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Attention deficit disorder with or without hyperactivity or impulsivity in children with Down's syndrome

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Abstract

Children with Down's syndrome show a higher prevalence of attention deficit disorder with or without hyperactivity or impulsivity (ADHD) than the rest of the general population. The diagnosis and identification of ADHD is important because it can affect performance at school and cause behavioural disturbances.

This research study has two objectives. First of all, in this review we consider the repercussions that ADHD has on Down's syndrome children. Secondly, we present a systematic analysis of the articles published in the scientific literature relating to the tests used to diagnose ADHD in DS children.

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Trastorno por déficit de atención con o sin hiperactividad en los niños con síndrome de Down

Resumen

Los niños con síndrome de Down tienen una prevalencia más elevada que el resto de población general de presentar trastorno por déficit de atención con o sin hiperactividad o impulsividad (TDAH). El diagnóstico e identificación del TDAH es importante porque puede afectar el rendimiento escolar y causar trastornos de la conducta.

El objetivo de este trabajo es doble. En primer lugar, se considera en esta revisión la repercusión del TDAH en los niños con síndrome de Down. En segundo lugar, se presenta un análisis sistemático de los artículos publicados en la bibliografía científica relativos a los tests utilizados para el diagnóstico de TDAH en niños con síndrome de Down.

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Attention deficit disorder with or without hyperactivity or impulsivity and Down's syndrome

Attention deficit disorder with or without hyperactivity or impulsivity (ADHD) affects approximately 3%-7% of schoolchildren in the general population,¹ whilst in mentally handicapped children this figure is as high as 14.8%² and, in Down's syndrome (DS), it can reach 9%.³ The cardinal symptoms are lack of attention, hyperactivity and impulsivity. The parents of children and adolescents with DS have described more behavioural disturbances and problems related with attention when they compare them with siblings who have shown normal development.⁴ Greater hyperactivity has also been described in DS children from 5-11 years of age when they are compared with a sibling group.⁵

ADHD is a genetic neurobiological disorder. In this disorder, there are functional and anatomical changes in the prefrontal cortex and its connections with the basal nuclei (especially the striate nucleus) and the cerebellum, predominantly involving catecholaminergic pathways and their neurotransmitters, dopamine and noradrenaline.

In a recent study conducted at the University of Cardiff,⁶ it was demonstrated that children with ADHD exhibit a greater number of DNA deletions or duplications, which are known as copy number variations (CNV), in comparison with children who do not have this syndrome. CNV cause the genes which are found in affected regions to be more or less active than they ought to be, leading to the production of excessive or insufficient amounts of the proteins which they code for. It has been postulated that, depending on the genes affected, children with ADHD will manifest one or other subtype of the disorder and, depending on the number of copies of each gene, ADHD intensity will vary.

There are two important concepts which can help us to understand how ADHD and DS are related: dual diagnosis and behavioural phenotype.

The term dual diagnosis, coined by Lovell and Reiss in 1993⁷ and introduced in Spain by Novell in 1999, is used to refer to a person who is mentally retarded and has a psychiatric disorder.⁷ In the past it was not generally accepted that mentally handicapped people could, at the same time, have a mental disease. Nowadays, it is recognised that psychiatric disorders and mental retardation can occur in the same person. Consequently, these disorders can benefit from medical treatment. Dual disorder can affect up to 18%-38% of children with DS.²

The behavioural phenotype concept⁸ means "the heightened probability or likelihood that people with a given syndrome will exhibit certain behavioural and developmental sequelae relative to those without the syndrome."

