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How Schizophrenia Affects a Child's Developing Brain

Astyn Farrell

Research Scholars Program, Harvard Student Agencies, In collaboration with Learn with Leaders

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ABSTRACT

Even though schizophrenia affects less than 1% of the global population, it has serious consequences that affect nearly every aspect of those who live with it, resulting in lower educational performance, poorer social relationships, and reduced quality of life (QOL). Through studies comparing the brains of individuals diagnosed with schizophrenia with those who are not, it was found that individuals diagnosed with early-onset schizophrenia (EOS) show impairments of medium to large effect size to their IQ, attention, memory, and executive function. Deeper research of confirmed schizophrenia cases would greatly improve the collective understanding of this disorder.

Keywords: Schizophrenia, memory, hallucinations.

Subject: Psychology

INTRODUCTION

Schizophrenia is a brain disorder that affects less than one percent of the global population (Public Health Agency of Canada, 2020; Schizophrenia, 2022b). For those who live with schizophrenia, however, the diagnosis comes with serious consequences that affect nearly every aspect of their lives. It is a severely debilitating brain disorder that alters the way a person thinks, feels, and behaves, as it affects the way in which a person perceives or understands reality (Schizophrenia, 2022a). This can result in unwanted behaviors that affect a person's relationships, ability to work and contribute to society, as well as their overall quality of life (QOL). It has been found that as early-onset schizophrenia (EOS) progresses, it increasingly shares clinical features with adult-onset schizophrenia (AOS) including hallucinations, delusions, and paranoia. It has also been found that EOS is often more severe and disabling than AOS, resulting in lower educational performance, poorer social relationships, and reduced QOL (Slomiak et al., 2017).

MATERIALS AND METHODS

Extensive secondary research was undertaken to assimilate various results of studies on schizophrenia. Significant research has been conducted to investigate risk factors for AOS. Studies comparing the brains of individuals diagnosed with schizophrenia with those who are not were reviewed, and results were analyzed.

DISCUSSION AND RESULTS

Schizophrenia is often diagnosed only after an individual's first psychotic episode, typically occurring in late adolescence and before the age of 30 (Schizophrenia, 2022a). Despite EOS being rare, affecting only 0.4% of youth under age 18, it has been diagnosed in children younger than 13 (Childhood Schizophrenia: Causes, Symptoms, Diagnosis & Treatment, 2019; Schizophrenia, 2022a). This indicates that schizophrenia may be affecting an individual's developing brain for years before symptoms are present. EOS is often misdiagnosed as a pervasive developmental disorder before the child develops psychosis (Schizophrenia, 2022a). This suggests that the developing brain is undergoing significant changes as compared with youth who are never diagnosed with schizophrenia. A healthy individual's brain goes through a number of key periods of growth, including a significant one during late childhood and early adolescence, approximately around age 1-10 (Mills &Anandakumar, 2020). Prior to exhibiting symptoms of schizophrenia, EOS is characterized by delayed milestones in all domains, including both gross and fine motor skills,

speech production and comprehension, emotion regulation, as well as social and cognitive development (Slomiak et al., 2017).

Frangou (2009) noted that compared to healthy children and adolescents, individuals diagnosed with EOS show impairments of medium to large effect in relation to their IQ, attention, memory, and executive function. This means that they have difficulty assessing and responding to people or situations. Despite increased clinical severity, the cognitive profile of EOS patients is comparable to that of AOS patients. Healthy adolescents show age-related improvement in their ability to perform tests of attention, memory, and executive function. Such improvements are not noted in EOS patients, resulting in increased age-related deviance in their performance compared to their peers. This apparent decline is mostly attributable to patients' failure to acquire new information and to use more sophisticated cognitive strategies (Frangou, 2009).

Schizophrenia is most frequently diagnosed only after an individual has experienced a psychotic episode that has been significant enough to negatively affect their life. This most commonly occurs between the ages of 16-30 (Schizophrenia, 2022a) and tends to be diagnosed in more males than females (*"Are Males More Likely than Females to Develop Schizophrenia?"* 1992). Prior to an individual's first episode of psychosis, research has found that there are gradual changes to their thinking, mood, and social functioning (Schizophrenia, 2022a).

