


Spring 2016

## Examination of the Relationship Between Caesarean Section Births and Attention Deficit Hyperactivity Disorder

Breea M. Rosas

Central Washington University, [breea.rosas@gmail.com](mailto:breea.rosas@gmail.com)

Follow this and additional works at: <https://digitalcommons.cwu.edu/etd>

 Part of the Behavior and Behavior Mechanisms Commons, Developmental Psychology Commons, Educational Psychology Commons, Obstetrics and Gynecology Commons, and the Other Mental and Social Health Commons

---

### Recommended Citation

Rosas, Breea M., "Examination of the Relationship Between Caesarean Section Births and Attention Deficit Hyperactivity Disorder" (2016). *All Master's Theses*. 299.  
<https://digitalcommons.cwu.edu/etd/299>

This Thesis is brought to you for free and open access by the Master's Theses at ScholarWorks@CWU. It has been accepted for inclusion in All Master's Theses by an authorized administrator of ScholarWorks@CWU. For more information, please contact [scholarworks@cwu.edu](mailto:scholarworks@cwu.edu).

EXAMINATION OF THE RELATIONSHIP BETWEEN CAESAREAN SECTION  
BIRTHS AND ATTENTION DEFICIT HYPERACTIVITY DISORDER

---

A Thesis

Presented to

The Graduate Faculty

Central Washington University

---

In Partial Fulfillment

of the Requirements for the Degree

Educational Specialist

School Psychology

---

by

Breea Marie Rosas

November 2015

CENTRAL WASHINGTON UNIVERSITY

Graduate Studies

We hereby approve the thesis of

Breea Marie Rosas

Candidate for the degree of Educational Specialist

APPROVED FOR THE GRADUATE FACULTY

---

---

Dr. Stephanie Stein, Committee Chair

---

---

Dr. Heidi Bogue

---

---

Dr. Liane Pereira

---

---

Dean of Graduate Studies

## ABSTRACT

### EXAMINATION OF THE RELATIONSHIP BETWEEN CAESAREAN SECTION BIRTHS AND ATTENTION DEFICIT HYPERACTIVITY DISORDER

by

Breea Marie Rosas

November 2015

Attention Deficit/Hyperactivity Disorder, a neurological disorder characterized by inattentive and hyperactive behaviors, has become increasingly more prevalent (CDC, 2010). Recent research has found associations between this disorder and Caesarean section births (Amiri et al., 2012; Juarez et al., 2008). The current study examined the relationship between C-section birth and self-reported symptoms of ADHD by college students on the Internal Restlessness Scale (Weyandt et al., 2003). Results of the study indicate a significant difference in mean ratings of ADHD symptoms between C-section and vaginally born participants ( $t = 3.683, p < .000$ ). The current study supports previous findings of a relationship between C-sections and ADHD.

## TABLE OF CONTENTS

Chapter	Page
I INTRODUCTION .....	1
II REVIEW OF THE LITERATURE .....	4
Attention Deficit Hyperactivity Disorder (ADHD) .....	4
Caesarean Sections (C-sections).....	8
Relationship between C-sections and ADHD.....	10
III METHODS .....	14
Design .....	14
Participants.....	14
Measure.....	15
Procedures.....	15
IV RESULTS .....	16
V DISCUSSION.....	18
Limitations .....	18
Recommendations for Future Research .....	19
REFERENCES .....	20
APPENDIXES .....	23
Appendix A- Perinatal Factors and Behaviors.....	23
Appendix B- Informed Consent.....	25
Appendix C- Study Closing Page .....	26

## CHAPTER I

### INTRODUCTION

Attention deficit/hyperactivity disorder (ADHD) is disorder that affects 5.4 million children in the United States (Centers for Disease Control and Prevention [CDC], 2010). This neurological disorder is characterized by inattention, hyperactivity, and impulsivity (Sattler, Weyandt, & Willis, 2006). ADHD impacts several areas of functioning in a person's life, particularly in a developing child. Children with ADHD may experience deficits in cognitive abilities, issues with social and adaptive functioning, disturbances in motivation and emotions, as well as motor and physical health issues (Sattler et al., 2006). Not surprisingly, these children suffer impairments in school (American Psychiatric Association [APA], 2013).

Although little is known about the cause of the disorder, some risk factors have been identified (Thapar, Cooper, Eyre, & Langley, 2013). Some research suggests that prenatal and perinatal influences may increase the likelihood of a child developing ADHD (Thapar et al., 2013). While some perinatal influence have been examined (Thapar et al., 2013), one aspect of perinatal influence that is less understood, as depicted by the review of literature by Thapar et al. (2013), is the method of delivery. Although many women deliver their children vaginally, others do so by Caesarean section (C-section), a mode of delivery that involves a major abdominal surgery to remove the infant from the mother's womb (Menacker & Hamilton, 2010). Caesarean section births have risen in number by 71% since 1996, making up nearly one third of all births in 2007 (Menacker & Hamilton, 2010). Thus far, C-sections have been associated with a number of short-term and long-term consequences for both mother and child (Hyde, Mostyn,

Modi, & Kemp, 2012). However, the effects researched are mostly related to the physical health rather than mental health of the child (Hyde et al., 2012).

