanding, and positive reinforcement for students with ADHD and dyscalculia, emphasizing their strengths and abilities.

8. Policy makers and school administrators should create policies that promote early screening, assessment, and intervention for ADHD and dyscalculia can help ensure that affected students receive the necessary support to thrive academically and socially in school.
9. Policy makers and school administrators should also allocate resources and funding for professional development opportunities to train teachers and staff on best practices for supporting students with ADHD, dyscalculia and other learning difficulties like dyslexia and dyscalculia

### **Conclusion**

The findings reveal a significant positive relationship between ADHD and dyscalculia. This is so as both ADHD and dyscalculia are associated with deficits in executive functioning, such as working memory, attentional control, and cognitive flexibility. Students with ADHD may struggle with sustaining attention and inhibiting impulsive responses, which can impede their ability to comprehend and apply mathematical concepts effectively. Result also shows that that gender has no significant influence on ADHD and dyscalculia suggesting that gender influence on these conditions may reflect comparable rates of occurrence among male and female students, leading to similar patterns of association between ADHD and dyscalculia across genders

The findings may be limited by the characteristics of the sample population, such as age range, socioeconomic status, and geographic location. Generalizability to broader populations outside the population of study may be restricted.

It is therefore suggested that further studies such as longitudinal studies to examine the developmental trajectories of ADHD and dyscalculia, including how these conditions manifest and interact over time be conducted amongst others.

### **References**

- American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed.; American Psychiatric Association: Washington, DC, USA,
- Barbarese, W. J., Katusic, S. K., Colligan, R. C., Weaver, A. L., & Jacobsen, S. J. (2005). Math learning disorder: incidence in a population-based birth cohort, 1976-82, *Rochester, Minn. Ambulatory pediatrics: the official journal of the Ambulatory Pediatric Association*, 5(5), 281–289. <https://doi.org/10.1367/A04-209R.1>
- Butterworth, B. (2003) *Dyscalculia Screener*. London: nferNelson Publishing Company.

- Capano, L.; Minden, D.; Chen, S.X.; Schachar, R.J.; Ickowicz, A. (2008). Mathematical Learning Disorder in School-Age Children with Attention-Deficit Hyperactivity Disorder. *Can. J. Psychiatry*. 53, 392–399
- Czamara, D.; Tiesler, C.M.T.; Kohlböck, G.; Berdel, D.; Hoffmann, B.; Bauer, C.P.; Koletzko, S.; Schaaf, B.; Lehmann, I.; Herbarth, O.; et al. (2013). Children with ADHD Symptoms Have a Higher Risk for Reading, Spelling and Math Difficulties in the GINIplus and LISApplus Cohort Studies. *PLoS ONE* 2013, 8, e63859130. <https://doi.org/10.33902/JPR.202320992>
- Dowker, A. 2004. *What Works for Children with Mathematical Difficulties?* Research Report RR554. Nottingham: DfES Publications.
- Dirks, E., Spyer, G., van Lieshout, E. C., & de Sonnevile, L. (2008). Prevalence of combined reading and arithmetic disabilities. *Journal of learning disabilities*, 41(5), 460–473. <https://doi.org/10.1177/0022219408321128>
- DuPaul G. J., Gormley M. J., Laracy S. D. (2013). Comorbidity of LD and ADHD: Implications of DSM-5 for assessment and treatment. *J. Learn. Disabil.* 46 43–51. 10.1177/0022219412464351
- Emerson, J., & Babbie, P. (2010). *The dyscalculia assessment*. New York, NY: Continuum International
- Eteng-Uket, S. (2023). "The Development, Validation, and Standardization of a New Tool: The Dyscalculia Test." *Numeracy* 16 (2) 1. <https://doi.org/10.5038/1936-4660.16.2.1417>
- Eteng-Uket, S. & Amaechi-Udogu, V. C. (2023). Differential Influence of Demographic Variables on Dyscalculia Dimensions. *International Journal of Educational Spectrum*, 5 (2), 146-166. <https://10.47806/ijesacademic.1294709>
- Eteng-Uket, S., & Iruloh, B.-R. N. (2023). Differential and interactional influence of socio-demographic variables on intellectual ability. *Journal of Pedagogical Research*, 7(4), 111-
- Geary, D.C. (2004a). Mathematics and Learning Disabilities. *Developmental Neuropsychology*, 32(1), 471–519.
- Geary D. C. (2004b). Mathematics and learning disabilities. *Journal of learning disabilities*, 37(1), 4–15. <https://doi.org/10.1177/00222194040370010201>
- Gershon, J. A Meta-Analytic Review of Gender Differences in ADHD. *J. Atten. Disord.* 2002, 5, 143–154
- Gross-Tsur, V., Manor, O., & Shalev, R. S. (1996). Developmental Dyscalculia: Prevalence and Demographic Features. *Developmental Medicine and Child Neurology*, 38,(1) 25–33.
- Hein, J., Bzofka, M., & Neumecker, K. (2000). The specific disorder of arithmetic skills. Prevalence studies in a rural and an urban population sample and their clinico-neuropsychological validation. *European Child & Adolescent Psychiatry*, 9, S87–S101. <https://doi.org/10.1007/s007870070012>

