Chapter 6
The Neurocognitive Characteristics of Children With Neurodevelopmental Disabilities and Their Clinical Implications

Kalliopi Megari
https://orcid.org/0000-0002-5861-7199
City College, University of York, Greece & University of Western Macedonia, Greece

Kremena D. Genova
https://orcid.org/0009-0001-5551-8523
New Bulgarian University, Sofia, Bulgaria

ABSTRACT

This literature review focuses on some more or less common neurodevelopmental disabilities and brain abnormalities during childhood and their implication in cognitive functioning. Illuminates the neurocognitive domains, impacted by such disabilities, assesses the degree to which each disability exhibits shared characteristics and connections, analyzes their limitations, and suggests future research methods for the gaps to be further covered. Alterations in brain activity are associated with the development of cognitive skills from infancy through early adolescence. Children diagnosed with various neurodevelopmental disorders exhibit neurocognitive deficits in domains, such as attention, memory, verbal communication, global intelligence, and certain executive functions, whereas their language and visuospatial abilities may differ. Adequate personalized treatment plans and strategies for those affected by such conditions enhance their overall well-being and reduce caregiver distress.

INTRODUCTION

The connection between complex processing and simple everyday processing converges around a function named as: ***neurocognitive function*** (Duarte et al., 2016), which can be defined as a multidimensional function, the ultimate purpose of which is to make sure that an individual is sufficiently functional, and that he or she can respond effectively to stimuli in the environment by eliciting appropriate responses. A

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good example of the above involves mainly cognitive and executive functions (i.e., cognitive flexibility, processing speed, attention, and memory) (Higgins et al., 2018).

It is an undeniable fact that the most important stage in life concerning cognitive development is *childhood* (Carson et al., 2016; Gilmore et al., 2018; Mills et al., 2016). For the purposes of this particular comprehensive literature review, the lifetime period from ***infancy to early teenagehood*** will be closely considered. During this lifetime period, the human brain is the recipient of some dramatic and very powerful alterations, which will eventually contribute to its completion. Some of the various alterations that have been observed and studied extensively by neuroscientists involve the synapses (Carson et al., 2016), which appear to be overproduced and overbranched. This is initially evident in early childhood in the sensory areas of the brain, as an infant starts processing sensory stimuli from the environment (Steiner, 2020).

The importance of childhood in the optimal development of the brain, and in particular the prolonged effectiveness of the neurocognitive functions of an individual has been understood. As a result, the early onset of symptoms of a disability can irreversibly affect the structural and functional development of the brain as well as the child's neurocognitive functioning (Hardy et al., 2017; Hemager et al., 2018; Patel et al., 2016; Ruebner et al., 2016; Ryan et al., 2016). There are different types of disabilities and injuries that can affect the physiology and development of the brain. The ones that will be addressed in this comprehensive literature review are: *Intellectual disability (ID)* (Hronis et al., 2017; Santegoeds et al., 2022; Zagaria et al., 2020), *Autism spectrum disorder (ASD)* (Bal et al., 2022; Mayes et al., 2018; Silleresi et al., 2021; Megari et al., 2024; Megari, Sofologi, et al., 2024; Megari & Smyrli, 2024), *Attention-deficit/hyperactivity disorder (ADHD)* (Areces et al., 2018; Becker et al., 2021; Celeste et al., 2019; Moura et al., 2019; Theodoratou et al., 2024), *Learning disability (LD)* (Castaldi et al., 2020; Toffalini et al., 2017; Sofologi et al., 2022), *Down syndrome (DS)* (Jafri & Harman, 2020; Lott & Dierssen, 2010; Grieco et al., 2015; Lukowski et al., 2019), *Cerebral palsy (CP)* (Fluss & Lidzba, 2020; Gosling, 2017; Stadskleiv, 2020; Stadskleiv et al., 2018), and *Craniosynostosis (CS)* (Kalmar et al., 2022; Kajdic et al., 2017; Stanton et al., 2022).

Nevertheless, deficits in neurocognitive functioning are very often found when a person is affected by a neuropsychological disorder and disability (Geller et al., 2018; Lande et al., 2017; Santegoeds et al., 2022; Testolin & Zorzi, 2016), a mood disorder (Duarte et al., 2016; Merikangas et al., 2017; Yoon et al., 2016), and more generally by physical injuries, such as a traumatic brain injury (TBI) (Beadle et al., 2018; Panwar et al., 2019). That's why, many cognitive impairments that are only witnessed when a child begins school, have been attributed to incomplete sensory stimuli, and to the synapses being pruned because they are left unused (Aboud & Yousafzai, 2016) diseases, such as carcinomas (Jacola et al., 2021; Wu et al., 2020a; Wu et al., 2020b).

Later in life, between middle and late childhood, it extends to higher-level areas, involving mostly executive functions, such as working memory and attention, and plasticity (Dow-Edwards et al., 2019). Plasticity is an intrinsic property that leads to the neuronal alteration of the connections through a process, referred to as ***long-term potentiation (LTP)***; this way, the synapses are much more efficient. Plasticity enhances synaptogenesis and neurogenesis (Skaper et al., 2017). With this process (i.e., the production and pruning of the synapses), the foundations are laid for an effective and intensive cognitive development that will lead to academic and social achievements and skills in the future (Steiner, 2019).

The aim of the present paper is to conduct a comprehensive literature review on the aforementioned disabilities and brain abnormalities during childhood and their implication in cognitive functioning. Faced with a plethora of research, such a review sheds light into the neurocognitive domains affected by