

Cognitive functioning and academic achievement in children and adolescents with Sickle Cell Anemia -A meta-analysis-

الأداء المعرفي والأكاديمي لدى الأطفال والمراهقين المصابين بفقر الدم المنجلي المزمن -دراسة تحليلية -.

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Abstract :

ملخص :

The current study aims to establish whether sickle cell disease (SCD) affects cognitive functioning and academic achievement in children and adolescents by analyzing previous research related to this subject. I conducted a meta-analysis of 15 studies on cognition and academic performance in SCD. Methodological factors were evaluated according to the size and frequency of group differences. There were small but reliable decrements in cognitive functioning on IQ measures. The most methodologically rigorous studies showed a highly similar pattern. Sampling issues associated with the effect size for IQ were identified. Measures of specific abilities appear more sensitive than IQ scores to cognitive decrements in SCD.

In conclusion, SCD is associated with cognitive and academic effects even in the absence of cerebral infarction. The causes of this cognitive and academic decrement may include direct effects of SCD on brain function or indirect effects of chronic illness.

Keywords: sickle cell disease, cognitive functioning, academic achievement, child and adolescent, meta-analysis.

تهدف الدراسة الحالية الى تحليل نتائج البحوث السابقة التي تناولت الأداء المعرفي والأكاديمي للأطفال والمراهقين المصابين بفقر الدم المزمن باستخدام المنهج الوصفي بأسلوب تحليل المحتوى. ولهذا الغرض قامت الطالبة الباحثة بانتقاء 15 دراسة وذلك بالاعتماد على عدة معايير، منها على سبيل المثال لا الحصر متغيرات الدراسة، الأدوات المستخدمة، وعينة الدراسة. ومن ثم تحليل محتوى هذه الدراسات، والخروج في الأخير باستنتاجات ودلائل يمكن تعميمها والاعتماد عليها لفهم دقيق لهذه الأداءات لدى هذه الشريحة من الأطفال. وافضت نتائج الدراسة الى ان أكثر البحوث دقة من الناحية المنهجية والاحصائية أثبتت تأثير الذكاء لدى الأطفال المتدربين المصابين بفقر الدم المزمن في حين تتأثر باقي العمليات المعرفية بشكل أكبر، ومن هنا يتضح ارتباط الإصابة بفقر الدم المزمن بالاختلالات في العمليات المعرفية لدى هذه الفئة من الأطفال. وفي ضوء هذه النتائج أوصت الدراسة بعدة توصيات من أهمها، دعوة المهتمين بالبحث في المجال النفسي العصبي والمعرفي للاهتمام بالاختلالات العصبية المعرفية الناتجة عن عديد الأمراض المزمنة عامة وعن فقر الدم الوراثي خاصة.

الكلمات المفتاحية: فقر الدم المنجلي المزمن، الطفل والمراهق، الأداء المعرفي، الأداء الأكاديمي، دراسة تحليلية.

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1. Introduction:

Over the years, sickle cell anemia has emerged as a significant global healthcare concern. Annually, experts estimate that at least 300,000 infants are born with the mentioned condition, and the number is projected to increase to 400,000 by 2050 (Piel et al. 1561). Fortunately, new technologies have allowed medical professionals to make an early diagnosis and decide the best set of action to protect children and manage the condition (Piel et al. 1561). New treatment approaches have enabled researchers to identify genetic and non-genetic strategies that can be used to improve the quality of life of individuals that have sickle cell anemia. Sadly, the condition does not have a cure; hence, it is a life-long struggle for many people.

According to Obeagu et al. (2015), individuals suffering from sickle cell anemia have a life expectancy of about 48 years (females) and 42 years (males). Mainly, the condition has been found to affect people from the sub-tropical and tropical regions. In most developed nations, for instance, the U.S, the prevalence of sickle cell anemia is small, and it is estimated to affect 1 in every 5,000 Americans (Obeagu et al. 2015). Different complications, related to the condition, such as stroke can affect individuals' cognition and affect their ability to excel in academics and other daily activities (Day and Elisabeth 330). In brief, sickle cell anemia is a severe global healthcare problem that has continued to affect the lives of millions across the world.

The main purpose of this research is to conduct a systematic review and meta-analysis of different research papers. The research articles that will be included will be in the subject of sickle cell anemia and cognition. The research summary and review will enable one to answer the key research question that has been generated in this area.

2. Research Question:

The review aims to assess the achievements and advancements that have been made by scientists in the management of sickle cell anemia in the last 20 years. In addition, the findings will be evaluated to understand how they pertain to the cognition as well as the treatment of the condition. Based on this, the researcher will critically analyze different research articles that have been written on the identified topic.

