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IMPACT OF CONGENITAL HEART DISEASE ON THE COGNITIVE AND PSYCHOLOGICAL DEVELOPMENT OF CHILDREN AT DIFFERENT STAGES OF CHILDHOOD

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Abstract: INTRODUCTION: Congenital heart disease (CHD) affects 1% to 2% of live births and impacts children's cognitive and psychological development. This review addresses the importance of early interventions, multidisciplinary support, and public policies focused on the health of these children. METHODOLOGY: This systematic review follows PRISMA guidelines and aims to identify the challenges and implications of congenital heart disease on children's cognitive and psychological development. Ten studies were selected from 87 initial results, with qualitative and quantitative analysis to highlight trends and clinical practices. RESULTS: CHD increases the risk of neurodevelopmental disorders in children, such as learning difficulties and behavioral problems. Early intervention and family support are essential to improve development. CONCLUSION: The impact of CHD on children's cognitive and psychological development requires continuous clinical and social attention. Early intervention, regular monitoring and psychosocial support are essential to promote development and improve the quality of life of these children.
Keywords: Congenital Heart Disease, Cognitive Development, Early Intervention, Children.

INTRODUCTION

Congenital heart disease (CHD) represents a major challenge for children's health, not only in terms of clinical treatment, but also in relation to the impact it has on children's cognitive and psychological development. This discussion becomes even more relevant when we consider the high prevalence of CHD, which affects between 1% and 2% of live births worldwide, as well as the frequent association with other conditions, such as Down's syndrome. Due to structural alterations in the heart, children with CHD often present additional difficulties in neuropsychological development and can face significant challenges in learning, behavior and social interaction. This panorama is aggravated by episodes of hypoxia, multiple surgical interventions and the continuous stress related to treatment, factors that affect not only the child, but also the family environment.[1,10]

In this review, we will explore how CHD influences children's cognitive and psychological development, the importance of early interventions and the need for integrated, multidisciplinary support that includes both medical and socio-emotional aspects. We will also address the importance of long-term follow-up and neonatal screening to ensure rapid and effective interventions, as well as the role of neuroplasticity in these children's ability to adapt and recover. Finally, we will analyze how the socioeconomic vulnerability of families impacts access to health services and the overall development of children with CHD, highlighting the importance of public policies focused on continuous and comprehensive support.[2,3]

METHODOLOGY

This systematic review on the impact of congenital heart disease on the cognitive and psychological development of children was prepared in accordance with the guidelines of the Statement of Main Items for Reporting Systematic Reviews and Meta-analyses (PRISMA). The aim is to identify the challenges related to these conditions and their implications for children's health. The inclusion criteria for the studies to be reviewed include: (1) studies that address the impact of congenital heart disease on cognitive and psychological development; (2) articles published in peer-reviewed journals in the last 14 years; and (3) publications in Portuguese, English or Spanish, ensuring broad comprehension and accessibility. On the other hand, the exclusion criteria include: (1) articles that do not directly

address the topic of congenital heart disease, ensuring the relevance of the analysis; (2) qualitative or quantitative studies that do not answer the guiding questions; (3) academic documents not published in journals; and (4) duplicate articles, in order to avoid redundancies in the analysis. The systematic literature search was carried out in electronic databases such as PubMed and Google Scholar. Standardized descriptors and a combination of keywords were used, including "Congenital Heart Disease", "Cognitive Development", "Early Intervention" and "Children", adjusting the strategy as necessary for each database. The search was carried out in Portuguese, English and Spanish. A total of 87 results were identified (figure 1), of which 10 were included in the review (table 1) after a rigorous inclusion and exclusion process. The analysis of the data collected included both qualitative and quantitative syntheses, depending on the nature of the studies included. For studies with homogeneous results, a meta-analysis was carried out, allowing the data to be statistically combined. For those with heterogeneous results, a narrative synthesis was chosen, highlighting the main trends and patterns observed in the literature. In addition, the implications of the results for clinical practice and future research in the area of child health were discussed, with special attention to the management of children with congenital heart disease and emphasizing the knowledge gaps that still need to be addressed.