Some research has attempted to link C-sections with ADHD. Amiri, Malek, Sadegfard, and Adbi (2012) conducted a correlational study in Iran connecting several risk factors to ADHD, including C-section delivery. Experimentally, another group of researchers examined the effects that C-sections have on rat pups. Juarez, Gratton, and Flores (2008) discovered that C-sections altered the brain development of rats in a way that is associated with dopamine-related disorders such as ADHD. One hypothesis for this connection between C-sections and mental health is that the trauma experienced during C-sections results in psychological shock (Emerson, 1998). This shock experienced by newborns makes it more difficult for them to adapt to later life experiences (Emerson, 1998). Instead, Emerson (1998) argues that it is important for newborns to experience typical birth in order to develop an adequate stress response. Hyde et al. (2012) hypothesized “that the stress response to birth is a key mechanism that modifies the differentiation of a number of cell types, preparing the baby not only for the challenges of extra-uterine life but also long-term health and well-being” (p. 238). In summary, the research suggests that C-section delivery could be inhibiting the child’s ability to function typically.

There is extensive research on the effects of C-sections, but a clear connection to ADHD has yet to be established. Prior research indicates that the connection between C-sections and ADHD needs to be further explored. The purpose of the current study is to explore the difference between self-reported ADHD symptom ratings of college students who were born C-section compared to those born vaginally, controlling for maternal

variables and circumstances surrounding labor. The control variables include maternal age, gestational age at delivery, birth weight, and complications during the birthing process such as loss of oxygen or heartbeat of the fetus. These variables were determined to be risk factors also associated with ADHD (Thapar et al., 2013), which is why they will be controlled for in the current study. It is important to conduct this study so that mothers can make informed decisions regarding the birthing methods they choose. The focus of this study is specifically on elective C-sections, as medically indicated C-sections are controlled for in the exclusionary factor of complications during the birthing process. For the purpose of this study, the definitions for the variables are as follows:

- Mode of delivery: The birth method with which the participant was delivered. The two conditions are vaginal birth (child exiting through the birth canal) and C-section birth (child surgically removed from the uterus);
- ADHD symptomology: Symptoms associated with ADHD will be measured by the participant's response to questions assessing internal restlessness on the Internal Restlessness Scale (Weyandt et al., 2003).



## CHAPTER II

### REVIEW OF THE LITERATURE

#### Attention Deficit Hyperactivity Disorder (ADHD)

The most common neurobehavioral disorder among children is ADHD (Amiri et al., 2012; CDC, 2010). The issues associated with ADHD directly impact a person's ability to function effectively in a variety of settings. Furthermore, the prevalence of this impactful disorder is only increasing (CDC, 2010). In the period from 2003 to 2007, the number of ADHD diagnoses in children rose by one million (CDC, 2010). By 2007, 9.5% of parents reported that their child had been diagnosed with ADHD at some point in time (CDC, 2010). In addition, the prevalence of this diagnosis is not limited to the United States. Polanczyk, de Lima, Horta, Bierdman, and Rohde (2007) conducted a review of literature from around the world that estimated the prevalence of ADHD to be 5.29%. It is clear that this disorder affects a large number of children and the consequences can be widespread.

According to the *Diagnostic and Statistical Manual of Mental Disorder- Fifth Edition* (DSM-5) (APA, 2013), ADHD is marked by a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning. ADHD is usually identified in children during elementary school (Sattler et al., 2006). The symptoms of ADHD may interfere with the typical developmental course of a child. Behaviorally, ADHD can involve symptoms of inattention such as being disorganized or off task, hyperactivity such as fidgeting or talkativeness, or impulsivity such as interrupting others or making rash decisions (APA, 2013). The difficulties with inattention, hyperactivity, and impulsivity can have a range of impacts on the child's life. The cognitive problems

associated with ADHD can be observed on tests of attention, executive function, or memory (APA, 2013). These impairments can lead to difficulties in school.

In addition to impaired executive functioning that may inhibit academic success, students with ADHD often have poor self-regulation (Martin, 2014). Specifically, Martin (2014) found that ADHD predicted schoolwork noncompletion, school suspension, school expulsion, and changing of schools. Further, children with ADHD rated themselves lower on conscientiousness, agreeableness, and emotional stability, and higher on neuroticism (Martin, 2014). These relative deficits can influence children's social functioning and interfere with their ability to create and maintain relationships. Clearly, the negative influence of ADHD on students' educational outcomes is important and warrants further research.