3. Method:

3.1. Recognition of Earlier Data:

The research articles were sourced from reputable databases such as MEDLINE/PUBMED. All the sources were authentic and peer-reviewed and keywords, for example, "Academic Achievement," "Sickle Cell Anemia" and "Cognition" were used to get relevant journal articles.

The data that was collected was comprehensive, and it included children that had sickle cell anemia and other related complications, for instance, stroke. All the 15 selected articles meet the inclusion criteria and were used in the meta-analysis as illustrated in -Table 1-.

3.2. The Inclusion Criteria:

All the studies had to meet the following criteria:

- a) Involved children that had been diagnosed with sickle cell disease (SDC)
- b) Whose ages varied from 6 to 12 years
- c) Are receiving primary education in various learning institutions
- d) Studies involved "IQ" data.

3.3. Tabulation Findings:

Table-1-: Selected studies included in the meta-analysis

The table below presents the summaries of the 15 peer-reviewed articles that were selected for this meta-analysis.

Autor(s)	Aims	Methodology	Findings	Implications
Crosby et al.	The research study highlighted the neuropsychological complications that are associated with SCD.	Adolescents, in various learning institutions, were involved in the study and questionnaires were used to collect the relevant data. Academic performance was evaluated, and the results were used to make the overall conclusions.	The results illustrated that SCD interfered with the learners' ability to capitalise on different educational strategies. Young people suffering from SCD must be supported and personalized education ought to be provided to improve performance.	The findings highlight the need for institutions to find suitable student-centred learning approaches that can boost their academic performance.
Day and Elisabeth	The study was aimed at examining the academic and cognitive impact of SCD on students across the United States.	The study reviewed various research articles that had been written in the area of SCD.	The researchers indicated that the most common complications, which are associated with SCD, are cognitive impairment, silent cerebral infarction, and strokes. The incidents of the mentioned issues are evident in children and affect their lives.	Children with SCD should be assisted by learning institutions and should be supported to ensure that they attain their academic goals. The outcomes show that schools can improve the lives of children that perform poorly due to SCD and its related complications. More research is required to understand the importance of technology in achieving this objective.
Schatz et al.	The research had a key objective of establishing if SCD affected children cognitive abilities even without the	This was a meta-analysis, and a total of 18 studies were reviewed. Children with SCD were compared with	SCD affects individuals' cognitive abilities, and this occurs even when cerebral infarction is not present. The main	The research indicates that it is possible for children to experience a decrement of

	occurrence of cerebral infarction.	others in the control groups and from this data, suitable outcomes were generated.	reasons for cognitive decrement can include the negative impact of the condition on the brain and, the longevity of the illness.	their cognitive abilities due to SCD. Indeed, more research must be carried out that will involve experimental and longitudinal designs.
Ruffieux et al.	The study had an overall aim of assessing cognitive deficits, among children with SCD, and their biological predicting factors.	Neuropsychological tests were used in evaluating the selected participants, and the approach assessed four main cognitive areas which include sensory-motor, memory, attention, and executive function skills.	The findings indicated that most children with SCD have cognitive deficits and the problems tend to increase as they become older.	Scientists must evaluate various approaches that can be used to limit cognitive deficits as children grow older.
Steen et al.	The purpose of the study was to evaluate if SCD is associated with MR imaging abnormalities and low haematocrit.	Children in different learning institutions, without a history of clinical stroke, were examined in this study.	Imaging abnormalities and low haematocrit result in cognitive impairment, and this affects young people intelligence quotient.	Further studies must be done in the area of chronic brain hypoxia and how the condition affects cognitive impairment among SCD patients.
Oluwole et al.	The study aimed to evaluate whether children with SCD have low cognitive capabilities when compared with others.	Cross-sectional surveys were conducted, and they involved children with SCD and others without the condition.	Children with SCD perform poorly due to low IQ and cognitive impairment.	SCD patients have cognitive difficulties, and the mentioned issues must be addressed to improve their ability to participate in social and economic activities.
Colombatti et al.	The study intended to reveal the causes of poor cognitive performances among children with SCD.	Children with SCD were involved in this cross-sectional study, and they were assessed for at least four months.	The outcomes revealed that SCD is associated with poor cognitive performance and improvements can be attained by closely monitoring young	Professionals must improve the use of fMRI in order to make sure that children with SCD have better