In ADHD inattention is manifested as difficulty in concentrating on an activity. The person appears not to listen when they are spoken to, is disobedient, easily distracted and restless, fails to pay attention, forgets and loses things, and avoids tasks that require sustained mental effort. Hyperactivity or impulsivity are characterised by restlessness, excessive activity (running about or jumping) in inappropriate situations and these children find it difficult

Table 1 Disorders which show comorbidity with ADHD

Tourette's syndrome/Obsessive-compulsive disorder
Generalised developmental disorders
Autistic disorder
Asperger's syndrome
Generalised non-specific developmental disorder
Communication disorder (specific language disorder)
Learning difficulties
Dyslexia
Dyscalculia
Dysgraphia
Non-verbal learning disorder
Developmental coordination disorder
Behavioural disturbances
Anxiety disorders
Depression and other affective disorders

to remain seated. They talk non-stop, act without thinking and find it difficult to wait their turn. All this leads to a deterioration in their social relationships and performance at school. The symptoms in DS children may appear before the age of three.⁹

Hyperactivity and impulsivity mean that children with DS and ADHD have a high risk of hurting themselves as a result of an accident, running away, getting lost, etc.

It is necessary to establish a differential diagnosis of ADHD in children with DS. Hyperthyroidism, hearing loss and sleep apnoea¹⁰ and the side effects of certain medications, such as histamine antagonists, caffeine and adrenergic agonists must be ruled out.

ADHD does not normally appear in isolation and it is usually associated with other disorders (comorbidity)¹¹ (table 1). 40%-60% of the ADHD population has an oppositional defiant disorder, 20%-40% an antisocial behaviour disorder,¹² 25% anxiety disorders, 24% mood disorders, and 12% have a nervous tic, as well as learning difficulties. There is also a strong link between autistic spectrum disorders and ADHD and DS.¹³

Diagnosis of ADHD, assessment scales and treatment

The diagnosis of ADHD is basically clinical. It is essential to prepare a detailed medical history in order to evaluate the symptoms. It must include DSM-IV-TR clinical criteria (table 2)¹⁴ and demonstrate the existence of functional repercussions which have a significant effect on the patient's quality of life. The symptoms must be present in two or more settings, for example at school and at home. There are three ADHD subtypes: the inattentive type (if inattention signs predominate), the hyperactive-impulsive type, and the combined type (if there are manifestations of both subtypes). The most common subtype is combined ADHD and the subtype which is most difficult to diagnose is inattentive ADHD. The hyperactive-impulsive type is the least common form.

Table 2 DSM-IV-TR ADHD criteria

These criteria require 6 to 9 variables related to attention deficit and hyperactivity-impulsivity to be met. They are as follows:

Inattention

Often does not give close attention to details or makes careless mistakes in schoolwork, work or other activities.
Often has trouble keeping attention on tasks or play activities.
Often does not seem to listen when spoken to directly.
Often does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace (not due to oppositional behaviour or failure to understand instructions).
Often has trouble organising tasks and activities.
Often avoids, dislikes or doesn't want to do things that take a lot of mental effort for a long period of time (such as schoolwork or homework).
Often loses things needed for tasks and activities (e.g. toys, school assignments, pencils, books or tools).
Is often easily distracted.
Is often forgetful in daily activities.

Hyperactivity-impulsivity

Often fidgets with hands or feet or squirms in seat.
Often gets up from seat when remaining in seat is expected.
Often excessively runs about or climbs when and where it is not appropriate (adolescents or adults may feel very restless).
Often has trouble playing or doing leisure activities quietly.
Is often "on the go" or often acts as if "driven by a motor".
Often talks excessively.
Often blurts out answers before questions have been finished.
Often has trouble waiting one's turn.
Often interrupts or intrudes on others (e.g. butts into conversations or games).

These characteristics must also comply with three conditions:

- Early onset (prior to the age of 7).
- Impairment in at least two relational settings (usually at home and in the school).
- They must be present for at least six months.

There is no specific marker or neuroimaging test that can aid diagnosis. Assessment scales are not diagnostic as such, but they are only useful for collecting data and determining whether diagnostic criteria are met. Making a diagnosis of ADHD in a DS child may be more difficult because some signs of ADHD and other comorbid disorders may be attributed to the child's intellectual disability.

When assessing DS children, it is advisable to have a clear understanding of their linguistic and cognitive development.