Difficulties related to ADHD in childhood typically continue in adulthood. In particular, although hyperactivity and outward restlessness may appear to subside, impulsivity is often still present in adulthood (APA, 2013). Symptoms of inattention in adults might present as the person having difficulty paying attention, struggling with organization, or becoming easily distracted (APA, 2013). Adult symptoms of hyperactivity or impulsivity may manifest as feelings of restlessness, excessive talkativeness, or urges to blurt out thoughts (APA, 2013). Internal restlessness is an important aspect of ADHD in adults, as Weyandt et al. (2003) found that college age students with ADHD endorsed significantly higher ratings of internal restlessness than their peers without ADHD.

As with children, the effects of ADHD can also have a negative impact on adult students. A recent review of literature by Fleming and McMahon (2012) identified

several influences of ADHD on college age students. In terms of academics, college students with ADHD tend to have lower academic performance overall when compared to their peers, with inattentive symptoms often predicting the most academic impairment. Fleming and McMahon report that studies have found issues with working memory, temporal processing, and organization to be associated with ADHD in college students. They claim that these symptoms make it difficult for college students to adjust to the demands associated with higher education such as attending class, managing assignments, and studying for tests. In addition to academic influences of ADHD on college students, there are emotional and social influences as well (Fleming & McMahon, 2012). These include issues with attending to conversations, maintaining relationships with peers, and effectively managing anger or impulsive comments. According to Fleming and McMahon, college students are more likely to display symptoms of depression and anxiety and are also more likely to use drugs and alcohol. Overall, the influence of ADHD on behavior, academic performance, and social relationships can be lifelong.

Given that so many people suffer from this disorder, it is important to not only understand how to help them, but also how to prevent the disorder from occurring. While the direct cause of ADHD is not clear, some risk factors for the disorder have been identified (APA, 2013). Thapar et al. (2013) developed a narrative review of the literature published since 1996 regarding the contributing factors to ADHD. They concluded that ADHD may have a genetic component, given that studies from their review have shown it is a heritable condition. Specifically, the likelihood of a child having ADHD is increased when a close family member also has the disorder (APA, 2013). An estimate of

the heritability of ADHD is approximately 80% (Polanczyk et al., 2007). A recent twin study in England was conducted with a sample of 5,581 pairs of 12-year-old twins, both monozygotic and dizygotic (Greven, Rijdsdijk, & Plomin, 2011). Parents of these twins completed a Revised Conner's Parent Rating Scale to assess symptoms of ADHD (Conners et al., 1998, as cited in Greven et al., 2011). Greven et al. (2011) found that correlations of both hyperactivity-impulsivity and inattention between monozygotic twins were twice as high as they were for dizygotic twins, indicating considerable genetic influence.

While there is strong evidence for genetic influence, there are additional risk factors for ADHD that occur during and soon after pregnancy. Other risk factors for ADHD include low birth weight, maternal smoking and alcohol consumption during pregnancy, as well as childhood abuse or neglect, and exposure to toxins (APA, 2013; Thapar et al., 2013). Smoking during pregnancy increases the odds of the child developing ADHD by a ratio of 2.36, while low birth weight and prematurity increase the odds of ADHD in a child by a ratio of 2.6 (Thapar et al., 2013). As a result of their review, Thapar et al. (2013) also concluded that maternal stress while pregnant is associated with the development of ADHD in the child. As noted, there are several factors associated with ADHD that are prenatal, perinatal, or that occur in early childhood. Given that prenatal and perinatal factors have been associated with higher incidences of ADHD, it is possible that there may be a relationship between the method of delivery and the incidence of ADHD.

### Caesarean Sections (C-sections)

A Caesarean section is defined as the “extraction of the infant, placenta, and membranes through an incision in the maternal and abdominal walls” (Menacker & Hamilton, 2010, p. 6). While vaginal delivery still occurs, C-sections are becoming increasingly prevalent (Menacker & Hamilton, 2010). This method of child delivery is performed for various reasons, ranging from convenience for the mother to emergency circumstances. In 2007, approximately one third of all births in the United States were via C-section (Menacker & Hamilton, 2010). This percentage indicates that approximately 1.4 million newborns delivered that year were done so via C-section. Additionally, the rate of C-sections for mothers age 40-54 was 48%; however, the rate for mothers under the age of 20 was half of that (Menacker & Hamilton, 2010). Smith et al. (2008) found a strong association between advancing maternal age and C-section deliveries, further concluding that the increase in C-section deliveries may be due to the trend of delaying maternal age of childbirth. Overall, the rates of C-sections rose significantly between 1996-2007 (Menacker & Hamilton). This increase is seen in places other than the United States as well. An analysis of birth records in Scotland revealed that the number of C-sections had doubled between 1980 and 2005 (Smith et al., 2008).