			people with SCD.	cognitive performance.
Al-Saqladi	The aim of this research study was to assess the impact of SCD on children, especially, in relations to academic performance and absenteeism.	Children with SCD were involved, and data about academic achievement, grade retention, and school attendance was collected.	The findings indicate that SCD increases the chances of cognitive impairment and this is cited as the main reason for poor academic performance and absenteeism.	Learning institutions must consider new measures that can be taken to assist learners suffering from SCD to improve learning and academic performance.
Swanson et al.	The aim of the literature review was to illustrate the difficulties experienced by children with SCD. The condition has been found to affect various organs including the brain.	The research involved an analysis of various trends and advancements in the field of SCD and its management.	SCD is associated with the impairment of body organs, and it can affect individuals' cognitive functions including language acquisition.	The findings highlight the importance of understanding major complications that can occur due to SCD and how affected individuals can be assisted.
Lughetti et al.	The primary purpose of the study was to provide key insights that can allow people to manage SCD during childhood.	The review evaluated trends and new approaches that are being adopted in the management of SCD.	The findings affirmed that HU treatment strategies are largely underutilized and other issues, for example, lack of matching donors have affected the management of SCD.	Further research must be done on how HU can be utilized in various regions. Comprehensive care ought to be provided in both developed and developing nations to improve the lives of children with SCD.
King et al.	The researchers intended to illustrate the need for cognitive rehabilitation, especially, for children with SCD and strokes.	A review of different studies that had been done on cognitive rehabilitation and how this can help children with SCD.	The outcomes highlighted the possibility of managing SCD and preventing children from having devastating strokes.	Experts must continue collecting data and monitoring children with SCD to provide personalized education and assistance in various institutions.
Colombatti et al.	The study aimed to establish the	The study reviewed past studies to	The findings illustrated the essence of	Healthcare officials and

	relationship between cerebrovascular complications and how they affect cognitive functions in children with SCD.	illustrate the progress made in the management of SCD from a global perspective.	managing various complications associated with SCD and how the approaches can improve the lives of children with SCD.	other stakeholders must increase awareness about SCD and its resultant complications to assist individuals suffering from the condition.
Hildenbrand et al.	The study aimed at evaluating the coping mechanisms employed by parents and children in coping with SCD.	The quantitative study involved 15 parents and 15 children who had SCD, and the two groups were assessed in relations to their coping abilities.	The findings illustrated that SCD could increase stressors and this can affect how individuals live.	Experts must increase awareness about various strategies that can be adapted to assist patients with SCD to cope with the condition.
Schatz and Carla	The purpose of the research was to evaluate short-term memory capabilities among children with SCD.	A total of 50 children were involved in the study, and half of them had SCD while the rest did not have the condition.	The outcomes established that SCD affects the short-term memory and this increases the cognitive deficit of such individuals.	Further research can be done to reveal the cause of short-term memory deficits among children with SCD.
Puffer et al.	The key objective of this study was to highlight the impact of SCD on somatic growth.	The study involved 64 participants who were aged between 4 to 8 years and had SCD.	The findings revealed that children with SCD were at risk of neurocognitive risk due to their low height-for-age when compared to others in the same ages.	Ideally, there is a relationship between cognitive deficits and somatic growth, and this can be explained based on nutritional deficits.

4. Research Gaps and Generalization:

The research findings reveal that different research gaps have not been addressed in the management of SCD and cognition. For instance, it was clear that medical treatment i.e. Hydroxyurea (Hydroxycarbamide HU) approaches have been underutilized in various regions across the world. In addition, few researchers have delved into the issue of nutritional deficits and how this affects the somatic growth of children with SCD.

Besides this, many strategies have been generalized, and as a result, they fail to tackle key issues facing children. Parents and other stakeholders must be notified of the most suitable therapies and learning approaches that can be effective in enlightening their children. Teachers and administrators must create personalized learning environments that would ensure that children with SCD attain high academic performance and do not fail to attend school.

Despite the medical solutions for the physical health of children with SCD, little is known about the clinical impact of this injury on the educational achievement and specific cognitive abilities. The researches included in this paper indicate that children with SCD have specific cognitive deficits, caused by silent brain infarct, typically involving frontal lobes. Silent infarcts are linked to neurocognitive problems. Other studies show that Academic attainment problems and cognitive impairment also occurs in the absence of brain infarction, with suggestion that this neurological deficit might be partly attributable to anemia and nutritional deficits in SCD.

And when children with SCD have obvious clinical and cognitive deficits, they are typically supported by a multidisciplinary rehabilitation team that often includes a paediatric neurologist, a physical therapist, an occupational therapist, a psychologist and a speech therapist. However, no formal programs, specific projects, or guidelines are established that focuses on cognitive rehabilitation and academic achievement improvement.

Most of studies included in actual research provide evidence of intellectual deficit in children suffers from SCD, but little is known about the manifestation process of those deficits and how they affect the academic performance in this category of childs.

5. CONCLUSION:

In the end, SCD is a global health problem, and all stakeholders must collaborate in tackling the issue to help children and adults living with SCD. Specifically, different research articles have been written on this area and continue to help professionals in their quest to understand the condition and how it can be managed. Notably, parents must be assisted in the management of SCD to reduce the stress that can go on and affect their children. Overall, people must comprehend that SCD has an impact on individuals' cognitive abilities and this affect academic performance and other general learning activities.

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