RESULTS

The results reveal a number of significant implications related to the neuropsychological development of children affected by congenital heart disease (CHD). The analysis of data collected from various sources and studies shows that CHD is associated with an increased risk of neurodevelopmental disorders, including learning difficulties, behavioral problems and anxiety and depression disorders. In particular, children with CHD show lower rates of mental development compared to children without these conditions, highlighting the need for early interventions and ongoing support.[4,7]

In addition, the study highlights the importance of socioeconomic background and family support in the development of these children. Families with limited resources often face additional challenges that can exacerbate psychological stress and negatively impact the child's developmental environment. The research also suggests that early intervention, including stimulation programs and psychological support, can significantly improve developmental outcomes, demonstrating that a multidisciplinary approach is essential to meet the complex needs of these children.[7]

The data also indicates that the prevalence of CHD is particularly high in children with Down syndrome, where the incidence of congenital heart disease ranges from 40% to 60%. This association not only increases the complexity of clinical management, but also implies a high risk of complications in cognitive and emotional development, requiring close monitoring and targeted interventions. The literature reviewed suggests that early identification and appropriate treatment of CHD are fundamental to mitigating the adverse effects on child development, highlighting the importance of public health policies that prioritize screening and support for these children and their families. [2, 4, 7]

Finally, the article's findings emphasize the need for further research to better understand the underlying mechanisms linking CHD to cognitive and psychological development. Collaboration between health professionals, educators and psychologists is crucial to develop effective strategies that meet the needs of these children and promote healthy, holistic development. The implementation of educa-

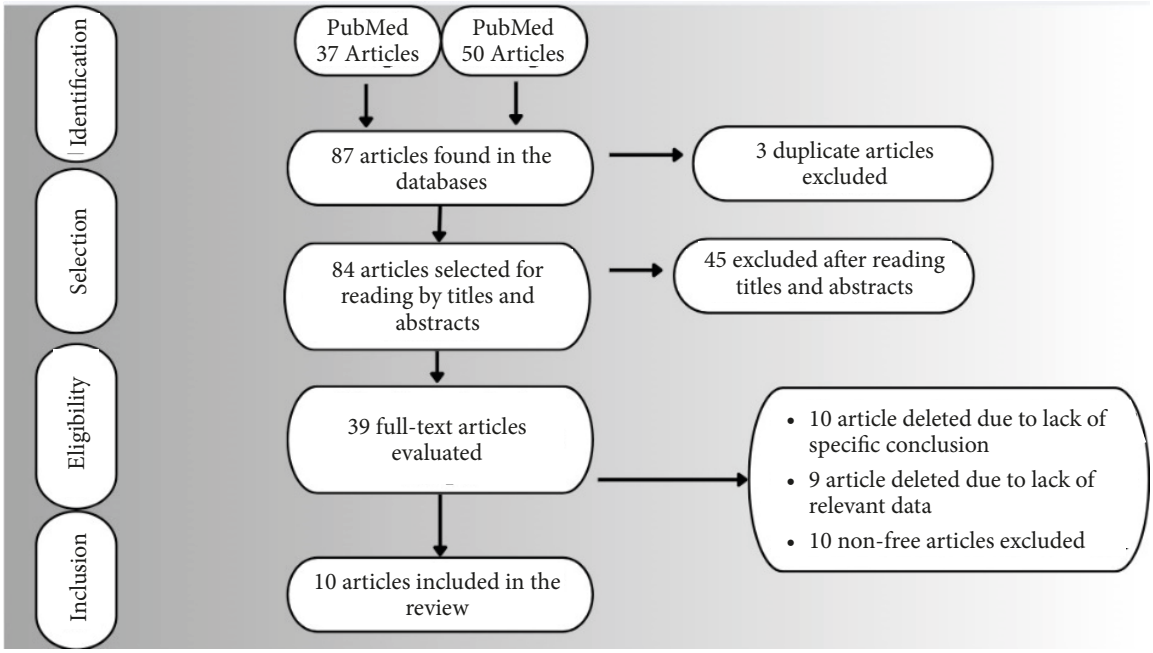

Figure 1. Flowchart of the articles included in this review.

Source: the authors.

	Author	Type of study	Objective	Results
1	LIU, Y et al.	Meta-analysis	Determine the global prevalence of congenital heart disease and assess prevalence trends	The prevalence of congenital heart disease increased from 1970 to 2017, mainly due to better post-natal detection of mild lesions.
2	LINHARES, I et al.	Integrative and experimental literature review	Emphasize the importance of early diagnosis of congenital heart disease in order to define the appropriate treatment and increase the likelihood of successful care for the neonate.	Early diagnosis of congenital heart disease is essential for determining prognosis and appropriate treatment. Fetal echocardiography is the most effective test, with an accuracy of 97.7%, specificity of 88.9% and accuracy of 93%.
3	MARI, M et al.	Original article	To evaluate child development and assess a possible association with impairment due to biopsychosocial factors in children with and without congenital heart disease.	Children with heart disease had more developmental problems, while 53.6% of healthy children had normal development.
4	MENDES, S. F. G. et al.	Systematic review	To identify neurological abnormalities in newborns with congenital heart disease before surgery and to explore the causes of altered neurocognitive outcome.	More than half of newborns with neurological abnormalities have white matter lesions and brain immaturity, similar to the effects of premature birth.
5	MORTON, P. D. et al.	Systematic review	Determine the causes of altered brain maturation in congenital heart disease and improve neurological function.	Children with congenital heart disease have worse neurological outcomes in the long term, with altered brain development in the fetal period being the main cause.
6	NUSWIL BERNOLIAN et al.	Original article	Explore congenital heart disease, its pathophysiology and ultrasound findings.	Congenital heart defects affect 1.35 million children a year, with 57.9% of cases involving interventricular, interatrial and interatrioventricular communications. Ultrasound screening can increase detection to 80%.
7	PANCERI, C. et al.	Original article	To evaluate the impact of cognitive-motor intervention on the motor and cognitive development of babies hospitalized for respiratory diseases.	The intervention resulted in significant improvements in the babies' motor and cognitive scores, unlike the control group.