As the prevalence of C-sections increases, it is becoming clear that in addition to the impact of this procedure on mothers, children born via Caesarean section may also experience negative effects. A review of literature done by Hyde et al. (2012) concluded that children born by C-section could suffer from both short-term and long-term consequences. For instance, they reported that initially at birth, newborns delivered Caesarean section have impaired lung function, as their lung volume and ventilation per

minute is less than those born vaginally. Additionally, newborns have impaired thermogenic responses, meaning they have lower axillary and skin temperatures after birth compared to infants delivered vaginally (Hyde et al., 2012). Further, the authors concluded that C-section delivered newborns typically suffer from altered metabolism, feeding, immune phenotype, and blood pressure directly after birth. “Caesarean deliveries can result in immediate symptomatic effects in babies such as nocturnal awakening, extensive crying, trauma crying (a kind of crying fuelled by birth trauma), feeding difficulties, digestive difficulties, colic, tactile defensiveness, and bonding deficiencies” (Emerson, 1998, p.36). As evident by this research, newborns can face aversive conditions following a C-section.

Besides the immediate effects of C-sections on newborns, children delivered this way have also been known to struggle with adverse conditions later in life. For example, they are more likely to suffer from immune-related conditions like asthma, food allergies, and type 1 diabetes (Hyde et al., 2012). Children born from Caesarean section also have a larger body mass than those born vaginally, as well as difficulties with liver function (Hyde et al., 2012). Caesarean section births may also be associated with neurological and stress-related problems, as Hyde (2012) explained that the stress response activated in natural childbirth is critical in dealing with extra-uterine life. These long-term effects of C-sections suggest that this birthing method can result in consequences for the child.

As demonstrated by the review of literature by Hyde et al. (2012), several studies investigated the association between Caesarean sections and the short- and long-term effects they may have on children. A recent study conducted by Kelmanson (2013) attempted to explicate the relationship between mental health disorders in children and C-

sections. The study compared internalizing and externalizing behaviors of 5 year olds born either C-section delivery at maternal request (CDMR) or via uncomplicated vaginal delivery. The results indicated that children born via CDMR were more likely to demonstrate internalizing disorders than those born via uncomplicated vaginal delivery; no significant differences between the groups were found on measures of externalizing behaviors. This study is a starting point for examining mental health issues connected to C-sections. However, a relationship between ADHD and C-sections has yet to be explored, despite the fact that the prevalence of both ADHD (CDC, 2010) and Caesarean sections (Menacker & Hamilton, 2010) have increased significantly in recent years.

#### Connection Between C-Sections and ADHD

Although empirical research demonstrating the cause and effect relationship between C-sections and ADHD in children cannot be conducted, a recent study on C-sections in rats shows evidence of changes in the brain that are associated with ADHD. In an experiment done by Juarez et al. (2008), 120 newborn rat pups were randomly assigned to one of three conditions: vaginal birth (VAG), Caesarean section only birth (C-only), or Caesarean section birth accompanied by an absence of oxygen (C+Anoxia). Neurons were drawn from the pups on both sides of the medial prefrontal cortex (PFC), nucleus accumbens (NAcc), and hippocampal CA1 regions at different postnatal ages over time. Following this, the brains of the rats were sliced into the PFC, NAcc, and hippocampal CA1 regions. Each section was examined via slides under a microscope. Dendritic tree length and density were compared at each postnatal age at which samples were collected and also after the brain was removed.

The results of the comparisons between conditions were that Caesarean sections, regardless of anoxia, affected prepubertal development of PFC and hippocampal CA1 neurons, as well as the NAcc medium spiny neurons (Juarez et al., 2008). The dopamine levels in the NAcc were found to be amplified in the rats born by Caesarean section, with or without anoxia. The results of this study indicate that changes in neurons can affect dopamine function in the PFC and NAcc, which are related to dopamine-related disorders such as schizophrenia, ADHD, and drug addiction. Motivation, reward processes, and motor behavior are often abnormal in people with ADHD (Wu, Xiao, Sun, & Zou, 2012); it is important to understand that dopamine is the neurotransmitter behind many of these systems (Wu et al., 2012). Juarez et al.'s (2008) study allowed for greater investigation of Caesarean sections and their effects on the developing brain.

Although the Juarez et al. (2008) study provided insight to the relationship between C-sections in rats and dopamine-related disorders, the relationship between C-section in newborn persons and diagnosis of ADHD is not yet clear. A correlational study in Iran explored the association of pregnancy-related maternal risk factors to ADHD (Amiri et al., 2012). A sample of 164 children with ADHD was selected via referrals from their doctors at a hospital in Iran. A comparison group of 166 children without ADHD were also selected. To be included in the ADHD group, the child had to be diagnosed with ADHD using the ADHD Rating Scale- Parent Version (DuPaul, Power, Anastopoulos, & Reid, 1998, as cited in Amiri et al., 2012), which is based on the *Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition* criteria (APA, 1984, as cited in Amiri et al., 2012). The inclusion requirement for the comparison group was that the child must not have been diagnosed with a major psychiatric disorder.