Table 3 Strengths and Difficulties Questionnaire (SDQ)

This questionnaire detects probable cases of mental and behavioural disturbances in children. It consists of 25 sections which are divided into 5 scales of 5 items each. These scales refer to:

- Emotional symptoms.
 - Behavioural problems.
 - Hyperactivity.
 - Problems with classmates, companions, etc.
 - Positive socialisation conduct.
1. Considerate of other people's feelings.
 2. Restless, overactive, cannot stay still for long.
 3. Often complains of headaches, stomach-aches or sickness.
 4. Shares readily with other children (treats, toys, pencils, etc.).
 5. Often has temper tantrums or hot tempers.
 6. Rather solitary, tends to play alone.
 7. Generally obedient, usually does what adults request.
 8. Many worries, often seems worried.
 9. Helpful if someone is hurt, upset or feeling ill.
 10. Constantly fidgeting or squirming.
 11. Has at least one good friend.
 12. Often fights with other children or bullies them.
 13. Often unhappy, down-hearted or tearful.
 14. Generally liked by other children.
 15. Easily distracted, concentration wanders.
 16. Nervous or clingy in new situations, easily loses confidence.
 17. Kind to younger children.
 18. Often lies or cheats.
 19. Picked on/ bullied by other children.
 20. Often volunteers to help others (parents, teachers, other children).
 21. Thinks things out before acting.
 22. Steals from home, school or elsewhere.
 23. Gets on better with adults than with other children.
 24. Many fears, easily scared.
 25. Sees tasks through to the end, good attention span.

The scales must be adapted to the level of development of the child and it is important to consider their mental age, taking as a basis their developmental age and not strictly their chronological age.

The methods used in diagnostic assessment include screening and specific questionnaires. The most widely used screening instruments are: the "Strengths and Difficulties Questionnaire" (SDQ) (table 3), "Rutter, Child Behavior Checklist" (CBCL) and Conners' tests. The specific psychometric tests used for ADHD are: "Schedule for Nonadaptive and Adaptive Personality IV" (SNAP IV) and DuPaul's "Attention Deficit Hyperactivity (ADH) Rating Scale" (table 4).

Below are the psychometric tests which are most widely used in the population diagnosed with psychopathology. In this study the PUBMED database was used, establishing a search strategy for the period from 1986 to 2010 and

Table 4 Conners' scale revised

	Not at all	Seldom	Quite often	Often
1. Displays excessive motor restlessness				
2. Has learning difficulties at school				
3. Disrupts other children				
4. Is often distracted/pays little attention				
5. Expects immediate satisfaction of demands				
6. Has difficulty with activities which require cooperation				
7. Is absent-minded/self-absorbed				
8. Fails to complete a task which has started				
9. Is not accepted by the group				
10. Denies mistakes and blames others				
11. Makes a lot of noise and in inappropriate situations				
12. Behaves arrogantly and is disrespectful				
13. Is restless and constantly in motion				
14. Argues and fights about anything				
15. Has unpredictable outbursts of bad temper				
16. Lacks a sense of rules and fair play				
17. Is impulsive and irritable				
18. Gets on badly with most of the other children at school				
19. His/her efforts are easily frustrated				
20. Has difficulty accepting the indications of the teacher				

employing Medical Subject Heading (MeSH) descriptors. The descriptors that we selected were: Down's syndrome, Attention deficit disorder with or without hyperactivity and diagnostic instrument.