- Huss, M.; Hölling, H.; Kurth, B.-M.; Schlack, R. (2008). How often are German children and adolescents diagnosed with ADHD? Prevalence based on the judgment of health care professionals: Results of the German health and examination survey (KiGGS). *Eur. Child Adolesc. Psychiatry*, 17, 52–58.
- Jordan, N. C., Hanich, L. B., & Kaplan, D. (2003). A longitudinal study of mathematical competencies in children with specific mathematics difficulties versus children with comorbid mathematics and reading difficulties. *Child Development*, 74(3), 834-850.
- Kim, J.; Mutyala, B.; Agiovlasitis, S.; Fernhall, B. (2011). Health behaviors and obesity among US children with attention deficit hyperactivity disorder by gender and medication use. *Prev. Med.* 52, 218–222.
- Kerner auch Koerner J, Visser L, Rothe J, Schulte-Körne G, Hasselhorn M. (2021). Gender Differences in the Comorbidity of ADHD Symptoms and Specific Learning Disorders in a Population-Based Sample. *Sustainability*. 13(15):8440. <https://doi.org/10.3390/su13158440>
- Koumoula, A., Tsiromi, V., Stamouli, V., Bardani, I., Siapati, S., Annika, G., ... von Aster, M. (2004). An epidemiological study of number processing and mental calculation in Greek school children. *Journal of Learning Disabilities*, 37, 377–388. <https://doi.org/10.1177/00222194040370050201>
- Kaufmann L., Nuerk H.-C. (2008). Basic number processing deficits in ADHD: A broad examination of elementary and complex number processing skills in 9- to 12-year-old children with ADHD-C. *Dev. Sci.* 11 692–699. <https://doi.org/10.1111/j.1467-7687.2008.00718.x>
- Landerl, K., & Moll, K. (2010). Comorbidity of learning disorders: Prevalence and familial transmission. *Journal of Child Psychology and Psychiatry*, 51(3), 287–294. <https://doi.org/10.1111/j.1469-7610.2009.02164.x>
- Landerl, K., Bevan, A., & Butterworth, B. (2004). Developmental dyscalculia and basic numerical capacities: a study of 8-9-year-old students. *Cognition*, 93(2), 99–125
- Mazzocco, M. M., & Myers, G. F. (2003). Complexities in Identifying and Defining Mathematics Learning Disability in the Primary School-Age Years. *Annals of dyslexia*, 53(1), 218. <https://doi.org/10.1007/s11881-003-0011-7>
- Moll, K., Kunze, S., Neuhoff, N., Bruder, J., & Schulte-Körne, G. (2014). Specific learning disorder: Prevalence and gender differences. *PLoS ONE*, 9(7), e103537. <https://doi.org/10.1371/journal.pone.0103537>
- Ogbogo & Opara, I. M (2021). Quantitative and Qualitative Analysis of Dyscalculia Test *International Journal of Education, Learning and Development*, 9, (7), 1-15.
- Ogbogo, & Orluwene, G. W. (2021). Psychometric Analysis of Dyscalculia Test (September 17, 2021). *British Journal of Education* 9(9), 55-70.