Mothers of children in both conditions were asked questions regarding age at pregnancy, duration of pregnancy, history of somatic disorders, history of psychiatric disorders, cigarette and alcohol exposure during pregnancy, delivery method, trauma to the abdomen, x-ray exposure, infections, dysentery (i.e., intestinal infection), bleeding, preeclampsia (high blood pressure), unwanted pregnancy, and history of abortion. The following variables were found to demonstrate significant difference between ADHD and the control group: somatic disease, psychiatric disorder, alcohol and cigarette exposure, and Caesarean section. For all of these variables, the percentage of mothers in the ADHD group was higher than in the control. While somatic disease, psychiatric disorders, and alcohol and cigarette exposure have previously been linked to ADHD (APA, 2013; Thapar et al., 2013), the correlation between C-section delivery and ADHD represented a new finding.

In summary, given that ADHD is increasing in prevalence, it is important to understand the possible causes of the disorder that impacts millions of children and adults. An area that has not been explored extensively, delivery method of the infant, should be further considered. A great deal of research has been done regarding some of the physical short-term and long-term effects of delivery via Caesarean section, but not specifically how this might effect the mental health of the child. Hyde et al. (2012) asserts that birth via C-section decreases the child's stress response, thus negatively impacting the health and well-being of the person. The study by Juarez et al. (2008) indicated that there is a link between Caesarean sections and changes in neurons related to ADHD in rats. Another important study found a correlation between ADHD and Caesarean sections in Iran (Amiri et al., 2012). However, there needs be more research to

support the relationship between C-sections and ADHD symptomology. The purpose of the current study is to investigate the differences between self-reported ADHD symptomology in college students depending on the mode of delivery, while controlling for confounding variables that could possibly influence the relationship. It is hypothesized that there is a significant difference in the ratings of ADHD symptoms of college-age students delivered vaginally and those born via C-section.

## CHAPTER III

### METHODS

#### Design

The current study was a quasi-experimental design exploring the relationship between C-sections and self-reported symptoms of internal restlessness, which is often used as measure of adult ADHD symptoms. The independent variable was method of delivery, while the dependent variable was symptoms of internal restlessness. A *t*-test was used to compare the means of ratings between methods of delivery. The two conditions for method of delivery are vaginal birth and Caesarean section birth.

#### Participants

The researcher recruited both male and female students attending Central Washington University. Most of the participants were offered extra credit and participation was completely voluntary. Participants were all over the age of 18 and English speaking, as that was the language the survey was administered in. Participants needed to be able access the Internet so that they could complete the survey online. Information about sex of participants was not collected. A total of 217 participants signed up for the study, though 11 participants were deleted for non-completion of the survey. In addition, a total of 103 surveys were not included in data analysis due to exclusionary factors: 4 for high maternal age, 58 for low gestational age, 21 for low birth weight, and 20 for complications during child birth. Furthermore, any responses marked “Unsure” for an exclusion criterion were not included in the analysis. In total, 101 surveys were included in the final analysis.

### Measure

Participants completed an online survey created by the researcher. The survey contained background questions as well as questions related to symptoms of ADHD (Appendix A). The six background questions addressed perinatal factors such as birth weight and method of delivery. The Internal Restlessness Scale (Weyandt et al., 2003) was administered following the background questions. This scale is a measure of feelings of restlessness that are typically reported in adults with ADHD (Weyandt et al., 2003; APA, 2013). It consists of 24 questions; each rated on a 7-point Likert scale. Weyandt et al. (2003) found that adults with ADHD scored significantly higher on this scale than adults without ADHD ( $F(1, 38) = 28.821, p > .0001$ ). In addition, the Internal Restlessness Scale is significantly correlated to the Adult Rating Scale of ADHD symptomology ( $r = .62, p > .01$ ) (Weyandt et al., 2003). Test-retest reliability for the Internal Restlessness Scale is .80 ( $p > .01$ ) (Weyandt et al., 2003).

### Procedures

Prior to conducting the study, the researcher received approval from the Human Subjects Review Board as a minimal risk study (study number H15007). The researcher then uploaded the survey to Central Washington University's Sona system to be completed online by students enrolled in psychology courses at Central Washington University. Data was collected between February 12, 2015 and March 13, 2015.