8	KASPARIAN, N. A. et al.	Systematic review	To evaluate the effectiveness and cost-effectiveness of mental health interventions for parents of infants with CHD in intensive care units, and to develop recommendations for health policies and practices.	Five trials showed that the interventions reduced maternal anxiety and improved mother--baby attachment and parental satisfaction, but there was insufficient evidence on quality of life and cost-effectiveness.
9	KATARZYNA ZYCH--KREKORA et al.	Systematic review	Summarize the influence of congenital heart disease on psychological and economic areas, highlighting the need for a holistic approach.	CHDs are the most common cause of birth defects, resulting in high morbidity and significant economic impact. Comprehensive care and psychological support are essential for the well-being of children and families.
10	KIM, M.A. et al.	Original article	To investigate the frequency and types of CHD in infants with Downs Syndrome (DS) in Korea.	The prevalence of CHD in babies with DS was 56.9%, with atrial septal defects being the most common.

Table 1. Systematization table of the articles included in this review.

Source: the authors.

tion and support programs for parents and caregivers is also essential to create an environment conducive to development, considering that the stress and mental health of caregivers have a direct impact on the child.[2]

DISCUSSION

The impact of congenital heart disease (CHD) on the cognitive and psychological development of children is a topic of growing relevance in medical literature, especially considering the high prevalence of these conditions in pediatric populations. CHDs, which include a variety of structural heart anomalies, are recognized as the most common congenital malformations, affecting approximately 1% to 2% of live births worldwide. The association between CHD and conditions such as Down syndrome (DS) is particularly significant, since studies show that between 40% and 60% of children with DS have CHD, which increases the complexity of the clinical management and development of these children.[1, 10]

The literature suggests that CHD not only affects physical health, but also has profound implications for the neuropsychological development of affected children. For example, an observational study revealed that children with CHD have a higher incidence of neurodevelopmental abnormalities, including learning difficulties and behavioral problems. These difficulties can be attributed to a combination of factors, including oxygen deprivation during episodes of cyanosis, early surgical interventions and the psychological stress associated with ongoing treatment. In addition, the presence of CHD can lead to an increased risk of anxiety disorders and depression in parents and caregivers, which in turn can impact the child's emotional and psychological environment.[5]

Early intervention is key to mitigating the adverse effects of CHD on cognitive development. Research indicates that psychological support and education for parents are essential for improving the mental health and developmental outcomes of affected children. Follow-up programs that include regular developmental assessments and therapeutic interventions can help identify and treat developmental problems more effectively. For example, the implementation of early stimulation programs has shown promising results in improving cognitive and social skills in children with CHD. [3, 9]

Furthermore, the relationship between CHD and socioeconomic factors cannot be ignored. Studies show that families of children with CHD often face significant financial challenges due to the costs associated with medical treatment, which can exacerbate psychological stress and affect family dynamics. Lack of resources can limit access to mental

health services and educational interventions, creating a vicious cycle that further impairs the child's development. It is therefore crucial that public health policies consider these factors when developing support programs for families affected by CHD. [8, 9]

The variability in the clinical presentations of CHD also suggests that the impact on development can differ significantly between individuals. For example, children with simple heart defects may have a more favorable prognosis compared to those with complex malformations that require multiple surgeries and intensive care. This diversity in results highlights the need for personalized approaches in the management of children with CHD, taking into account not only the medical conditions, but also the psychological and social factors that can influence development. [3, 5]

In addition, research into neuroplasticity suggests that children have a remarkable capacity for adaptation and recovery, which can be exploited in therapeutic interventions. Neuroplasticity is a phenomenon that allows the brain to reorganize and adapt to new experiences, and early interventions can potentially stimulate this process in children with CHD. Programs that promote social interaction and playful learning can be particularly effective in fostering cognitive and emotional development in affected children.[3, 5]

The importance of early detection and treatment of CHD cannot be underestimated. Newborn screening for CHD has proven effective in identifying conditions that can be treated before they cause significant developmental damage. Early identification allows for surgical and therapeutic interventions that can significantly improve children's quality of life and developmental outcomes. In addition, educating parents about the warning signs and the importance of regular follow-up can facilitate early detection of developmental problems. [5,6]