- Pandey, S. & Agarwal, S, (2015). Assessment of learning disability (dyscalculia) among school going children: today's concern. *International Journal of Current Research*, 7, (10), 22033-22035
- Polanczyk, G.; De Lima, M.S.; Horta, B.L.; Biederman, J.; Rohde, L.A. (2007). The worldwide prevalence of ADHD: A systematic review and meta regression analysis. *Am. J. Psychiatry*, 164, 942–948.
- Reigosa-Crespo, V., Valdes-Sosa, M., Butterworth, B., Estevez, N., Rodriguez, M., Santos, E., Lage, A. (2011). Basic numerical capacities and prevalence of developmental dyscalculia: The Havana survey. *Developmental Psychology*, 48, 123–135. <https://doi.org/10.1037/a0025356>
- Sarma, M. & Padmavath, R.D. (2022). Relationship between attention deficit hyperactivity disorder (ADHD) and dyscalculia among high school students. *Journal of Emerging Technologies and Innovative Research* .9(1), 116-124
- Silva, D.; Colvin, L.; Glauert, R.; Stanley, F.; Srinivas Jois, R.; Bower, C. (2020). Literacy and Numeracy Underachievement in Boys and Girls With ADHD. *J. Atten. Disord.* 24, 1392–1402
- Shalev, R., & M. von Aster. (2008). “Identification, Classification, and Prevalence of Development Dyscalculia.” *Encyclopedia of Language and Literacy Development: published online*. <https://doi.org/10.5167/uzh-12874>.
- Shalev, R. S., Manor, O., Kerem, B., Ayali, M., Badichi, N., Friedlander, Y., & Gross-Tsur, V. (2001). Developmental dyscalculia is a familial learning disability. *Journal of Learning Disabilities*, 34(1), 59–65.
- Shalev, R. S., Manor, O., & Gross-Tsur, V. (2005). Developmental dyscalculia: a prospective sixyear follow-up. *Developmental medicine and child neurology*, 47(2), 121–5.
- Tripp, G.; Schaugency, E.A.; Langlands, R.; Mouat, K. (2007). Family interactions in children with and without ADHD. *J. Child Fam. Stud.* 2007, 16, 385–400
- Trott, C. (2010a). Dyscalculia: A practitioner's view. *Assessment & Development Matters*, 2(2), 19–21.
- Vogley, Jillian, "Gender Differences in ADHD" (2019). Honors Theses. 3165. [https://scholarworks.wmich.edu/honors\\_theses/3165](https://scholarworks.wmich.edu/honors_theses/3165)
- Yoshimasu, K.; Barbaresi, W.J.; Colligan, R.C.; Killian, J.M.; Voigt, R.G.; Weaver, A.L.; Katusic, S. (2010) Gender, ADHD, and Reading Disability in a Population-Based Birth Cohort. *Pediatrics* 2010, 126, e788–e795.
- Yoshimasu, K.; Barbaresi, W.J.; Colligan, R.C.; Killian, J.M.; Voigt, R.G.; Weaver, A.L.; Katusic, S.K (2011). Written-language disorder among children with and without ADHD in a population-based birth cohort. *Pediatrics*, 128, 605–612
- Zerafa, E. (2015). Helping Children with Dyscalculia: A Teaching Programme with three Primary School Children. *Procedia - Social and Behavioral Sciences*, 191, 1178-1182. <https://doi.org/10.1016/j.sbspro.2015.04.516>