Before beginning the survey, participants read over and electronically signed an informed consent (Appendix B). The informed consent provided details about the study, confirmed anonymity, and also informed participants that they could discontinue the survey at any time. Participants who clicked "I disagree" to the terms were directed to a

closing page (Appendix C) and did not complete the survey. They were still granted extra credit through Sona for their participation. Participants who selected “I agree” to the informed consent began the online survey. The online survey began with six background questions. Regardless of answers to the background questions, the participants were directed to the next section of questions. The proceeding questions addressed internal restlessness. A closing page including the researcher’s contact information followed the completion of the survey.

Surveys not completed were deleted and their data were not included.

Additionally, those who did not meet inclusion criteria due to high maternal age at birth (above 40 years of age), low gestational age of infant at delivery (prior to 37 weeks gestation), low birth weight (below 5.5 pounds), and complications during the birthing process were not examined and their data was deleted. Responses of “Unsure” for the inclusion criteria questions were also excluded. There were three items scored in reverse (“I am organized,” “I feel mentally calm,” and “I focus on tasks”). The researcher reverse scored these items by hand for all participants. The researcher used SPSS to obtain a Total Symptoms rating for each participant and calculate descriptive and inferential statistics.

## CHAPTER IV

### RESULTS

The hypothesis for this study is that people who were born via C-section would report more symptoms related to ADHD than those who were born vaginally.

There were a total of 101 surveys included in the analysis of this study. Eighty-five participants were born vaginally while 16 were born C-section. Three participants reported being diagnosed with ADHD (2.97%), which is less than the 5.29% prevalence of the population (APA, 2013). The skewness (.179) and kurtosis (-.836) of Total symptoms were within normal limits, indicating the overall Total Symptoms ratings were normally distributed. Data was analyzed using a *t*-test. Total symptom ratings between vaginal birth and C-section delivery were significantly different ( $t = 3.683, p < 0.000$ ) with a large effect size ( $d = 1.026$ ). Levene's test of homogeneity of variance was non-significant ( $W = 1.90, p = 0.664$ ). This indicates that the populations from which the Vaginal Delivery group and the C-section Delivery group were equal in variability.

Table 1

*Descriptive Statistics of Total Symptom Ratings Between Modes of Delivery*

	Mode of Delivery	<i>N</i>	Mean	<i>SD</i>
Total	Vaginal	85	78.92	24.567
	C-Section	16	104.13	28.004

## CHAPTER V

### DISCUSSION

The results of this study show a relationship between mode of delivery and symptoms of ADHD in college students. Participants born via C-section had higher total ratings of internal restlessness, which is considered an indicator of ADHD in adults (Weyandt et al., 2003). Participants who reported confounding variables such as high maternal age at birth, low gestational age of infant at delivery, low birth weight, and complications during the birthing process were excluded from this study to eliminate already existing risk factors associated with ADHD. The hypothesis of the study was confirmed: participants born via C-section reported a significantly higher degree of internal restlessness than those born vaginally. This study supported the results of Amiri et al.'s (2012) research, which found a correlation between C-sections and ADHD.

#### Limitations

The results of this study should be interpreted with caution, as there are several limitations. First of all, the scope of the study was limited to a small sample of college-aged students enrolled in psychology classes at Central Washington University. Therefore, the sample may not be representative of the general public. Additionally, several risk factors were addressed, but others were left out of this study. Specifically, the researcher did not include questions regarding the mother's use of alcohol, cigarettes, or drugs during pregnancy, as well as the mother's somatic diseases or psychiatric disorders, which have been linked to ADHD diagnosis by Amiri et al. (2012). Demographic information about participant's gender or current medication use was not collect. These are both limitations, as ADHD if more prevalent in males than females (CDC, 2010) and

medication use could influence a person's report of symptoms. Further, as with all self-report questionnaires, the Internal Restlessness Scale is not a direct measure of ADHD. Therefore, it was not possible to definitively conclude that the participants had ADHD, only that they reported symptoms associated with the disorder. Finally, participants' responses may be influenced by outside factors that cannot be controlled by the researcher, such as mood or stress level while completing the survey. For example, if the student completing the survey was preparing for a stressful test, he or she may endorse feelings of disorganization, difficulty focusing, and mental restlessness.

#### Recommendations for Future Research

Currently, little is known about the long-term effects of birthing interventions, such as C-section, on mental health. In order to further investigate this issue, the current study should be replicated using a larger, more diverse sample. In the current study, only three participants reported having a diagnosis of ADHD; one reported being born via C-section and the other two vaginally. It would also be beneficial to use participants who had actually received a diagnosis of ADHD so that the relationship between C-section births and ADHD could be assessed more directly. Additionally, all known risk factors for ADHD should be addressed to eliminate confounding variables. Finally, investigation into the relationship between C-sections and social-emotional and behavioral disorders would allow for greater understanding regarding possible consequences of C-section births. Specifically, future studies should examine the correlation of C-section births and anxiety and depression, as they can be comorbid with ADHD (APA, 2013).