According to the National Institute of Mental Health (Schizophrenia. (2022a), one of the most severe and widely-recognized symptoms of schizophrenia ispsychosis. This is when a person is disconnected from reality and is often experienced as hallucinations or delusions, which frequently manifest as thoughts, feelings, impulses, or actions that are unwanted and uncontrollable (Schizophrenia, 2022a). Those who live with Schizophrenia often experience significant trouble with memory, attention, and problem-solving skills (Schizophrenia, 2022b). These can result in unwanted behaviors that affect a person's relationships, ability to work and contribute to society, as well as their overall QOL.

The human brain is a highly complex organ. It requires neurons, or brain cells, to grow and connect with one another. By working together or creating circuits, neurons are responsible for every aspect of life, from controlling breathing and movement to emotion regulation and learning (*What Is a Neuron?*,2019). Any brain disorder that develops during childhood or adolescence may interrupt the key processes taking place in this vital organ.

Schizophrenia has been found to correlate with specific physical changes in the brain, including a structural loss in grey matter (GM). GM is made up of neurons and is essential to human life. Neurons are responsible for sending and receiving messages related to emotion control and movement, as well as memory creation, storage, and retrieval (*What Is a Neuron?*,2019). Studies comparing the brains of individuals diagnosed with schizophrenia with those who are not show that the former demonstrates a greater loss of GM in the frontal lobe and the left frontal lobe's cerebrospinal fluid (CSF) (Arango et al., 2007). The frontal lobe is responsible for key functions, including voluntary movement and various cognitive skills, such as planning, organizing, and self-monitoring (Queensland Health, 2013). Such functions are essential for individuals to successfully engage in daily pursuits, including learning, relationships, and self-actualization.

CSF is essential

For healthy brain function, as it provides nutrients, removes waste, and protects the brain (Cerebrospinal Fluid Anatomy, 2022). According to Arango et al. (2007), an accelerated loss of GM has been observed in the prefrontal, supplementary motor, sensorimotor, and temporal cortices of individuals diagnosed with EOS. Changes in the total GM and left parietal GM, which is responsible for speech production and comprehension, were also significantly different between test subjects and controls (Arango et al, 2007; DeLisi et al., 2006). Note that changes in GM likely occur before the onset of clinical symptoms in cortical regions, particularly the areas involved with language processing. This means that well before symptoms of schizophrenia are present in an individual, their brain is already experiencing an atypical loss of essential brain cells, which is a cause for concern.

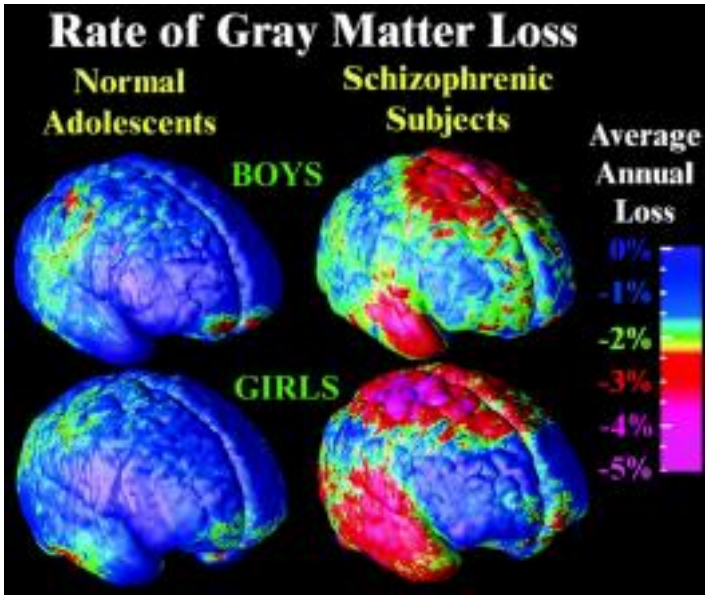

Figure 1: Magnetic Resonance Image (MRI) showing grey matter loss in the frontal, parietal, and temporal regions of the brain in both males and females diagnosed with EOS. (Thompson et al., 2001)

Progressive losses of cortical GM and increases in ventricular volumes, which is the amount of blood being pumped through veins have been reported in a group of EOS patients during adolescence (Edmiston et al., 2011). Studies show brain differences between individuals diagnosed with schizophrenia and those who are not, including temporal lobe volume reductions which impact the encoding of memories, and anomalies of the superior temporal gyrus, which is responsible for language and social cognition, as well as temporal and frontal lobe white matter connections (Arango et al., 2007). White matter, which refers to the myelinated axons that extend from neurons into deeper regions of the brain, is essential for the successful sending of messages between neurons (*Learn Science at Scitable*, 2010). Therefore, any interruption of this critical process changes an individual's ability to think, learn, and interact.