1. *Reiss Scales for Children's*. These behavioural assessment scales were specifically designed for screening and diagnosing psychopathology in children diagnosed with dual disorder. They have been used in children with DS.¹⁵
2. *Rutter Behavioural Scale*. Gath and Gumley¹⁶ used it in 1986 in a sample of DS children from state schools. They estimated the prevalence of important behavioural problems, infantile autism, childhood psychosis, emotional disturbance and hyperactivity, revealing significant differences in the behavioural patterns of DS children and another group of mentally retarded children with similar characteristics (age, sex and mental and physical impairment).
3. *DSM-III-R criteria*. Myers and Pueschel¹⁷ used them in 1991 to determine the prevalence of psychiatric disorders in 497 children with Down's syndrome, based on clinical outpatient visits. Amongst the most common diagnoses, infantile autism, repetitive stereotyped behaviour, anxiety disorders, behavioural disturbances, hyperactivity and attention deficit were detected.
4. *Developmental Behaviour Checklist (DBC)*. This questionnaire, containing 96 items, is designed to evaluate the emotional and behavioural problems of mentally retarded children from 4 to 18 years of age. The questions refer to the behaviour observed in the last 6 months. It has been used to screen for autism.
5. *Child Behaviour Check List (CBCL)*. Developed by Achenbach in 1991. It was initially used as a diagnostic

screening tool at a mental health unit to assess behavioural problems in minors, including DS children.¹⁸ It is widely used in clinical practice and research, owing to its demonstrated reliability and validity. One of its drawbacks is that it comprises over 150 items and its interpretation is time-consuming and requires computer skills.

6. *Strengths and Difficulties Questionnaire (SDQ)*. Known in Spanish as the *Cuestionario de Dificultades y Capacidades*, it is a wide-spectrum scale, which was developed by Robert Goodman at the Institute of Psychiatry in London in 1997. It is the most widely used scale in the world and it is a short test consisting of only 25 attributes, which is easy to use in paediatric visits. It addresses the presence of emotional disturbances, behavioural problems, hyperactivity, and problems with classmates, etc. It is an instrument which has been well validated in the Spanish population. The SDQ can be a useful option for screening for psychiatric disorders and also as an aid during the first phase in the diagnosis of ADHD in DS children.¹⁹ It assesses children and teenagers from 4 to 16 years of age and can be downloaded free of charge at www.sdqinfo.org. It has been translated into more than 40 languages, including Spanish, Catalanian, Galician, Basque, Rumanian, Arabic, Chinese and Swahili.
7. *Aberrant Behavior Checklist (ABC)*. It includes a scale of 5 factors and 58 items. In Spanish it is known as the *Escala de Comportamiento Anómalo*. Capone²⁰ uses it in his study on the comorbidity of autistic spectrum disorders and DS, and neurobehavioural disturbances.
8. *SNAP-4*. This is a short version of the DSM-IV based on the detection of 18 diagnostic items. It is divided into two 9-item sections, which represent the domains of inattention and hyperactivity / impulsivity respectively.

9. *Conners' Rating Scale (CRS-R)*. It consists of 4 subscales: oppositional, cognitive problems and inattention, hyperactivity and ADHD index showing the risk of developing the disorder.
10. *ADHD Rating Scale-IV*. Proposed by DuPaul, it contains 18 items which are directly related to the DSM-IV diagnostic criteria for ADHD.

The most effective treatment for ADHD is multimodal, in other words, a combination of medication and behavioural therapy, the latter consisting of individualised psycho-educational measures both in the school and at home. The drug of choice is methylphenidate, which regulates the dopaminergic system. The use of methylphenidate is indicated in mentally retarded children if there are ADHD symptoms which are intense and disproportionate to their underlying pathology. However, treatment must be initiated by professionals who are familiar with the disorder and they will subsequently have to monitor their patients, adjusting the dose, depending on the response. Children with SD must be closely monitored due to the simultaneous presence of other pathologies.

Conclusion

Both early diagnosis and prompt therapeutic measures improve the learning ability and quality of life of these children and their families, and they can substantially reduce the comorbidity associated with ADHD, which is always a bad prognostic factor.

The diagnosis of ADHD is complex and more so in DS children, and there are no specific standardised scales for them, although there are general scales for making a preliminary diagnosis. We need to continue investigating the applicability of the most appropriate scales for these children in clinical practice.

Conflict of interests

The authors affirm that they have no conflict of interests.

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