## REFERENCES

- American Psychiatric Association [APA]. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing
- Amiri, S., Malek, A., Sadegfard, M., & Abdi, S. (2012). Pregnancy-related maternal risk factors of Attention-Deficit Hyperactivity Disorder: A case-control study. *ISRN Pediatrics*, 2012, 1-5. doi:10.5402/2012/458064
- Centers for Disease Control and Prevention [CDC] (2010). Increasing prevalence of parent-reported Attention-Deficit/Hyperactivity Disorder among children-United States, 2003- and 2007. *Morbidity and Mortality Weekly Report*, 59, 1439-1443. Retrieved from <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5944a3.htm>
- Emerson, W. (1998). Birth trauma: The psychological effects of obstetrical interventions. *Journal of Prenatal and Perinatal Psychology & Health: APPPAH*, 13, 11-44.
- Fleming, A.P., & McMahon, R.J. (2012). Developmental context and treatment principles for ADHD among college students. *Clinical Child and Family Psychology Review*, 15, 303-329. doi: 10.1007/s10567-012-0121-z
- Greven, C. U., Rijksijk, F. V., & Plomin, R. (2011). A twin study of ADHD symptoms in early adolescence: Hyperactivity-impulsivity and inattentiveness show substantial genetic overlap but also genetic specificity. *Journal of Abnormal Child Psychology*, 39, 265-275. doi: 10.1007/s10802-010-9451-9
- Hyde, M. J., Mostyn, A., Modi, N., & Kemp, P. R. (2012). The health implications of birth by Caesarean section. *Biological Reviews*, 87, 229-243. doi: 10.1111/j.1469-185X.2011.00195.x

- Juarez, I., Gratton, A., & Flores, G. (2008). Ontogeny of altered dendritic morphology in the rat prefrontal cortex, hippocampus, and nucleus accumbens following cesarean delivery and birth anoxia. *The Journal of Comparative Neurology*, *507*, 1734-1747. doi: 10.1002/cne.21651
- Kelmanson, I. (2013). Emotional and behavioural features of preschool children born by Caesarean deliveries at maternal request. *European Journal of Developmental Psychology*, *10*, 676-690. doi: 10.1080/17405269.2013.787024
- Martin, A. J. (2014). The role of ADHD in academic adversity: Disentangling ADHD effects from other personal and contextual factors. *School Psychology Quarterly*, *29*, 395-408. doi: 10.1037/spq0000069
- Menacker, F., & Hamilton, B. E. (2010). Recent trends in Cesarean delivery in the United States. *NCHS Data Brief*, *35*. Hyattsville, MD: National Center for Health Statistics. Retrieved from <http://www.cdc.gov/nchs/data/databriefs/db35.pdf>
- Polanczyk, G., de Lima, M.S., Horta, B.L., Biedman, J., & Rohde, L.A. (2007). The worldwide prevalence of ADHD: A systematic review and metaregression analysis. *American Journal of Psychiatry*, *146*, 942-948. doi: 10.1176/appi.ajp.164.6.942
- Sattler, J. M., Weyandt, L., & Willis, J. O. (2006). Attention Deficit/Hyperactivity Disorder. In J. M. Sattler & R. D. Hoge. (Eds). *Assessment of children: Behavioral, social, and clinical foundation* (p. 374-389). San Diego, CA: Jerome M. Sattler Publishing

- Smith, G. C., Cordeaux, Y., White, I. R., Pasupathy, D., Missfelder-Lobos, H., Pell, J. P., Charnock-Jones, D. S., & Fleming, M. (2008). The effect of delaying childbirth on Cesarean section rates. *PLoS Medicine*, *5*, 1123-1132. doi: 10.1371/journal.pmed.0050144
- Thapar, A., Cooper, M., Eyre, O., & Langley, K. (2013). Practitioner review: What have we learnt about the causes of ADHD? *The Journal of Child Psychology and Psychiatry*, *54*, 3-16. doi: 10.1111/j.1469-7610.2012.02611.x
- Weyandt, L. L., Iwaszuk, W., Fulton, K., Ollerton, M., Beatty, N., Fouts, H., ... Greenlaw, C. (2003). The Internal Restlessness Scale: Performance of college students with and without ADHD. *Journal of Learning Disabilities*, *36*, 382-389. doi: 10.1037/t07774-000
- Wu, J., Xiao, H., Sun, H., Zou, L., & Zhu, L. (2012). Role of dopamine receptors in ADHD: A systematic meta-analysis. *Molecular Neurobiology*, *45*, 605-620. doi: 10.1007/s12035-012-8278-5

## APPENDIXES

## Appendix A

## Perinatal Factors and Behavior

1. What was your mother's age when you were born? (select one)

Under 40 years old                      Over 40 years old                      Unsure