Finally, ongoing research into the relationship between CCD and cognitive and psychological development is vital to inform clinical practice and health policy. Future studies should focus on identifying the underlying mechanisms linking CHD to developmental deficits, as well as evaluating the effectiveness of specific interventions. Collaboration between pediatricians, cardiologists, psychologists and educators will be essential to develop integrated approaches that meet the complex needs of these children and their families.[5]

CONCLUSION

In conclusion, the impact of congenital heart disease (CHD) on children's cognitive and psychological development is a complex issue that requires ongoing clinical and social attention. The combination of factors such as oxygen flow restrictions, surgical interventions and the psychological stress associated with treatment directly influences children's neuropsychological development, often amplifying learning and behavioral challenges. Given the importance of early intervention, regular monitoring and psychosocial support are essential to promote the development of these children and improve their quality of life.

The integration of medical, psychological and social care, together with family support programs and interventions based on neuroplasticity, has shown promise in mitigating the adverse effects of CHD. In addition, the implementation of public policies that take into account the socioeconomic conditions of families is fundamental to guaranteeing access to mental health services and educational programs, with a view to integral development. Future research is needed to improve intervention strategies and provide these children with a more inclusive and healthy future, reaffirming the importance of an interdisciplinary and individualized approach.

REFERENCES

LIU, Y.; CHEN, S.; ZÜHLKE, L.; et al. Global birth prevalence of congenital heart defects 1970-2017: updated systematic review and meta-analysis of 260 studies. **International Journal of Epidemiology**, v. 48, n. 2, p. 455–463, 2019. Oxford University Press.

LINHARES, I. C.; GONÇALVES, M. H.; PINTO, P. M.; et al. Importância do diagnóstico precoce das cardiopatias congênitas: uma revisão integrativa. **Revista Eletrônica Acervo Científico**, v. 35, p. e8621, 2021. Acesso em: 27/12/2021.

MARI, M. A.; CASCUDO, M. M.; ALCHIERI, J. C. Congenital Heart Disease and Impacts on Child Development. **Brazilian Journal of Cardiovascular Surgery**, v. 31, n. 1, 2016. Disponível em: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5062696/>.

MENDES, S. F. G.; CAVALCANTI, L. P. DE M. A.; ALMEIDA, L. B. DE; et al. Desenvolvimento neurológico após correção de cardiopatia congênita no período neonatal. **Research, Society and Development**, v. 11, n. 13, p. e505111335717, 2022. Acesso em: 18/11/2022.

MORTON, P. D.; ISHIBASHI, N.; JONAS, R. A. Neurodevelopmental Abnormalities and Congenital Heart Disease. **Circulation Research**, v. 120, n. 6, p. 960–977, 2017.

NUSWIL BERNOLIAN; RADIYATI UMI PARTAN; SITI NURMAINI; KESTY, C.; BENEDICTUS WICAKSONO WIDODO. Congenital Heart Diseases in Pregnancy. **Bioscientia medicina**, v. 5, n. 4, p. 988–1004, 2021. Acesso em: 8/11/2023.

PANCERI, C.; PEREIRA, K. R. G.; VALENTINI, N. C. A INTERVENÇÃO MOTORA COMO FATOR DE PREVENÇÃO DE ATRASOS NO DESENVOLVIMENTO MOTOR E COGNITIVO DE BEBÊS DURANTE O PERÍODO DE INTERNAÇÃO HOSPITALAR. **Cadernos Brasileiros de Terapia Ocupacional**, v. 25, n. 3, p. 469–479, 2017.

KASPARIAN, N. A.; KAN, J. M.; SOOD, E.; et al. Mental health care for parents of babies with congenital heart disease during intensive care unit admission: Systematic review and statement of best practice. **Early Human Development**, v. 139, p. 104837, 2019. Disponível em: <https://www.sciencedirect.com/science/article/pii/S037837821930475X>.

KATARZYNA ZYCH-KREKORA; OSKAR SYLWESTRZAK; GRZESIAK, M.; MICHAŁ KREKORA. Impact of Prenatal and Postnatal Diagnosis on Parents: Psychosocial and Economic Aspects Related to Congenital Heart Defects in Children. **Journal of clinical medicine**, v. 12, n. 18, p. 5773–5773, 2023. Multidisciplinary Digital Publishing Institute. Disponível em: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10531545/>. Acesso em: 8/5/2024.

KIM, M.-A.; LEE, Y. S.; YEE, N. H.; et al. Prevalence of Congenital Heart Defects Associated with Down Syndrome in Korea. **Journal of Korean Medical Science**, v. 29, n. 11, p. 1544, 2014. Disponível em: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4234923/>. Acesso em: 3/12/2019.