Research also found that individuals with schizophrenia have a smaller than average cranial size. This is particularly important as cranial development is completed within the first few years of life (Andreasen et al., 2013). Thus, smaller than the average cranial size would suggest that schizophrenia is already impacting an individual by age three. 3-dimensional maps of the brain show cortical wave loss in adolescents with EOS (Arango et al., 2007). Findings support a strong association between reduced parietal grey matter volume and expression of psychosis (Burke et al., 2008). It is important to note that greater left frontal GM volume loss was related to more weeks of hospitalization, whereas the severity of negative symptoms correlated with CSF increase in patients with schizophrenia (Arango et al., 2007). For young people who are already dependent on the creation and maintenance of personal connections, and more particularly for those who struggle with this, extended periods of hospitalization are likely to have a negative impact on an individual's ability to make and keep friends.

Individuals with schizophrenia are 2-3 times more likely to die early than the general population due to physical illnesses, including cardiovascular, metabolic, and infectious diseases. People with schizophrenia also often experience human rights violations due to stigma, which contributes to discrimination, which in turn can limit access to general health care, education, housing, and employment (Schizophrenia, 2022b). These are significant consequences to face for being affected by a brain disorder that, according to current research, one has no means of preventing.

As a diagnosis of schizophrenia is a cause for concern at any age, diagnosing it as early as possible could have far-reaching implications for improving a person's QOL. Regardless of the age of diagnosis, people who live with schizophrenia are found to experience trouble with memory and attention, as well as problem-solving (Schizophrenia, 2022b).

With much still unknown about EOS, many clinicians are hesitant to make this diagnosis and it takes an average of two years from the onset of symptoms to a diagnosis (Slomiak et al., 2017). This is partly due to it being difficult to attribute hallucinations to a pathological process when approximately 8% of children experience non-pathological hallucinations, such as having imaginary friends (Childhood Schizophrenia: Causes, Symptoms, Diagnosis & Treatment, 2019). More

research regarding the factors supporting a diagnosis of EOS must be done in order to improve the futures of all individuals who live with schizophrenia.

CONCLUSIONS

It can be concluded that once a diagnosis of schizophrenia has been made, there are limited options for treating the individual so diagnosed. Psychotherapy and the use of medication, particularly antipsychotic drugs, are the main treatment options used. There is considerable controversy existing regarding the use of antipsychotics in children due to the limited data on safety and efficacy (Vyas &Gogtay, 2012). It has been found that in general, the higher the antipsychotic medication doses, the greater the loss of brain tissue (Whiteman, 2015). It is particularly concerning that using medication to treat EOS may improve a child's symptoms while negatively affecting their brain's growth and development.

EOS has a significant negative impact on an individual and more research is required to better understand the short and long-term effects this disorder has on the developing brain. Additional research should be conducted on how to treat EOS as well. Due to a lack of research regarding the safety and effect of antipsychotics in children, there is uncertainty regarding how they may impact a developing brain.

Given the scarcity of schizophrenia diagnoses in childhood, conducting additional research on confirmed cases of EOS focusing on the positive symptoms of schizophrenia, such as hallucinations and delusions, and negative symptoms, such as memory loss, would improve understanding of what is happening in the brain at such a key stage of development. This could, in time, lead to improved approaches for supporting those living with this disorder. From the research available, it is clear that not enough is currently known regarding risk factors associated with schizophrenia, nor is there adequate information about preventative measures that might mitigate the most severe symptoms or outcomes associated with this disorder. Furthermore, research needs to be conducted into the best ways to treat EOS, whether through psychotherapy, antipsychotic medications, or a combination of both, before an individual suffers irreversible brain changes that may negatively impact their QOL.

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