2. What was the gestational age at the time of your delivery? (select one)

Preterm                                      Term                                      Unsure  
(<37 weeks)                                      (>37 weeks)

3. What was your birth weight? (select one)

Less than 5.5lbs                      More than 5.5lbs                      Unsure

4. What was your the mode of delivery?                      Vaginal                      C-section

5. Were there any complications during childbirth?  
(i.e. loss of heartbeat or deprivation of oxygen for fetus)                      Yes                      No                      Unsure

6. Have you been diagnosed with ADHD?                      Yes                      No                      Unsure

### The Internal Restlessness Scale

Following is a list of statements that people have used to describe themselves. Please indicate, in general, to what extent each one applies to you. Be sure to answer all of the items.

	None of the time	1	2	3	4	5	6	7
1. I am organized.	1	2	3	4	5	6	7	
2. I am told that I interrupt people.	1	2	3	4	5	6	7	
3. Thoughts race through my mind.	1	2	3	4	5	6	7	
4. Mental restlessness prevents me from sleeping.	1	2	3	4	5	6	7	
5. I am always thinking; I have difficulty putting thoughts to rest.	1	2	3	4	5	6	7	
6. While listening to others, my attention drifts to unrelated thoughts.	1	2	3	4	5	6	7	
7. I lose my train of thought conversing with others.	1	2	3	4	5	6	7	
8. I have urges to blurt out thoughts.	1	2	3	4	5	6	7	
9. I have difficulty maintaining focus.	1	2	3	4	5	6	7	
10. I feel compelled to interrupt others during conversations.	1	2	3	4	5	6	7	
11. I feel mentally calm.	1	2	3	4	5	6	7	
12. I have difficulty relaxing because of reoccurring thoughts.	1	2	3	4	5	6	7	
13. I am distracted by sounds.	1	2	3	4	5	6	7	
14. I have difficulty organizing my thoughts.	1	2	3	4	5	6	7	
15. I replay situations in my mind.	1	2	3	4	5	6	7	
16. I worry about becoming bored.	1	2	3	4	5	6	7	
17. I focus on tasks.	1	2	3	4	5	6	7	
18. I have difficulty planning.	1	2	3	4	5	6	7	
19. Unrelated thoughts seems to pop into my head.	1	2	3	4	5	6	7	
20. I am distracted by visual stimuli.	1	2	3	4	5	6	7	
21. My mind wanders.	1	2	3	4	5	6	7	
22. Many possible outcomes to future scenarios run through my mind.	1	2	3	4	5	6	7	
23. I seek mental stimuli.	1	2	3	4	5	6	7	
24. I feel internally restless.	1	2	3	4	5	6	7	

## Appendix B

### Informed Consent

Participation in this survey is voluntary. It will take approximately 20 minutes to complete. The purpose of this study is to determine the relationship between birthing interventions and symptoms associated with ADHD. Participating in this survey may benefit society by contributing to existing literature about risk factors associated with ADHD. The survey you are about to take will ask you questions related factors surrounding your birth and your current behavior. Completing this survey may present some level of discomfort for the participant. Participation in this survey is completely anonymous. Reasonable and appropriate safeguards have been used in the creation of the web-based survey to maximize the confidentiality and security of your responses; however, when using information technology, it is never possible to guarantee complete privacy. You can discontinue this survey at any time without penalty. To participate in this survey you must be of legal age to give consent (18 years old). By continuing on, you are giving your consent to participate in this survey.

If you have questions or concerns, please contact the principal researcher, Breea Rosas, at [rosasb@cwu.edu](mailto:rosasb@cwu.edu) or the faculty sponsor, Dr. Stephanie Stein, at [steins@cwu.edu](mailto:steins@cwu.edu)

TO PROTECT YOUR PRIVACY, PLEASE CLEAR THE CACHE (HISTORY) THEN CLOSE THE BROWSER BEFORE LEAVING THE COMPUTER.

## Appendix C

### Study Closing Page

Thank you for your participation. If you have questions or concerns, please contact the principal researcher, Breea Rosas, at [rosasb@cwu.edu](mailto:rosasb@cwu.edu) or the faculty sponsor, Dr. Stephanie Stein, at [steins@cwu.edu](mailto:steins@cwu.edu)

If you have concerns that you may have ADHD, here are some resources for you:

-CWU Student Medical and Counseling Clinic (Medical: 509-963-1881/ Counseling: 509-963-1391)

-CWU Disability Services (509-963-1202 or [DS@cwu.edu](mailto:DS@cwu.edu))

TO PROTECT YOUR PRIVACY, PLEASE CLEAR THE CACHE (HISTORY) THEN CLOSE THE BROWSER BEFORE LEAVING THE COMPUTER.